

## 1.0 GENERAL

### 1.0.1

- a. Wigwam Mutual Water Company Design and Construction Specification is to provide guidance to Developers, Engineers, Contractors, Builders, and other interested parties with respect to the design and construction of water system improvements and extensions within Wigwam Mutual Water Company Service Area.
- b. The purpose of these specifications is to assure consistency in the design, quality and uniformity in the installation of water mains and appurtenances with the Service Area.

## 1.1 Revisions and Additions

### 1.1.1

- a. These specifications may be revised, amended, or added to as deemed prudent, in the best interest of the Wigwam Mutual Water Company and its service area. Such revisions, amendments or additions shall be binding and in full force immediately upon formal adoption by the Wigwam Mutual Water Company. All parties using this document are responsible for determining that they have the most recent changes by contacting the water company manager.

## 1.2 Interpretation

### 1.2.1

- a. This specification is composed of criteria for engineering design, water company procedures and policies, construction and material specifications, and standard drawings. The interpretation of any section or of differences between sections, when appropriate, shall be made by the water company in a timely manner. Requests for interpretation are to be submitted in writing to the water company manager. The interpretation issued by the water company shall be binding and controlling in its application.

## 1.3 Definitions

### 1.3.1

- a. Water Operator – shall mean the person duly authorized by the water company to enforce these specifications and licensed by the State of Colorado to operate a community water system..
- b. Developer – shall mean any person, company, corporation, partnership, joint venture, local governmental entity or other entity.
- c. Water Company Manager – shall mean the person duly authorized by the water company to manage the every day operations of the water company.
- d. Conditional Acceptance – Upon recommendation by the water company manager for conditional acceptance of a water main, and upon provision to the water company of all appropriate easements for the maintenance and operation of such facilities, payment of all fees and charges due, completion of appropriate bill of sale date to coincide with the expiration of the 12 month warranty period, and compliance with any other applicable requirements contained herein, the water company shall conditionally accept the water main and/or related facilities.

- e. Contractor – shall mean any person, firm or corporation authorized by the water company to perform work and to furnish material within the water company service area.
- f. Water System – all mains, together with all appurtenances, materials, equipment and property receiving potable water and conveying it to individual consumers that are members of the water company.
- g. Return Water System – all mains, together with all appurtenances, material, equipment and property receiving non-potable water and conveying it to individual consumer that are members of the water company.
- h. Transmission Main – shall mean a water line of any size and distance that conveys water from a point of supply to a body of distribution pipes for consumptive use by members of the water company.
- i. Distribution mains shall mean a pipe 12” or less in diameter and appurtenances receiving potable or non-potable water and conveying it to individual member service lines.
- j. Member – shall mean a person, company, corporation, partnership, joint venture, local government entity or other entity that owns stock in the water company.
- k. Service Lines – shall mean the pipe, line or conduit from the water main to an individual house or other structure.
- l. Applicant – shall mean any person, company, corporation, partnership, joint venture, local governmental entity, other entity, engineer, that applies for a project permit within the water company service area.

#### 1.4 Abbreviations

##### 1.4.1 Agencies

- a. AAMA - Architectural Aluminum Manufacturers Association
- b. AASHO American Association of State Highway Officials
- c. ACI American Concrete Institute
- d. AGA American Gas Association
- e. AGC American General Contractors
- f. AISC American Institute of Steel Construction
- g. AISI American Institute of Steel Institute
- h. AMA Air Moving and Conditioning Association
- i. ANSI American National Standards Institute
- j. APWA American Public Works Association
- k. AREA American Railway Engineering Association
- l. ASA American Standards Association
- m. ASCE American Society of Civil Engineers
- n. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Eng.
- o. ASME American Society of Mechanical Engineers
- p. ASTM - American Society for Testing and Materials
- q. AWS American Welding Society
- r. AWWA - American Water Work Association
- s. JIC Joint Industrial Council
- t. IPCEA Insulated Power Cable Engineers Association
- u. NEMA National Electrical Manufacturers Association
- v. NFPA National Fire Protection Association
- w. NSF National Sanitation Foundation
- x. OSHA Occupational Safety and Health Act
- y. RICS Roofing Inspection and Consulting Service

z.	SSPC	Steel Structures Painting Council
aa.	UBC	Uniform Building Code
bb.	UL	Underwriter's Laboratory
cc.	USAS	United States of America Standard
dd.	USEPA	United States Environmental Protection Agency
ee.	WWMWC	Wigwam Mutual Water Company
ff.	CDOT	Colorado Department of Transportation

1.4.2 The following abbreviation may be found in the Specifications:

a.	PVC	-	Polyvinyl Chloride
b.	DI	-	Ductile Iron
c.	GPM	-	Gallons per Minute.
d.	PRV	-	Pressure Reducing and Regulation Valve
e.	ARV	-	Air release Vacuum Breaker Valve
f.	A.C.		Alternating Current
g.	AWG		American Wire Gage
h.	B.M.		Bench Mark
i.	CAB		Crushed Aggregate Base
j.	c-c		Center to Center
k.	o.c.		On Center
l.	C&G		Curb and Gutter
m.	CIP		Cast Iron Pipe
n.	CMOS		Ceramic Metal Oxide Silica
o.	CMP		Corrugated Metal Pipe
p.	Conc.		Concrete
q.	DIP		Ductile Iron Pipe
r.	D.C.		Direct Current
s.	EMT		Electrical Metal Tubing
t.	F.H.		Fire Hydrant
u.	G.V.		Gate Valve
v.	HOA		Hand-Off-Automatic
w.	hp		horsepower
x.	HTH		Calcium Hypochlorite
y.	I/O		Input/Output
z.	kw		kilowatt
aa.	Lb		Pound
bb.	Max.		Maximum
cc.	LED		Light Emitting Diode
dd.	MCC		Motor Control Center
ee.	Min		Minimum
ff.	OD		Outside Diameter
gg.	PID		Proportional Integral Derivative
hh.	PROM		Programable Read Only Memory
ii.	PSI		Pounds Per Square Inch
jj.	RAM		Random Access Memory
kk.	SCH		Schedule
ll.	SDR		Size Dimension Ration
mm.	SPDT		Single Pole Double Throw
nn.	D		Diameter

## 1.5 General Requirements

### 1.5.1 Request for Development Information

- a. Information may be obtained at the Wigwam Mutual Water Company's general office by appointment on weekdays – excluding holidays, or by letter.
- b. Questions concerning these specifications may be directed to the water company via telephone or through a prearranged meeting during weekdays – excluding holidays, or by letter. The office phone number is 719.638.0456. Mailing address is P.O. Box 75656, Colorado Springs, Colorado 80970.

### 1.5.2 Plan Format, Submission, Review and As-Builts

- a. The Applicant shall submit a water company project application form fully filled out, and design drawings for review by the water company. No construction of any portion of the water system shall begin until design drawings have been approved by the water company manager. A set of approved drawings and a copy of this document shall be available at the job site while water system improvements are under construction. Subsequent to initial approval, any design changes shall be submitted to the water company manager for review and approval.
- b. Drawings shall be drawn on sheets size 24"x 36". North shall be to top or right of sheet. Scale shall be 1"=50' horizontal, 1"=5' vertical. Cover sheet shall show location map and proposed system plan indicating street names, pipe sizes, valves, fire hydrants and all appurtenances. System shall also indicate development name, the name and address of the Developer, and consulting engineer.
- c. Two complete sets of drawings and any special project conditions shall be submitted to the water company for review. Normal review time will be two weeks. One marked set of the submittal will be returned. If desired, a review conference may be scheduled. When revisions are required, two sets of revised drawings shall be resubmitted for subsequent review. When acceptable, the water company manager will approve drawings, said approval indicating conformity with the water company regulations, and return one approved set of the submittal.
- d. Upon completion of construction, and before acceptance, one complete set of project blacklines indicating all changes from original approval shall be submitted to the water company manager for water company's use. As-built drawings shall be on CD disk in .dwg format. If no changes have been made during construction, the sheet shall so indicate.
- e. Unless construction commences within six months, approval of project and plans shall be null and void.

### 1.5.3 Warranty and Acceptance

- a. The Developer, or contractor on behalf of the Developer, shall warrant the constructed facilities for a period of one year after conditional acceptance. Conditional acceptance will be granted by the water company when the following conditions have been met by the Developer:
  1. The entire improvement has been constructed, pressured tested and sterilized, and a negative standard bacteriological water test results received from the contractor.

2. All necessary approval of design on construction, contracts, and agreements have been fully executed and delivered to the water company.
  3. The project cost in tabular form listing pipe sizes and footage for different sizes, appurtenances with quantity and presented to the water company, and
  4. Record drawings have been presented to the water company.
- b. During the warranty period the developer, or contractor on behalf of the developer, shall repair or correct all deficiencies that become apparent in a timely manner when notified by the water company.
  - c. Final acceptance by the water company will be by letter at the end of the warranty period provided all deficiencies have been corrected or repaired in a manner satisfactory to the water company.
  - d. If a reimbursement agreement is applicable, it should be executed prior to final acceptance.

#### 1.5.4 Pre-construction Conference

- a. Prior to beginning any work on the project, the developer shall schedule a pre-construction conference with a least 1 week notice to the following:
  1. The water company manager
  2. The contractor
  3. The Geo-technical Engineer
  4. All existing utilities that will be involved in the project.
  5. El Paso County Department of Transportation
  6. Water company water operator
  7. Water company engineer

## 2.0 General Design Standards

### 2.1.1 Deviation from Standard

- a. These design criteria shall be adhered to for all water main facilities to be installed with the water company service area insofar as practical. If any deviation from these criteria is desired, a request must be submitted to the water company in writing.
- b. The request will be evaluated and the decision of the water company shall be adhered to for the design of the project.

### 2.1.2 Colorado Department of Health Regulations

- a. It is not intended that any regulations promulgated by the Colorado Department of Health pertaining to public water systems be annulled by these design criteria. When the Department of Health regulations are more stringent they shall take precedence.

### 2.2.1 Hydraulics

- a. Flow velocity shall not exceed five feet per second on a peak demand day.
- b. Flow velocity shall not exceed 8 feet per second on a peak demand day during fire flow conditions,
- c. This water system is in general not accepted for fire protection, however, some fire hydrants will be located on 8" mains, if 8" mains exist in the system.
- d. Minimum design pressure shall be 35 psi, maximum design pressure shall be 125 psi, for all flow and static conditions.

- e. Minimum diameter of water mains is 2 inches in residential areas and 4, 6, 8, and 12 inches elsewhere.

#### 2.3.1 Locations

- a. Water mains shall be installed five feet off the east right-of-way-line of north south streets and five feet off the north right-of-way line of east west streets. The foregoing shall be adhered to insofar as practical on curved streets. Water line should not be installed in ditch lines.
- b. Any request for deviation from the above shall be submitted in writing to the water company, including where public water mains are proposed to be installed in easements.
- c. Water mains shall be designed for a minimum of five feet and a maximum of five feet six inches of cover, except where another utility causes a conflict, then the water main shall be lowered as necessary.

#### 2.4.1 Looping

- a. Dead-end mains are discouraged. Looping shall be designed both in the project proposed, and provision be made for looping as the mains are extended for adjacent projects.
- b. Dead-ends may be allowed in cul-de-sacs provided they do not exceed 500 feet.

#### 2.5.1 Profile

- a. When 12 inch diameter water main is proposed, the drawings shall include a profile view which also shows the proposed finish surface above the water main and elevations and station of all fittings shall be noted. Elevation of pipe flow line shall be noted.

#### 2.6.1 Separation from Pollution Sources

- a. In general, water mains shall be designed to have ten feet horizontal separation from possible sources of pollution. When the horizontal separation is not achievable, then the water main shall be designed so that the bottom of the water main is two feet above the top of any sewer pipe. When two feet of vertical separation can not be achieved then the water main will be constructed in 20' sections of pipe with the water pipe joints centered in off each section of sewer pipe with 10' to each opposing joint.
- b) The foregoing separation provision applies to fire hydrants and service lines as well as to water mains.

#### 2.7.1 Casing

- a. Where required by a highway authority or private utility, casing pipe for the water main shall be installed for the crossing as directed by the highway authority or private utility. Carrier pipe shall be installed with casing spacers and end seals.

#### 2.8.1 Fire Lines

- a. Private fire lines and fire sprinkler system connections shall be provided with backflow preventers and check valves to preclude reverse flow into the distribution system that could cause contamination of the system. Written approval from the Hanover Fire District is required for all private fire line, sprinkler systems and their appurtenances.

Please note that as of the date of this manual, the water system is unable to meet the demand for this type of equipment.

#### 2.9.1 Water Main Crossings

- a. Pre-construction Meeting. Before any water main crossing excavation commences, it is required in all cases that a pre-construction meeting be scheduled with the water company.

#### 2.10.1 Final Inspection.

- a. The crossing will be given a final inspection by the water company before backfilling. Contractors will also give the water company a one year written warranty for work performed in accordance with the water company's rules and regulations.

### 3.0 Pipeline Specifications

#### 3.1.1 Material Specifications-General

- a. All material incorporated into the construction of the water system shall be new and of first class quality. Used, damaged, or imperfect material will not be permitted and shall be removed from the job site by the contractor when so directed by the water operator.
- b. The contractor shall be responsible for storing material at the job site in a manner to prevent damage or contamination of the material. Security is the contractor's responsibility, the water company is not responsible for loss of material from the job site.

#### 3.2.1 Pipe

- a. 4"-12" IPS Pressure-Rated PVC pipe shall conform to ASTM D2241, SDR21 (200psi), and shall have rubber gasketed joints conforming to ASTM F-477. Pipe shall be manufactured from compounds conforming to ASTM D-1784 with a cell classification of 12454B. . The ratio of the outside diameter to the wall thickness for 4 inch through 12 inch diameter water distribution and supply pipe shall not be greater than 21. For other pipe, 2 inch diameter or less, the ratio of the outside diameter to the wall thickness shall not be greater than 11, and ASTM 1785 Standard Specification for Polyvinyl Chloride Pipe (Schedule 80) with standard fittings. The minimum hydrostatic design stress shall be 2000 psi. The pressure rating as determined by the International Standards Organization shall not be less than 200 psi. All material, manufacturing operations, testing and inspection of pressure rated potable water pipe shall conform to the requirements of the applicable Quality Standards listed above. SDR21 pipe shall be furnished with integral bell gasketed joints. Standard laying lengths shall be used. Random lengths shall only be used where necessary to meet fitting and/or valve locations.
- b. Unless otherwise specified, pipe joints for underground mains shall be push on with bell gasketed joints

#### 3.3.1 Fittings

- a. PVC fittings shall be used for 2 inch diameter or less PVC piping. All joints shall be solvent cemented glued according to manufacturer's specifications and allowed to cure twenty- four hours before filling water pipe.
- b. Mains 4, 6, 8, and 12 inch in diameter shall be ductile iron mechanical fittings (except at normal pipe runs) conforming to AWWA C-153 for sizes 4" through 12". MJ transition gaskets shall be used for proper fit with IPS PVC pipe. All mechanical joints shall be restrained with series 2000 PV megalugs. Schedule 80 glued fittings may be used for pipe sizes 2" or less in diameter. Schedule 40 glued fittings may be used where approved by the water company manger. All threaded valves and fittings shall be adapted using fabricated heavy duty male adapters, as supplied by Colorado Springs Winwater or equal. Molded Schedule 40 or Schedule 80 male adapters shall not be used underground..

#### 3.4.1 Valves, Valve Location, Installation, and Value Boxes

- a. Valves shall be placed at locations so as to least disrupt service, should it be necessary to close a valve. In general, 1250 feet shall be the maximum spacing on distribution mains. Valves shall be located approximately 12", or 1 pipe diameter from tees and crosses. All crosses shall have three valves and all tees two valves unless otherwise specified.
- b. A valve shall always be provided where a main will be extended in the future to facilitate connecting to the existing main without disrupting service. There shall be a ten-foot stub past the blow off valve to facilitate ease of connection.
- c. Additional valves may be required at major stream or roadway crossings to isolate the crossing.
- d. Wherever a water main is installed in an easement, a valve may be required at each right-of-way line the main crosses.
- e. All C.I. valves shall be poly wrapped.
- f. Valves shall be handled in such a manner as to prevent any injury or damage. All joints shall be thoroughly cleaned before installation.
- g. Valves shall be set and joined to the pipe in the manner as laying and joining mechanical joint pipe. Valves shall be set in such a manner that the valve stems are plumb. Valves will be blocked using only precast concrete blocks. No wood blocking will be allowed.
- h. A valve box shall be provided for every valve. The valve box shall not transmit shock or stress to the valve, and shall be centered and plumb over the operating nut of the valve, with the box cover set to the required elevation. It will be the responsibility of the contractor, to insure that valve boxes are plumb and raised to the proper elevation. Valves located in a manhole or vault shall have standard hand wheel. Valve boxes for underground valves shall be Cast Iron style 664-A slip type, with extensions as needed.
- i. Gravel roads should have valve boxes 1' below finish grade if located in a travel lane or shoulder. Valve boxes not in gravel travel lane or road shoulder, but located just inside road right-of-way lines shall be set to finish grade.
- j. Paving of any street requires that all existing valve boxes be located and prepared for final raising to the finish street surface as shown on standard drawings. Inspections should be requested twenty four hours in advance of need.
- k. Stem shall be non-rising with a two- inch operating nut and o-ring seal.
- l. End connections shall conform to AWWA Standard C111.
- m. All gate valves shall be resilient wedge style conforming to AWWA C-509 and shall open counter-clockwise (open left). Underground valves shall have mechanical joints in sizes 2" through 12" (except 10"). Threaded ends may be used for 2" size. MJ transition gaskets shall be used for proper fit with IPS-PVC pipe. All mechanical joints

shall be restrained with series 2000PV megalugs. 2" threaded valves shall be adapted using fabricated heavy duty male adapters, as supplied by Colorado Springs Winwater. Molded sch40 or sch80 male adapters shall not be used underground. Valves that are used above ground or in vaults shall have flanged ends and be equipped with handwheels.

#### 3.5.1 Location Wire System

- a. Under this item the contractor shall furnish and install a locator wire system along the entire length of the pipeline to facilitate the location of water mains. Work shall include connectors, wire, materials, labor, equipment, and testing necessary to complete the work described.
- b. Location Wire shall be No. 12 AWG blue, insulated, stranded copper wire tapped to the pipe with tape at a distance of not greater than 6' on center. There shall be a 6" diameter wire loop in the location wire not to exceed 100' on center along the pipe line. The locator wire shall be terminated above ground at every valve box or pit, PRV, ARV, or every 1,000 feet with 4"x4"x8' pressure treated wood post set just inside the right-of-way line just outside the property line. The post shall be set 5 feet out of the ground with the wire secured to the full height of post and the last 8" of wire stripped. A 12 AWG non-insulated wire shall have a 6" loop over end of post, stapled down side of post and grounded with proper clamp and 3/8" x 2' copper ground rod located 5' off pipe line. The wire shall be wrapped around the outside of the valve box and secured to the box with cable ties. To facilitate the use of pipe finding equipment, the ends should be brought into the valve box leaving a pigtail a minimum of 24" long with the last 8 inches stripped.
- c. Locator wire from each run of pipe at tees and crosses shall be jumped and led to each valve box at the intersection. When connecting ends or splicing use an approved plastic wire connector. Seal all connections with air seal putty and wrap with electrical tape to prevent corrosion and to maintain continuity.
- d. The locator wire systems shall be tested for electrical continuity by the contractor. Any faults or interruptions shall be corrected by the contractor..
- n. All in-line water valve boxes shall be buried with a minimum one foot of cover between the box cover and the final grade of the road whenever the valve location falls within an unpaved road. No line valves are to be located in the flowline of the roadside ditch/barrow pit area unless approved by the water company manager.. Valves approved for location in the ditch/barrow pit must be buried a minimum of one foot below the flowline elevation.

#### 3.6.1 Blow-off Assemblies

- a. Blow-off Assemblies shall be provided at all dead ends if there is not a fire hydrant at the end of the main.
- b. The contractor shall provide Blow-off Assemblies shall include standard MJ Ductile Iron TEE fitting off main line x 2" diameter blow-off lateral line that will run to edge of right-of-way. 1' from the riser shall be installed a 2" diameter gate, resilient wedge valve with Tyler C.I. Adjustable service box 100-E(24T & 21B & #154 Ext). At edge of right-of-way line shall be installed a 2" PVC 90° elbow with two 1/4" diameter holes drilled at the bottom for drainage. There shall be a 2" diameter PVC riser to a height of 3" above finished grade, terminating with a 2" diameter male adapter glued onto riser and 2" threaded PVC cap. The 2" diameter lateral shall slope downstream from the tee with a two percent (2%) grade to the riser. At the 90° elbow with glued joints shall be a thrust block and 1/3 cubic yard pit of 3/4" washed gravel below the elbow for drainage. There shall be a 4' diameter x 4" concrete pad placed around the riser. Miscellaneous fittings necessary for the installation of the blowoff shall be the responsibility of the contractor.

- c. All dead ends on new mains shall be closed with caps; such dead ends shall be equipped with suitable concrete anchors and blow-offs facilities.
- d. The contractor shall furnish, install or remove temporary blow-offs at locations shown on the drawings or designated by the water company. See standard drawing.
- e. The contractor shall furnish and install permanent blow-offs where indicated on the drawings. A permanent blow-off is defined as one that will be left in place at the completion of all proposed installations. Refer to standard drawing.

3.7.1 Air Release Valve Assemblies

- a. Combination air-relief-vacuum breaker valves in manholes shall be provided at all high points in the system or as shown on the approved plans.
- b. The contractor shall provide air release valve assemblies consisting of an air-vac, PVC vent, saddle, corp stop, post, ball valve, and fittings. The assembly shall be installed inside a 30" diameter by 5 foot HDPE pipe, dual wall pit with 36" HDPE lid and 30"Øx3" foam insulator, set on 8 inch glass 5 gravel, buried near the right-of-way line at high points in the system as shown in the drawings. The saddle shall be 1 inch IPS, brass with double stainless steel straps. The corp stop shall be 1 inch AY McDonald 4704, 4704 flared, 3131 MIPxMIP or equal. The air release valve shall be a 1 inch ARI D-040 combination air-vac, or equal. The vent pipe provided shall be a 1 inch Schedule 40 PVC pipe anchored to a 4 inch x 4 inch x 8 foot redwood or pressure treated post.
- c. The assemblies shall be installed inside an 18" diameter by 5 foot HDPE pipe dual wall pit with 18" cast iron flat lid and 19"x3" form insulator. The valves shall be tapped into the top of the water main with a one-inch tap. The pipe stem between the water main and the air release valve shall contain a gate valve to isolate the air release valve for maintenance purposes. Pipe and fittings shall be threaded galvanized iron, standard weight; gate valve shall be bronze and have hand wheel.
- d. The work under this item shall consists of all the work necessary to furnish and install air release valves (ARV) at the locations shown on the plans. This item shall include, but not be limited to, tapping the new main, installing the saddle, corp stop, ball valve, air/vac, vent pipe, pit, lid, insulator, and gravel as shown on the drawings. Miscellaneous fittings necessary for the installation of the air/vac shall be the responsibility of the contractor.

3.8.1 Pressure Reducing and Regulating Valves Assemblies

- a. Pressure reducing and regulating valves in concrete vaults shall be provided as necessary to control the pressure within the allowable range. The work necessary to furnish and install pressure reducing valves (PRV) at the locations shown on the approved plans.
- b. Pressure reducing valve assemblies shall match the pipe diameter on which it is installed and shall consist of a pressure reducing valve, 2- gate valves, 2 unions, pipe main diameter x 1/2" tee, pressure gauge. Precast or poured-in-place concrete manhole or vaults shall be used for the following size mains:

2" main	4' diameter precast concrete manhole
4"	5' wide x 8' precast concrete vault
6"	5' wide x 10' precast concrete vault
8"	6' wide x 12' precast concrete vault
12"	6' wide x 14' precast concrete vault

- c. All manholes and vaults shall have light weight traffic manhole ring and cover on 8" thick concrete base with 3/4" washed rock sump, as shown on standard drawings, shall

- be installed in the distribution system water mains at the locations shown on the plans. Miscellaneous fittings necessary for the installation of the PRV shall be the responsibility of the contractor. The manhole or vault shall include aluminum rungs. Cast iron rings and covers of a pattern approved by the water company manager, with the word "WATER" cast thereon, and shall be in accordance with the details in standard drawings.
- d. The PRV shall have a Watts, ACV 115-7, Pressure Reducing Valve, FLxFL, or equal. Gate valves shall be flange x flange, resilient seated, non-rising stem, open left, cast iron body with a hand wheel and shall conform with the provisions of the AWWA C509-87. Flange adaptors shall be provided for each valve connection. The pressure gauge shall be a 200 psi inlet with threaded 1/2" male pipe base and 2" dial. Pipe in vault shall be Schedule 80 PVC. 2" Schedule 80 for 2" MIP fabricated spools and ductile iron flanged fittings for 4"-12" pipe.
  - e. Pressure reducing and regulating valves shall be installed where directed by the water company manager. The valve, piping, and appurtenances shall be installed in reinforced concrete vault or manhole with access cover in the roof. The access cover shall be set to proposed final surface elevation and shall be adjusted for paving if necessary. All piping shall be supported within the vault to permit removal of components for servicing.
  - f) Automatic control valves shall be fluid actuated and have a single moving assembly. A flexible, non-wicking, FDA approved, nylon fabric reinforced synthetic elastomer diaphragm shall be integral with this assembly to form a sealed chamber, operating free of drag or wear. The diaphragm shall not be used as a seating surface. This assembly shall have a stem which is fully guided by separate upper and lower bearings to preclude binding or deflection. When the valve is in the closed position sealing at the seat shall be accomplished by the contact between one edge of a securely retained elastomer quad ring and a smooth seat surface. The seat design shall be removable and not have edges that will induce seal cutting, or wear at low flows. Progressive throttling of flow shall be accomplished by a characterized profile quad ring retainer washer. The valve body and cover shall be of cast iron. An FDA approved fused epoxy coating shall be applied to the internal and external exposed surfaces of the components after cleaning and degassing. This coating shall be standard on all basic valves 1-1/4 to 16 inch. All internal valve components shall be removable and repairable while the valve body remains in the line. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the valve or controls. Valve sizes 1-1/4 to 3 inches shall be standard equipped with a flow-clean strainer mounted in the inlet supply port of the main valve. Valve sizes 4 inch and larger shall be standard with externally mounted y-strainer for protection of the control circuit and WATTS ball valves (or equal or as approved by water company manager) to isolate the pilot system from the main valve.
  - g) The valve shall maintain a constant downstream pressure regardless of demand fluctuations. It shall also be capable of pressure controlled quick closing in the event of downstream pressure surges. The reducing control shall be an adjustable, spring loaded, direct acting, normally open, diaphragm valve designed to permit flow when controlled and pressure is less than the spring setting. The control system shall consist of an adjustable closing speed needle valve and adjustable opening speed flow control valve. The surge pilot shall be a normally closed, adjustable, spring loaded, diaphragm valve designed to open when downstream/ outlet pressure exceeds the spring setting, allowing valve inlet pressure into the main valve cover chamber, closing the main valve. The surge control shall also be capable of functioning as a backup control of the pressure reducing control. The specification shall note when valves 6 inches and large are to be installed with the stem in a horizontal position.
  - h) Pipe in the vault shall be Schedule 80 PVC.

### 3.9.1 Fire Hydrants And Installation

- a. Fire Hydrants shall be located only off a minimum 8 inch diameter water main within the water system. A fire hydrant may serve as a blow off valve on dead end mains.
- b. All hydrants shall be poly wrapped below the finished grade line.

### 3.9.2 Fire Hydrants

- a. All fire hydrants shall be designed and manufactured in strict compliance with AWWA Standard C502 for Dry-barrel Fire Hydrants. All references made in this specification are to be above standard unless otherwise noted.

### 3.9.3 Acceptable Brands

- a. Clow (Medallion),

### 3.9.4 Size of Hydrant

- a. Hydrants shall have a main valve opening size of 5-1/4 inches and shall have a five foot bury unless otherwise approved by the water company manager.

### 3.9.5 Type of Hydrant

- a. All hydrants shall be the traffic model type. Hydrants shall be the three way type with one pumper nozzle and two hose nozzles all located on the same horizontal plane.

### 3.9.6 Inlet Connection

- a. Hydrant base shall be provided with a mechanical joint inlet to accommodate 6 inch diameter PVC pipe with mega-lug, all in accordance with AWWA Standard C111, Rubber Gasket Joints for Ductile iron and Gray Iron Pressure Pipe and Fittings". Incorporated into the base shall be two lugs for rodding or strapping of pipe.

### 3.9.7 Main Valve Assembly

- a. Main valve of the hydrant shall be 5-1/4 inch diameter compression type which closes with water pressure.
- b. Gasket for valve shall be a replaceable type fabricated of a resilient material, with a threaded bottom plate or nut, complete with seal to prevent leakage of the hydrant shaft
- c. The valve assembly shall include one or more drain valves which will work automatically with the main valve and drain the barrel when the main valve is in the closed position.
- d. All parts of the main valve assembly shall be so designed that removal of the assembly from the barrel is accomplished without excavation.

### 3.9.8 Operating Shaft Nut

- a. Operating nuts and cap nuts shall be 1-1/2" pentagon. See standard drawing. Bushings in the bonnet shall be so constructed that it will prevent the operating nut from

traveling during opening or closing operation; also the bushing shall be a gasket or seal to prevent moisture or foreign material from entering the lubricant reservoir.

- b. The hydrant shall be open by turning the operating nut to the left in a counter-clockwise direction and shall have an arrow on top of the bonnet to designate the direction of opening.

#### 3.9.9 Pumper Nozzle and Cap

- a. The pumper nozzle shall be 4-1/2 inch NST threads and hose nozzles shall have 2-1/2" NST threads. Threads shall be right hand. See standard drawing.
- b. Nozzle caps shall be furnished with a synthetic rubber gasket installed in a retaining groove and the dimensions and shape of the nozzle cap nut shall be the same as the operating shaft nut as described in these specifications. Nozzle caps shall be furnished with security chains with one end of each securely attached to the upper barrel section of the hydrant.
- c. All nozzle caps shall be removed by turning counterclockwise.

#### 3.9.10 Hose Nozzles and Caps

- a. The two hose nozzles shall be 2-1/2 inch NST threads. Threads shall be right hand. See standard drawing. Each nozzle shall include a nozzle cap with nut, security chain and shall be removed by turning counterclockwise.

#### 3.9.11 Color

- a. The upper exposed section of the hydrant above ground shall be painted rustoleum 659 yellow or equal. The buried portion of the hydrant shall be given a bituminous coating in accordance with Section 10-8.1 of AWWA Standard C110.

#### 3.9.12 Location

- a. Where possible, fire hydrants shall be located in the northeast quadrant of the intersection. See standard drawing for typical installation.

#### 3.9.13 Installation

- a. All hydrants shall be staked for location and grade. Final location and grade shall be in accordance with the approved drawings. All hydrants shall stand plumb and be installed as indicated on standard drawing. Each hydrant shall be connected to a minimum eight inch diameter main, by a six inch branch line. An independent six inch gate valve shall be installed on each fire hydrant branch. No service line connections shall be installed between the fire hydrant and the fire hydrant control valve. Inlet shoes shall be mechanical joint. MJ transition gaskets shall be used for proper fit with IPS-PVC pipe. All mechanical joints shall be restrained with series 2000PV megalugs.

#### 3.9.14 Anchorage

- a. The bowl of each hydrant shall be well braced against the un-excavated earth at the end of the trench with a concrete thrust block. The bottom of the hydrant bowl and the

hydrant valve shall be supported with 18 x18 by 4 inch pre-cast concrete blocking slabs. Use anchor tees main to valve megalug or other end of valve and megalug on fire hydrant.

- b. Whenever a fire hydrant is installed at the termination point of a main extension (such as in a cul-de-sac), concrete reverse anchors will be required for both the fire hydrant valve (which in this case is also a line valve on the main) and the fire hydrant lateral or branch line connected to the fire hydrant. See standard drawing. Additional concrete anchors may be required at the direction of the water operator.
- c. If bends are needed to bring a hydrant to a desired horizontal or vertical position, special concrete reverse anchors, and/or anchor pipe or all-thread tie back rods, or a combination of all of those along with a riser may be required. In any case, a riser may be required. A riser no longer than two feet will be acceptable and it will be the contractor's responsibility to set the safety flange at the proper grade.

### 3.9.15 Drainage

- a. Wherever a hydrant is set, drainage shall be provided at the base of the hydrant by placing rock from the bottom of the trench, to at least twelve inches above the barrel flange of the hydrant, and to a distance of one foot around the elbow. The minimum distance from the bottom of the trench to the bottom of the hydrant elbow shall be six inches. The minimum quantity of rock placed shall be 1/3 cubic yard. The rock shall be a well graded gravel cobble, or crushed rock free of dirt.

### 3.9.16 Hydrant Protection in Corrosive Soils

- a. All ductile iron branch lines and hydrants shall be protected. All pipe, rods, and fittings, from finished ground level on the hydrant barrel up to and including the tee, shall be encased in poly wrap. The type of polyethylene and manner in which it is to be installed shall conform to these specifications.

### 3.10.1 Service Connections, Curb Stop, Exterior Meter Pit, And Interior Meter Installation.

- a. Service lines, taps, and meters shall be sized in accordance with AWWA manual (M22), Sizing Water Service Lines and Meters.
- b. No service lines shall be installed until front property corners have been located. Service lines for each property shall be ten feet uphill of the lower property pin or as approved by the water operator or water company manager.  
Length of service lines from the meter pit to the house will be limited as follows:  
1" 600'  
All service lines shall have tracer wire installed according to standard specifications elsewhere in this manual.
- c. Lengths greater than 600' or for a larger meter size needs to be determined by the water operator or water company manager.
- d. All service connections to mains shall be made in the top one-half of the pipe. Tapping of mains for service connections shall only be accomplished with the use of an approved tapping machine and tapping saddle.
- e) All standard service lines shall have a JCM 406 Series or Smith Blair 317 Series Tapping Saddle for PVC pipe mains from 2" diameter to 12" diameter for a 1" diameter tap. Non-standard Service lines 2" or larger in diameter shall be extended off the main with a MJ tapt outlet, concrete base and thrust blocks. All service lines 2 inches or larger shall have an MJ gate valve located in the right-of-way near the property line with a Tyler C.I. Adjustable curb box 100E-(24T & 21B & #154 Ext). The curb box shall be installed so that the lid is 2" off finished grade. All standard service lines shall have a

4701-33 or 4701-3Q 1" Corporation stop at the tapping saddle and a AYMCD 6100-33 or 6100-3Q with SS insert stiffened curb stop within 1 foot of the meter pit with required pipe fittings. The 2<sup>nd</sup> corporation stop shall be accessed by a Tyler C.I. Service Box Model 95E. Standard service lines pipe shall be 1" PE3408 SIDR-7 (ID Controlled) 200 psi rated polyethylene piping. All service lines shall have tracer wire installed according to standard specifications elsewhere in this manual.

- f. No water taps will be made prior to hydrostatic testing, approved Bacteriologicals and acceptance of the water mains. Water service shall be located a minimum of ten feet from sewer service, and will be generally located on the uphill side of the property pin or in the middle of the lot. Service lines shall be installed in a continuous straight line and shall enter the property a minimum distance of five feet from the nearest lot corner. Service line shall be as close to ninety degrees (90°) as possible to the right-of-way line. Service lines in driveways are not permitted.

### 3.10.2 Service Meters, Exterior Meter Pits, Interior Meter Loops

- a. The acceptable location for ¾" inch water meters shall be within a meter can located within the road right-of-way two feet from the property line. 2 inch and larger meters shall be located inside the structure as approved by the water company manager and prior to the installation of the water meter loop.
- b. Water meter locations selected shall provide adequate protection against freezing.

### 3.10.3 Inside Water Meter Installations

- a. Inside 2 inch and larger meters. Plans for inside water meter loop (to include support) installations for 2 inch and larger water meters shall be submitted to the water company for approval prior to installation of the meter loop and should be similar in design to the meter loop piping and support shown on standard drawings. Meters shall be provide by the water company.
- b. Provided in the meter loop shall include a angle ball valves on input and output side and a double check valve assembly. A floor drain is required within 1 foot of the backflow preventer.
- c. Inside meter installation shall include the installation of a two wire insulated conductor 18 gauge interconnecting cable between the meter and the remote reader as shown on standard drawings. The wire shall be installed in a work-men-like manner standard in the industry and shall be tested for electrical continuity at the time of installation. If the cable is to be installed in concrete or masonry walls, electrical conduit must be installed in advance of the cable installation.

### 3.10.4 Outside Service Meter

- a. Only 5/8x¾ inch meters may be installed in an exterior meter pit unless otherwise approved by the water company manager. The water meter shall be provided by the water company.. The meter setters shall be A.Y. McDonald 21-245WDZZ-44, 5/8"x34x45" with angle dual check BFP on outlet, with 1" Q-compression inlet and outlet sized for SIDR7 PE pipe. Stainless steel stiffeners shall be used inside all compression connections.
- b. The location of the meter pit for ¾ inch water meters will be located within the right-of-way near the property line. The meter pit shall not be located in a ditch flow line. If a problem arises on the location, the decision will be determined by the water company manager.

- c. The only pit acceptable to the water company for a ¾” diameter service line is a 18” diameter x 5 foot HDPE pipe, dual wall pipe over 8” gravel base. Meter box cover shall be 18” cast iron flat lids, marked “WATER METER”. A Foam pad manufactured specifically for insulating meter boxes shall be installed under the lid, and shall fit tightly. See standard drawings and the accompanying notes. Regulators or sprinkling system devices are not acceptable in meter pits

#### 4.0 General Procedures

##### 4.1.1 Installation by Licensed Contractor or Excavator

- a. Installation of water mains and services shall be done by or under the direction of a Licensed Contractor or excavator licensed by the State of Colorado or the Pikes Peak Regional Building Department.

##### 4.1.2 Start of Construction

- a. Plumbers and contractors shall not begin construction of public mains without an approved plan and a pre-construction meeting.
- b. Construction of water services or extensions shall not proceed without obtaining the connection permits as required. Backfilling of water services shall not be initiated until the installation has been inspected and approved by the water operator.

##### 4.1.3 Protection of Existing Underground Facilities

- a. It shall be the responsibility of the contractor to verify the existence and location of all underground facilities along the route of work. The omission or the inclusion of facility locations on the plans is not to be considered as the nonexistence of or a definite location of existing underground facilities.
- b. The contractor will take the necessary precautions to protect existing facilities from damage due to his or her operations. All damage to the facilities will be repaired at the contractor’s expense, and all claims for disruption will be settled by the contractor at his or her expense.

##### 4.1.4 Detours – Traffic Control

- a. Traffic will be permitted to use the street at all times, unless a detour is specifically permitted by the El Paso County Department of Transportation. Access to all abutting residences and properties shall be maintained to the maximum extent possible.
- b. The contractor shall furnish flag men or flag women and sufficient signs to facilitate the direction of traffic. These signs shall conform to the Manual of Uniform Traffic Control Devices. Signing of detours shall conform to Traffic Control Devices Handbook, Federal Highway Administration.

##### 4.1.5 Disinfection

- a. Pipe extensions shall be chlorinated in accordance with AWWA Standard C601, “Disinfecting Water Mains”. Prior to being put into service. The chlorination of the finished pipeline shall be done prior to installation of any service taps. Before filling the pipe with water, the pipe shall be clean and free of debris to the satisfaction of the water

operator. Disinfection by chlorination of the pipe shall be performed prior to the water company's acceptance. The chlorinating agent, and method of application, shall be approved by the water company manager in accordance with AWWA Standard C601. The contractor shall provide material for disinfection of water mains. If chlorine tablets are used for disinfection, the tablets shall be attached to the inside top of the pipe using a water based non-toxic glue just prior to the pipe installation in the trench.

OUNCES OF CALCIUM HYPOCHLORITE GRANULES AND  
NUMBER OF CALCIUM HYPOCHLORITE TABLETS OF  
5g. STRENGTH REQUIRED TO GIVE  
50 PPM PER 20 FOOT OF PIPELINE  
(Based on 0.65g available chlorine per g)

Pipe Size	Ounces of Granules Required per 20 foot Length of Pipe	Number of 5g. Tablets Required per 20 Ft. Length of Pipe
2"	1/32	0.25
4"	1/8	1
6"	1/4	2
8"	1/2	4
12"	1-1/4	7

- b. After the calcium hypochlorite has been placed in the pipeline by the contractor, disinfection must be completed within ten calendar days. Should disinfection not be completed within this period, the water company will void this method of chlorination and require that the main be disinfected by mobile gas chlorinator, or slug method, at the expense of the contractor.
- c. After the pipe is filled with water and chlorine at less than one foot/second, and unless approved otherwise by the water operator, the chlorinated water shall be held in contact with the pipe for twenty-four hours. At the end of the twenty-four hour period, the water in the pipeline shall be tested by the water operator to insure a residual chlorine content of not less than twenty-five mg/l. The pipeline shall then be thoroughly flushed to remove the heavily chlorinated water. Care shall be taken in flushing the pipeline to prevent property damage and danger to the public. Samples of water shall be collected for bacteriological examination and residual chlorine content testing before the pipe is put into service. Testing of residual chlorine, and sampling shall be done by a State certified laboratory at the expense of the contractor.
- d. No main that has been disinfected and flushed shall stand stagnant for more than fifteen days without being re-flushed.
- e. A new main will be preliminarily accepted by the water company and release for taps when the disinfection has been completed, bacteriological testing has been done and is acceptable and the main has been flushed and charged.

#### 4.1.6 Hydrostatic Testing

- a. A formal pressure test will be required of the water mains. Valves, and fittings in the system constructed. Where any section of main is provided with concrete thrust blocks, the test shall not be made until at least five days have elapsed after the concrete was installed. If high-early-strength cement is used in the concrete thrust blocks, the test shall not be made until at least two days have elapsed.

- b. The pipeline or sections thereof shall be filled with water, and subjected to a pressure/leakage test with water as set forth in AWWA C600-93. Test length shall not exceed one mile and each separate lateral shall be tested. Leakage shall not exceed 10 gallons per inch of pipe diameter per mile of pipe per eight hours when tested at 150 psi. Any excessive indicated leakage, as determined by the water operator, shall be located and repairs made. Should the pipeline or sections thereof not come within the permissible leakage limits, the contractor shall be required to excavate and locate the source of leakage and make repairs. After the contractor has notified the water operator that repairs have been made, the test will be repeated until the pipeline or sections thereof are made satisfactory.
- c. The water operator shall be notified twenty-four hours in advance of testing. All testing shall be made in the presence of the water operator.
- d. Only the following methods are acceptable for supplying potable water for hydrostatic testing:
  - 1. Water may be taken from a nearby pressurized water source which has been previously chlorinated, tested and accepted, such as a fire hydrant.
  - 2. Water may be delivered to the site in a chlorinated water tank having a minimum capacity of 300 gallons. The water tank shall be used exclusively for the transportation of potable water.
  - 3. Any previously tested, chlorinated and accepted water main which is pressurized and is to serve the new main extension may be tapped on the pressurized side of the closed valve.
  - 4. In any event, the method of supply water as well as the source of water for hydrostatic testing shall be as approved by the water operator. Use of barrels, sanitary or otherwise, to supply water for hydrostatic testing is strictly prohibited.
  - 5. All water mains shall be field hydrostatically tested to a minimum pressure of 150 p.s.i.
- e. The pipeline shall be properly backfilled and shall be in a state of readiness for testing. All bulkheads, pumps, taps, and appurtenances necessary to fill the pipeline and maintain the required pressure shall be in place. The pipeline shall be filled with water and the test pressure shall be applied to the pipeline by means of a continuously operating pump, equipped with a bypass valve for regulating pressure. When filling the pipeline, it shall be filled at a rate that will not cause any surges nor will it exceed the rate at which the air can be released.
- f. All air in the line shall be properly purged. Where blow-offs or hydrants are not available or are not effective in purging air from the line, the water operator shall require a tap, at the contractor's expense, to purge the line. The location and size of tap shall be at the water operator's discretion.
- g. While the test pressure is maintained, an examination shall be made of the pipeline in general, and any leaks shall be repaired. Any pipe or fitting found to be faulty shall be removed and replaced. No leakage is allowed through the bonnet of the line valve. Any valve leaking through the bonnet shall be repaired in place or removed and replaced. Cutting and replacing pavement, excavating and backfilling may all be necessary parts of locating and repairing leaks discovered by pressure testing of pipe.
- h. Tests shall be conducted with fire hydrant valves closed and the hydrant shut off for the first hour. Main line valves shall be tested by relieving the pressure in the sections of main adjacent to the section being tested.
- i. After all visible leaks have been stopped, the full test pressure shall be maintained for two continuous hours.
- j. Solvent cemented joints shall be tested with joints exposed. No leakage shall be allowed on solvent cemented joints.

## 5.0 Excavation

### 5.1.1 Safety

- a. The disturbed area due to construction shall be confined within the construction limits as required in the specifications or as shown on the plan. The length of trench to be opened at one time only may be limited when, in the opinion of the water operator, such limitation is necessary. The amount of open or unfilled trench shall not exceed 500 lineal feet, unless ordered by the water operator, and failure to comply with this requirement shall be cause for shut down of the entire project until such backfilling is accomplished.
- b. The sides of the trench shall be sloped or braced and trench drained so that workmen can work safely and efficiently. All work must be done in a dry trench and no water will be permitted to discharge down the pipe previously laid. The discharge from groundwater pumps shall be laid to approved natural drainage channels or storm sewer. All OSHA regulations pertaining to trenching must be complied with.
- c. In all cases where the water main alignment is located so that space and access is very limited with respect to the safety and welfare of adjoining buildings, such as property lines between houses, the contractor shall discontinue open trench excavation and shall jack and/or auger a liner pipe in place for an adequate length to safeguard against settlement and damage to these adjacent structures. All jacking methods and materials must be approved by the water operator. Sheet piling and bracing as later described may be approved by the water operator as an alternative.
- d. Pits of adequate size to accommodate necessary equipment shall be excavated, braced and drained so that workmen can work safely and efficiently.

### 5.1.2 Construction Stakes

- a. All work shall be constructed in accordance with lines and grades shown on drawings and as established by the engineer. These lines and grades may be modified by the engineer only after approval by the water company manager.
- b. The contractor shall give the consulting engineer sufficient notice of his need for the establishment of line and grade so that the consulting engineer may have time to provide the same. The consulting engineer shall set all vault and manhole rim stakes at the finished street grade elevation, if applicable. After lines and grade for any part of the work has been given by the consulting engineer, the contractor will be held responsible for the proper execution of the work to such lines and grades and all stakes or other marks given shall be protected and preserved by him until he is authorized by the water operator to remove them. The contractor shall at his own expense, correct any mistakes that may be caused by their unauthorized disturbance or removal. The water operator may require that work be suspended at any time when, for any reason, such marks cannot be properly followed.
- c. Line and grade stakes shall be set for each fitting and grade point shown on the drawings and at intervals necessary to maintain the pipe slope when so indicated on the drawings.
- d. The method and equipment used to establish and check line and grade of the pipe shall be approved by the inspector prior to the start of work.

### 5.1.3 Trench Width

- a. The trench width at the top of the excavation may vary depending upon the depth of the trench and the nature of material encountered. However, the maximum allowable width

of trench at the level of one foot above the top of the pipe shall not be greater than the outside diameter of the pipe plus 24 inches.

#### 5.1.4 Over-excavation

- a. Care must be taken to avoid over-excavation, should any over-excavation exceeding two inches be encountered, the material added shall be moistened and compacted to the satisfaction of the water operator, or granular material shall be added as required by the water operator. The finished subgrade shall be prepared accurately by means of hand tools.
- b. If, when dry, the bottom at subgrade is soft and in the opinion of the water operator cannot support the pipe, a further depth shall be excavated as directed by the water operator and refilled to pipe bedding grade as required under the above paragraphs, or other approved methods shall be adopted to assure a firm foundation for the pipe. The class of type of material which is to be used for refilling up to pipe grade shall be foundation material consisting of ¾ inch to 2 inch binder stone as approved by the water operator or foundation material as defined in Section 4 Materials. In the case of rock excavation the excavation shall be carried to a minimum depth of 6 inches below grade and this material will be removed and the trench backfilled with granular material to give a suitable subgrade.
- c. All excavated material shall be piled within the construction limits or in a location obtained by the contractor in a manner that will not endanger the work and that will avoid obstructing sidewalks, driveways, and fire hydrants. Gutter or ditches shall be kept clear or other satisfactory provisions made for street drainage at all times.

#### 5.1.5 Blasting

- a. Blasting will be permitted for portions of the work that may be expedited thereby, provided that a written permit is given by the municipal authority having jurisdiction. The water operator shall have the right to limit the use of explosives or to order the discontinuance of any blasting methods which, in his or her opinion, endanger any part of any public or private property, the safety of inhabitants of the area, or the traveling public.
- b. The contractor shall enlist the services of a professional explosives engineer. In addition to together insurance requirements, contractor shall provide the water company with sufficient blasting insurance as may be directed by the water company.
- c. All blasting shall be in accordance with the Explosive Statutes of Colorado.
- d. Blasting shall be performed in such a manner that no damage will result to any building, structures, pipe line, or facility on or off the site of work, or above or below ground line. Any damage caused as a result of blasting shall be repaired to the satisfaction of the property owner and the water company at the contractor's expense.

#### 5.1.6 Sheeting and Bracing

- a. The contractor, to confine his work within the construction limits and to prevent the disturbing or settlement of adjacent road surfaces, foundations, structures, utility lines or railroad tracks shall furnish and place all sheeting and bracing necessary for safe conditions, and prevent damage and delay to the work. The contractor shall be responsible for the strength and sufficiency of all sheeting and bracing.
- b. Any damage to the work or to adjacent structure or property caused by settlement water or earth pressures, slides, cave-ins, or other reasons due to failure or lack of sheeting and bracing, or improper bracing, or through negligence, or fault of the contractor in any manner shall be repaired by the contractor at his expense without delay.

- c. If in the opinion of the water operator the sheeting and bracing at any point is deemed to be inadequate or improperly constructed, he or she may require additional sheeting and bracing be placed at the contractor's expense. This shall not be construed to relieve the contractor of sole responsibility of job site supervision.
- d. Bracing shall be so arranged as to provide ample working space so as not to interfere with the work, and so as not place any strain on the structures being constructed, until such structures are, in the opinion of the water operator, of sufficient strength with withstand such strain. No sheeting and bracing shall be removed until the construction has proceeded far enough to provide ample strength for its safe removal.
- e. Sheeting or bracing may be left in place in the trench at the discretion of the contractor. Any sheeting or bracing left in place shall be cut off approximately ten inches from the surface and the cut off portion removed, unless the water operator gives permission to leave it in place.

## 6.0.1 Pipe Bedding and Laying

### 6.1.1 Bedding and Backfill

- a. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The granular bedding under the pipe shall have a minimum thickness of one-fourth the outside diameter of the pipe, or four inches, whichever is less. Selected material shall be placed up to twelve inches above the pipe. All bedding material shall be carefully placed and compacted under, around, and over the pipe. Select backfill shall be placed and compacted over the bedding material., except where trenches are not under existing or future pavements, driveways, parking area or sidewalks, excavated soil may be used for backfill. Excavated material used for backfill shall be thoroughly compacted. Native bedding material may be used in lieu of granular bedding material if approved by the water company manager. No angular rocks larger than 1" in diameter or any rock more than 2" in diameter may be allowed in bedding material.

### 6.1.2 Laying of Pipe

- a. Proper implements, tools, and facilities satisfactory to the water operator shall be provided and used by the contractor for the safe and convenient execution of the work.
- b. Pipe materials shall be unloaded and distributed on the job in a manner approved by the water operator. In no case shall materials be thrown or dumped from the truck.
- c. Before lowering and while suspended, the pipe shall be inspected for defects to detect any cracks. Any defective, damaged, or unsound pipe shall be rejected and removed from the job site.
- d. All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means, as determined by the water operator during and after laying. All openings along the line of water main shall be securely closed as directed, and in the suspension of work at any time, suitable plugs shall be placed to prevent earth or other substances from entering the pipe.
- e. Pipes shall be laid to a true line and at uniform rates of grade between grade points as shown on the plans. Fine grading, to the bottom of the trench, shall proceed ahead of the pipe laying, and should any over excavation exceeding two inches be encountered, the material added shall be granular bedding or foundation material shall be added at the expense of the contractor to the satisfaction of the water operator.
- f. Holes shall be dug for the pipe bells. The pipe shall be supported along its bottom as required by these rules and throughout its length except for the minimum distance

necessary at the bell holes. Bell holes shall be adequate to make the joint, but no larger than necessary so that maximum support will be provided for the pipe. The remainder of the pipe shall be surrounded as required by the appropriate bedding, shovel placed and hand tamped, to fill completely all spaces under and adjacent to the pipe.

- g. No pipe shall be laid in water or when the trench conditions are unsuitable for such work.
- h. When connecting to existing water mains, the contractor shall take every precaution necessary to prevent dirt or debris from entering the existing lines.

#### 6.1.3 Length of Pipe

- a. The length of pipes for curvilinear water main shall be determined by the radius using joint deflection not exceeding the manufacturer's recommendations.

#### 6.1.4 Fittings

- a. Fittings shall be installed where shown on the plans. Pipes shall be cut as necessary to install fittings at the proper locations. Fittings shall be provided with thrust blocking and megalugs as necessary per these specifications.

### 7.0 Backfill and Compaction

#### 7.1.1 General

- a. No backfilling will be allowed until the pipe as installed conforms to the specified requirements.
- b. Granular material shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench to a height of six inch above the crown of the pipe, shovel placed and hand tamped to fill completely all spaces under and adjacent to the pipe.
- c. All backfill shall be compacted to a minimum of 95% of modified proctor density at optimum moisture, ASTM D-1557, by tamping or other means approved by the water operator. Jetting, puddling or ponding will not be used except where approved by the water company, sufficient cover the pipeline will be hand tamped to prevent flotation of the pipe. Backfill for water main trenches shall be suitable earth free from rocks over three inches in diameter, large roots or excessive sod or other vegetation.
- d. Backfilling and compacting shall be done as thoroughly as possible so as to prevent after settlement. Depositing of the backfill shall be done so the impact of falling material will not injure the pipe or structures. Grading over and around all parts of the work shall be done as directed by the water operator.
- e. Backfilling shall be done in lifts of uniform layers not to exceed the depth shown in the compaction chart and each lift shall be completely over the full width of the excavation area. Compacting shall continue until the specified relative compaction has been attained. (Three feet of material over the top of the pipe shall be required before a vibratory or sheepsfoot roller is operated over the pipe.)

#### COMPACTION CHART

Compaction Type	Sands	Maximum Loose Soil Lift Height Plastic Soil
Vibratory Roller (Vibro-Plus CK-10) or equal	4.00	Not Allowed

Sheepsfoot (150 OSI Minimum)	Not allowed	2.0
Vibratory Sheepsfoot (Essick Vf-54T) or equal)	4.00	2.00
Button Head Pneumatic	0.50	0.50
Plate Temper	1.00	1.00
Plate Vibrator	1.00	Not Allowed

- f. Succeeding layers of backfill may contain coarse materials, but shall be free from large pieces of rock, frozen material, concrete, roots, stumps, tin cans, rubbish, and other similar articles whose presence in the backfill, in the opinion of the water operator, would cause settlement of the trench or damage to the pipe. No stone large than six inches in diameter shall be placed within three feet of the pipe.
- g. Wherever select material, that exists in place in the upper four feet of the finished grade of the paved or traveled portions of the street or roadway, is removed by the trench excavation, the contractor shall replace said material (or material of equal quality) as backfill in the upper four feet of the finished grade. Where select material does not exist in place as described above, the material available from other excavations on the project may be used.
- h. Special compaction shall be done around all valve boxes and vaults, manholes, curb boxes, water services, other structures, and utilities by the use of pneumatic tampers, plate tampers, or plate vibrators with lifts not to exceed that shown in the compaction chart.
- i. Water service trenches must be compacted in the same manner as the water main trenches. All excavation in trenches shall be backfilled to the original ground surface or to such grades as specified or shown in the plans. The backfill shall begin as soon as practical after the pipe has been placed and shall thereafter be carried on as rapidly as the protection of the balance of the work shall permit.
- j. Compaction tests at the expense of the contractor shall be conducted by an independent testing laboratory to a depth not greater than two feet above the pipe. One test shall be conducted for each run, or every four hundred feet whichever is greater, or as required by the controlling agency.

## 8.0 Misc. Construction Specifications

### 8.1.1 Thrust Blocks

- a. Concrete thrust blocks shall be installed at all tees, plugs, bends, caps, reducers, valves, air vacs and fire hydrants in accordance with the standard drawings. Where thrust blocks are used in conjunction with 8 mil thickness of polyethylene as bond breaker, care shall be taken not to block weep holes outlets or to cover bolts, nuts, clamps, or other fittings or to make them inaccessible. Size of thrust block, type of concrete, and dimensions shall be in accordance with the details in the standard drawings. Concrete shall be not less than 2,000 psi at 28 days.

### 8.2.1 Concrete

- a. General. The contractor shall perform all the concrete work on the drawings or required these specifications. The work shall consist of furnishing and placing forms and

concrete, including mixing, placing, curing, repairing, finishing, and all equipment, tools and related work required to produce finished concrete work. Concrete work shall conform to all requirements of ACI 301-72 as per the latest revision thereof except as noted below.

- b. Forms. Forms shall be constructed to maintain the dimensions, lines, and planes shown on the plans. Forms shall be tight to prevent leakage of mortar.
- c. All vertical surfaces of concrete members shall be formed unless placement of the concrete against the ground is called for on the drawings or is explicitly authorized by the engineer or water company manager. The dimensions of concrete members shown on the drawings apply to formed surfaces except where otherwise indicated, and not less than 1 inch of concrete shall be added where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- d. Re-entrant corners and exterior corners shall be formed with nominal fillets and 1 inch chamfers, unless otherwise ordered. Provide coring and blockouts in slabs and walls for mechanical and electrical work, size and locations, as directed by respective trades. Access openings shall be provided for inspection of forms and reinforcement prior to and during placing of concrete.
- e. Board forms shall be Standard grade D.F., T & G or shiplap, S1S2E, not wider than 8 inches and normal one inch thick. Plywood forms shall be DFPA Exterior "Plyform", 5/8" thick or equal. Approved steel forms may be used in lieu of wood forms.
- f. Form ties shall be Dayton Sure-Grip, Richmond Snap-Tys, Bowman Snap-Ties, or a type recommended by the manufacturer for the conditions of installation. Wire ties and wood spacers are not permitted.
- g. Forms shall be properly treated before pouring concrete. Wood formwork shall be lightly oiled with an approved stainless form oil prior to placing concrete. Metal form shall be coated with an approved type of release compound applied in accordance with manufacturer's directions.
- h. Remove forms at time and in such manner as to insure complete safety of the structure and without damage to concrete surfaces.
- i. Inserts. Furnish and install all inserts and built-in items to complete the concrete construction and to provide for anchorage of the other members that are to attach to it.
- j. General Requirements. Concrete where indicated on the plans, or suggested for use in this work shall mean a ready-mix concrete which shall be mixed and delivered in accordance with requirements set forth in Tentative Specifications of ready-Mix Concrete (ASTM C-94). All concrete furnished for structures in this contract, shall a minimum of 3,500 psi in 28 days, Type II cement.
- k. Concrete shall be mixed, handled, placed and allowed to cure according to the intentions of the latest revision ASTM specifications for the control of reinforced concrete.
- l. Air-Entraining Agents. An air-entraining agent shall be used in all concrete. 3/4" aggregate concrete shall have 6% and 1-1/2" aggregate concrete shall have 4.5%.
- m. Protection in Cold Weather. During severe weather, when the mean daily temperature at the site falls below 40°F for two or more consecutive days, the temperature of the freshly placed concrete shall not be less than 50°F or more than 70°F and shall be maintained with this temperature range for at least three days after placing.

#### 8.3.1 Reinforcement Steel

- n. General Requirements. Billet steel bars shall conform to the requirements of Tentative Specifications for Minimum Requirement (ASTM A-82) and ASTM Specification A-15,

- intermediate grade. Each piece of steel shall be grade marked or each shipment shall be accompanied by a certificate of inspection.
- o. Accessories including all devices necessary for the proper placing, spacing, supporting and fastening of steel reinforcement shall be provided. Metal accessories shall be galvanized where legs will be exposed in finished spaces. Concrete, ceramic or plastic accessories may be substituted for steel. Chairs and bolsters shall be plastic tipped for structural slabs over the clearwell and appurtenant areas.
  - p. Anchor bolts shall be A307 galvanized for steel construction.
  - a) Fabrication and Installation. Reinforcement shall be fabricated in the sizes and dimensions shown and placed in the locations shown on the drawings. All bars shall be bent in a manner that will not injure the material.
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- b) Whenever bars are spliced they shall be lapped in accordance with the latest ACI Building Code. Provide 90° corner bars of proper lap at all exterior and re-entrant corners. Support steel at proper height upon metal chairs and spaces, or transverse steel in slabs on grade, with precast concrete cubes at frequent intervals. Securely wire all reinforcing in place with No. 16 wire. Place all reinforcement before imbedded electrical conduit is installed.
  - c) Before placing reinforcement, and again before concrete is placed, clean rust, scale, oil, and other foreign coatings that may destroy or reduce bonding.
  - d) Concrete Protection for Reinforcement. The metal reinforcement shall be protected by the thickness of concrete indicated in the plans. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:
    - 1. Where concrete is exposed to the weather, or exposed to the ground without the use of forms, not less than three inches.
    - 2. Where concrete is exposed to the weather, or exposed to the ground but placed in forms, not less than two inches.
  - e) Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion by concrete or other adequate covering.

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