

Appendix “B”

Engineering & Construction Standards

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Arapahoe County Water and Wastewater Authority
Rules & Regulations
Appendix B
Engineering & Construction Standards

Section I. General

1.1 Purpose

The purpose of these Rules and Regulations is to provide for the control, management and operation of the water and wastewater systems of the Arapahoe County Water and Wastewater Authority, including additions, extensions and connections thereto, and to provide for the administration and enforcement of such Rules and Regulations as well as applicable State and Federal Laws. Service by the Authority will be available in accordance with these Rules and Regulations, subject to availability and capacity of facilities.

1.2 Authority

These Standards are promulgated by the Arapahoe County Water and Wastewater Authority (ACWWA) Board of Directors. The enforcement and revision of these Standards is hereby delegated by the Board to the General Manager.

1.3 Regulations by Other Governmental Entities

Any limitation, restriction or prohibition validly placed upon the Authority by any governmental entity or by any agreement between the Authority and any other governmental entity is hereby incorporated into these Rules and Regulations by this reference and shall constitute a limitation, restriction and/or prohibition on each Customer of the Authority as applicable.

1.4 Effective Date

These Standards (APPENDIX B) shall be effective immediately upon adoption by the ACWWA Board of Directors and shall supersede all former Authority Engineering Standards which are in conflict herewith.

1.5 Revisions, Amendments, or Additions

These Standards may be revised, amended or added to from time to time, and such revisions, amendments and additions shall be binding and of full force and effect, when adopted in the manner set forth in Section 1.2, above. Current editions of standards such as ASTM, AWWA and ANSI shall apply where referenced in these Standards.

1.6 Repeal of Conflicting Resolutions

All previous resolutions or parts of previous resolutions in conflict herewith are hereby repealed, except as may be as expressly provided herein.

1.7 Authority Control

These Standards will apply to the installation, operation and maintenance of all water and sewer facilities under the control of the Authority. Such control will be exercised in accordance with the Authority's General Rules and Regulations.

Notwithstanding any variance from these Standards that occurred or was authorized in the past or that may be authorized in the future, the Authority shall not be restricted or limited in the exercise of its lawful powers. No action, direct or indirect, of or by any person, including any owner, operator or agent of an owner or operator of any facility in making any connection, disconnection, repair or otherwise doing work with respect to any facility served from the Authority system, in violation of these Standards, shall continue after discovery of such violation, or the enforcement of corrective action as to such violation.

1.8 Interpretation

The interpretation of any section, or of differences between sections, when appropriate, shall be made by the General Manager and his interpretation shall be binding and controlling in its application.

1.9 Severability

The invalidity of any section, clause, sentence, or provision of these Standards shall not affect the validity of any other part of these Standards which can be given effect without such invalid part or parts, and to this end the provisions of these Standards are hereby declared to be severable.

END OF SECTION

Section II. Definitions

2.1 Definitions

See Arapahoe County Water & Wastewater Authority RULES AND REGULATIONS – SECTION II. DEFINITIONS

END OF SECTION

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Section III. Main Extensions

3.1 Application Procedures

The Authority will establish, and may amend from time to time, procedures to be followed by Applicants for extensions of mains. These procedures will include all requirements for planning submittals, fees, engineering design, construction and acceptance.

The engineering design and construction portions of the main extension applications shall include the following:

- An initial submittal by the Applicant including an overall or master plan showing the area to be developed and any other adjoining proposed developments by the Developer/Owner,
- A preliminary plat of the subdivision,
- Lists of all properties to be served,
- Building or zoning types and plan sites,
- Proposed main sizes and all taps to be made on the proposed extension.

The Authority returns to the Applicant its requirements for:

- Points of connection to existing facilities.
- Sizes on mains to be installed.
- Locations of mains to be installed.
- Special features such as in-line valves, pressure regulating valves, air release and vacuum relief valves, blow-offs, manholes, backflow prevention devices, etc.
- Acceptable main materials.

The Applicant will then submit final plans prepared by, stamped by, and signed by Developer/Owner or her Professional Engineer for review by the Authority. This submittal will contain all of the items listed in the procedures as established in these Standards including detailed plans and specifications, recorded plat, Fire Department requirements for hydrants, easements, right-of-way, permits, applications and fees.

The Authority will review all submittals for conformance with these Engineering and Construction Standards and other applicable rules and regulations and either approve the submittal or return it to the Applicant for correction and resubmittal. This review of submittals by the Authority or its representative will in no way relieve the Applicant from responsibility for errors, nor relieve the Applicant's obligation for compliance with the Authority's Standards, Federal, State, or County Standards and other applicable rules and regulations.

All drawings submitted for review must include SUE Level A investigations for any crossing of ACWWA's water mains and Level B investigations for crossings of ACWWA sewer lines.

3.2 Construction Procedures

Following final approval of the plans and specifications, scheduling and holding the pre-construction meeting with ACWWA, and approval of applications for water and/or sewer service including payment of all applicable fees, the Applicant may proceed with construction. In addition to all construction requirements contained in these Standards, the Applicant and/or the Applicant's Contractor shall observe the following:

Plan Approval – Commence Construction. Construction shall commence within 6 months of the approval date shown on the plans, or the plans must be resubmitted for review and approval. If construction on the main installation is halted for more than 6 months, plans must be resubmitted for review and approval and should fee costs change, a recalculation of the total fees taking into account any previously paid fees.

Fees and Permits Payments - The Applicant shall secure and pay for all licenses and permits required for the system extension.

Per the Development Process, the Applicant will be required to pay to the Authority an imprest account as identified in Appendix A. Applicant will also be required to pay any required tap fees.

The Authority's Development Review Manager will verify payment on all fees, prepare final documents for main extensions and authorize the tapping of the main by the Authority or by the Applicant's Contractor.

The extension shall be accurately surveyed and staked by the Applicant's registered land surveyor in accordance with the approved plans.

All materials needed to complete the work shall be acquired so that the project may proceed without delay.

Contractor shall notify the Authority Construction Observer, in writing, a minimum of five (5) business days prior to any proposed outages that will affect existing customers. This notice for proposed outage shall contain the location, date, time, and length of the proposed outage. Outages shall be kept to a minimum. No work will be performed by the Applicant until the Authority approves the proposed outage. Authority staff will notify customers of the required outage.

Preconstruction Meeting - A preconstruction meeting shall be held and the attendees shall include at least the Applicant, the Applicant's Contractor and Engineer, and the Authority Construction Observer. The purpose of the meeting shall be to discuss the construction project, scheduling, regulations, testing required, project closeout procedures and requirements, and to define responsibilities for the personnel involved in the project. Any proposed outages of water, sewer or other services will be included in the discussion.

Notification Requirements - For water main extensions, the Contractor shall notify the Authority Construction Observer a minimum of five (5) business days prior to requiring a valve to be opened or closed on the existing water system. Only Authority personnel are authorized to operate valves.

Inspection Requirements - All taps or connections shall be inspected by the Authority Construction Observer. Mains will only be tapped after having been installed to the satisfaction of the Construction Observer, pressure tested, chlorinated and standard bacteriological tested, and released by the local health authority having jurisdiction.

As-Built Documentation - The Applicant's Contractor is responsible for maintaining field As-built information. Probationary acceptance of the lines by the Authority is contingent upon receipt and approval of such information.

3.3 Plans and Specifications

Detailed plans and specifications for system main extensions shall be prepared for approval with the submittal to the Authority. All plans and specifications submitted shall be in strict compliance with the Engineering Standards contained herein and shall meet all special conditions that may be reasonably required. The design and installation of all facilities shall insure development of an integrated system. No work shall commence on any facilities until the plans and specifications for construction are approved in writing by the Authority. Plans and specifications should not be submitted for work that will not be installed within 6 months of the approval date. All final plans shall contain, but are not limited to, the following information:

Plan view containing or showing:

- Locations and dimensions of dedicated streets, easements and rights-of-way.
- Lots to be served including legal description of lots.
- All existing and/or proposed curb and gutter.
- All existing and/or proposed utilities and locations of conflicts.
- All existing and/or proposed obstructions such as vaults or manholes, catch basins, traffic islands, etc.
- The proposed alignment of the water lines and sewer lines and the location of all proposed facilities such as valves, fire hydrants, fittings, vaults and/or manholes, cleanouts, meter pits and taps and backflow prevention as required. Proposed alignments shall include stationing and shall be used throughout the plan set.

Typical street cross-sections showing:

- Property lines.

Street, curb and gutter, and existing or proposed utilities, complete with dimensions to property lines and street centerlines, utility easements, gas, electric, etc.

Centerlines profile of the mains showing:

- Existing and/or proposed street grades.
- Existing and/or proposed ground lines.
- Any proposed and/or existing crossing of the water mains and sewer.
- Any existing utilities and separation distances with proposed utilities.

An overall map of the system showing contour lines, property lines, mains and appurtenances.

Detail sheets of all features such as in-line valves, vaults and/or manholes, meter pit installations, hydrants, concrete thrust blocks, pipe bedding details, encasement details, and pavement and pavement patching details.

Additionally, all plans shall:

- Be developed from actual field surveys referenced to land corners or other official survey control points and be of sufficient accuracy so that the facilities can be accurately staked for installation and can be readily located after installation for maintenance, tapping and control.
- Be of suitable scale to show all necessary information, preferably 1" equals 50' horizontal and 1" equals 5' vertical or larger. In the case of Plan and Profile Drawings of mains, a larger scale as may be required to adequately show specific details of mains, connections and other installations. Consider using a 1" equals 40' scale and 1" equals 4' vertical.
- Show sufficient adjacent area to give the relation of new facilities to existing facilities, preferably on a location map of 1":1000' or other appropriate scale.
- Have proper signed signature blocks on the cover sheet.
- The cover sheet for all water line construction drawings shall be signed by the Fire Marshall of the appropriate jurisdiction
- The cover sheet for all water and sewer line construction drawings shall be signed by a Colorado registered Professional Engineer under whose supervision the plans were prepared.
- All plan sets shall have ACWWA General Notes and signature blocks for Authority's General Manager and Authority Engineer approval.
- Proposed ACWWA utilities shall include stationing in plan and profile
- A summary of quantities table shall be provided on the cover sheet of each proposed ACWWA utility alignment. This shall include items such as: length of pipe by diameter, quantity of fittings by size and type, etc.
- In the case of water line construction drawings, provide sufficient water usage information to determine if and what type of backflow prevention device will be required, if needed.

- The specifications and details provided shall conform to the Authority specifications and details described in these Standards and supplemental AWWA standard details.

The precedence of construction documents shall be as follows:

- In the drawings - calculated/stated/detailed dimensions shall take precedence over scaled dimensions; noted/identified material over graphic indication.
- Conflicts between the drawing and specifications will be clarified by the engineer of record, and submitted for acceptance/approval by the Authority Engineer, or AWWA's Development Review Engineer

Any and all dedicated streets, right-of-way, easements and planned development complexes shall conform to the requirements of the district/planning area jurisdiction in which the project is being constructed. A copy of the recorded subdivision plat, easements or right-of-way shall be furnished to the Authority.

3.4 Construction Observation

Installation of all new facilities and infrastructure in the Authority designated service area shall be observed by the AWWA Construction Observer, or an AWWA authorized representative.

The Construction Observer shall ensure that the provisions of the Engineering and Construction Standards are complied with in regard to the quality of workmanship and materials.

The Construction Observer shall have access to all work and shall arrange with the Contractor to be present during testing as well as any other phases of construction as the Construction Observer may deem necessary. Any work done in the absence of the Construction Observer, without prior approval, shall be excavated for inspection if so ordered by the Construction Observer. Any such excavation shall be at the expense of the Contractor.

All work shall be performed in accordance with and these Engineering and Construction Standards. Any work not accepted by the Construction Observer shall be corrected until compliance with these Engineering and Construction Standards is achieved. The Construction Observer shall not supervise nor set out work nor give line and grade stakes, nor shall he undertake any of the responsibilities of the Contractor, Subcontractors, or Contractor's Superintendent.

All appropriate permits and approved plans shall be on the jobsite and shall be checked by the Construction Observer before starting construction.

All materials used shall be subject to the inspection and verification of the Construction Observer at all times. The Construction Observer has the right to perform any testing deemed necessary to insure compliance of the materials with these Standards. No material shall be used before being inspected and verified by the Construction Observer.

Failure or neglect on the part of the Construction Observer to reject inferior materials, or work, shall not be construed to imply their acceptance should their inferiority become evident at any time prior to the expiration of the warranty period. Equipment or materials rejected Construction Observer shall be immediately removed from the jobsite.

After receipt of approved plans from the Authority's Development Review Engineer or Authority Engineer, the Contractor shall give at least 48 hours' notice to the Authority Construction Observer immediately prior to starting construction. No construction shall commence within 48 hours of receipt of approved plans.

3.5 Contractors

No work shall commence until the preconstruction meeting has been held and the Contractor has an approved set of plans and specifications in his possession. All work shall be performed in strict conformance with the approved plans and specifications and shall be inspected and approved by the Authority's designated representative.

Contractors performing all work within the Authority shall be competent, licensed firms with adequate manpower and equipment to accomplish the work in accordance with these Engineering and Construction Standards. The Contractor shall be licensed in the jurisdiction where the work is to be performed.

Contractor shall be on ACWWA's approved Contractor's list or provide relevant qualifications including recent (within last 3 years) projects of similar scope and size for review and approval by ACWWA. ACWWA will consider Contractor's that are on other metro area water utilities approved Contractor's list.

The Contractor and/or his Surety on the Performance Bond shall be jointly responsible through the warranty period following the final acceptance of all work performed. The Contractor and/or Surety shall be responsible for the satisfactory repair or replacement of all work, material, services and equipment which becomes defective during this period.

3.6 Special Conditions

Construction within the Authority may involve or require approval from other districts or agencies. All conditions of these other districts or agencies must be satisfied prior to final ACWWA approval.

All designs, drawings and calculations submitted to any other agencies shall also be submitted to the Authority Engineer for review and approval.

Should a conflict in the plans and specifications occur between the Authority and the other agency, the Applicant's design engineer shall resolve the conflict to the acceptance of all agencies involved.

3.7 Inspection and Review Fees

The Applicant who is submitting construction plans for review shall establish an Imprest Account with ACWWA as outlined in the Rules and Regulations and noted in Appendix A.

The Imprest Account is used for, but is not limited to plan review, construction observation and other Authority expenses. In addition, the Applicant is responsible for all fees or charges related to other special requirements whether within the ACWWA service area or outside the service area.

END OF SECTION

Section IV. Water Main Construction

4.1 Pipe

All materials in this specification shall conform to the latest editions of applicable ASTM, AWWA and ANSI standards. Pipe classes indicated shall be considered minimums.

It shall be the responsibility of the Applicant's Design Engineer to design the pipe system in accordance with the latest appropriate design standards and for the actual site conditions. Proof of design may be requested by the Authority as part of the drawing review process.

4.2 Ductile Iron Pipe

4.2.1 General

All ductile iron pipe furnished under this specification shall be manufactured in strict accordance with AWWA C151 and shall conform to the following additional requirements:

4.2.2 Size of Pipe

4 inch through 64 inch

4.2.3 Joint Type

Push on joints: bell and spigot, gaskets shall conform to AWWA C111.

Flanged joints: flanged joints per AWWA C110 and AWWA C115, ANSI B 16.1, Class 125. Gaskets shall conform to Grade B ASTM A 307.

Restrained joints: restrainers shall be ductile iron per AWWA C111 and ASTM A 536 as manufactured by EBAA Iron, Uni-Flange, or approved equal. Twist-off nuts shall be provided. Restrainer shall have a working pressure of 250 psi minimum with a safety factor of 2:1. When a pipe joint is restrained adjacent to a fitting, a harness type restraint device shall be used.

4.2.4 Material

Centrifugally cast, grade 60-42-10 iron meeting requirements of AWWA C150, C141, and C111.

4.2.5 Joint Length

Pipe shall have a nominal joint length of 18' or 20'.

4.2.6 Pressure Rating

4 inch through 12 inch shall be Pressure Class 350

16 inch through 20 inch shall be Pressure Class 250

24 inch shall be Pressure Class 200

30 inch through 64 inch shall be Pressure Class 150

4.2.7 Protective Coatings

The surface finish of all pipe shall conform to the following:

- a) Interior - Pipe shall have standard cement mortar linings in accordance thickness with AWWA C104. Any type of lining shall be NSF61 approved.
- b) Exterior - Asphaltic, one mil thick per AWWA C151.

4.2.8 Polyethylene Wrapping

Polyethylene encasement material shall be manufactured in accordance with AWWA C105 with the following additional requirements or exceptions.

Polyethylene encasement shall be linear low-density polyethylene film with a minimum thickness of 8 mils.

Polyethylene encasement shall be clear (natural color).

Flat tube material shall be used for pipe and fitting encasement; flat sheet material shall be used for valve encasement.

The manufacturer shall furnish a sworn statement that the inspection and all specified tests have been completed and that results comply with the requirements of these Standards. A copy of the Certification shall be provided to ACWWA.

All pipe (including copper service lines) shall be wrapped with polyethylene in accordance with ACWWA Standard Detail W-23.

4.3 Polyvinyl Chloride Pipe (PVC)

All PVC pipe furnished under this specification shall be manufactured in strict accordance with AWWA standards and shall conform to the following additional requirements.

4.3.1 Size of Pipe

AWWA C900 - 4 inch through 12 inch

AWWA C905 – 14 inch through 48 inch

4.3.2 Joint Type

Push-on joints: Bell and spigot, gasketed in accordance with ASTM D3139. Gaskets shall conform to ASTM F477.

Restrained joints: Restrainers shall be ductile iron per AWWA C111 and ASTM A536 as manufactured by EBAA-Iron and Uni-Flange or approved equal. When a pipe joint is restrained adjacent to a fitting, a harness type restraint device shall be used. Twist-off nuts shall be provided. Pressure rating shall be the same as PVC pipe.

4.3.3 Material

Class 12434 A or B material per AWWA C900, AWWA C905, ASTM D1784, ASTM D 1785, and ASTM D2241.

PVC pipe to be used for the purpose of irrigation (i.e. non-potable, re-use, effluent) shall conform to the standards in this section, however shall be purple in color.

4.3.4 Pressure Rating

4 inch through 12 inch: Class 150 (DR 18) per AWWA C900

14 inch through 20 inch: Class 165 (DR 25) per AWWA C905

4.3.5 Joint Length

Pipe shall have a nominal joint length of 20'.

4.3.6 Storage and Handling

All Pipe and pipe materials shall be stored per manufacturer's and AWWA requirements. Pipe shall be stored to protect it from sunlight. Sun bleached pipe shall be rejected. Pipe shall be stored off the ground surface with the ends capped/wrapped to prevent foreign material from entering the pipe.

Bedding of pipe is critical for proper pipe operation and shall be in strict accordance with these specifications.

4.4 High Density Polyethylene Pipe (HDPE)

4.4.1 General

HDPE pipes/fittings shall be allowed for use as water, wastewater, and reclaimed water pressure pipe where compatible with the specific conditions of the project.

The use of material other than HDPE pipe may be required by ACWWA if it is determined that HDPE pipe is unsuitable for the particular application.

All HDPE pipe furnished under this specification shall be manufactured in strict accordance with AWWA C906 and shall conform to the following additional requirements.

4.4.2 Size of Pipe

4 inch through 63 inch per AWWA C906-07

4.4.3 Joint Type

Joint type shall be thermal butt-fusion (HDPE pipe to HDPE pipe) according to ASTM D3261 or mechanical adapter for valve, fitting, or dissimilar pipe to pipe connections.

4.4.4 Material

Polyethylene pipe shall be made from HDPE material having a material designation code of PE3608 or higher. The material shall meet the requirements of ASTM D 3350 and shall have a minimum cell classification of PE345464C.

In addition, the material shall be listed as meeting NSF-61.

4.4.5 Pressure Rating

4 inch through 12 inch: 160 psi (DR 11)

16 inch through 20 inch: 160 psi (DR 11)

24 inch through 36 inch: 160 psi (DR 11) (HDD only)

4.4.6 Pipe Marking

Permanent identification shall be provided by co-extruding multiple equally spaced color stripe into the pipe outside surface or by solid colored pipe shell.

4.5 Steel Casing

Smooth wall casing shall be of welded steel construction and shall be new material with a minimum yield point of 35,000 psi. The casing pipe in its final position shall be straight and true in alignment and grade, and there shall be no space between the earth and casing.

4.5.1 Size of Pipe

14 inch through 66 inch

4.5.2 Joints

Electric fusion (arc) welded by certified operators meeting the requirements of the American Welding Society Standard AWS D7.0 procedures and in accordance with AWWA C206. Field weld joints shall be tapered approximately 45 degrees. All joints shall be welded the full circumference of the joint.

4.5.3 Material

Steel casing shall be ASTM A139 Grade B, minimum yield strength of 35,000 psi. The pipe shall have a minimum thickness in accordance with requirements of the regulatory agency, but shall in no case be less than 0.25" for 30" and smaller pipe, and 0.31" for pipe larger than 30".

Wall Thickness: Meet the latest requirements of ACWWA Standard Detail W-20

4.5.4 Length of Pipe Section

Full pipe length shall be provided with a minimum length of 8 feet.

4.5.5 Coating

Wire brush welded joints and paint with Koppers Inetrol Primer 6276 or equal. The casing pipe shall be cleaned and coated both inside and outside with coal tar paint.

4.6 Water Main Appurtenances and Installation

4.6.1 Ductile Iron Fittings

Shall be cement mortar lined ductile iron and shall conform to AWWA C110, C111, C115, and C135 and shall have a minimum pressure rating of 350 psi.

Long body fittings shall normally be installed. Compact fittings shall be used when conditions so warrant.

Fittings shall be UL/FM approved and shall conform to NSF Standard 61 as applicable. Fittings furnished by the approved manufacturer shall be cast and machined at one foundry location to assure quality control.

Fittings shall have cast on them the pressure rating, nominal diameter of openings, manufacturer's name, foundry location, plant code, and degrees or fraction of the circle.

All ductile iron fittings shall be externally coated and internally lined per ductile iron pipe specifications.

4.6.2 Polyethylene Fittings

Polyethylene Mechanical Joint (MJ) Adapters fittings shall be PE3408 HDPE, Cell Class 345464C per ASTM D3350

Mechanical connections of HDPE pipe (4 inch through 24 inch diameter) to Ductile Iron or PVC piping, fittings or valves shall be by a self-restraining, fusible mechanical joint adapter with or without an integral, internal stainless steel insert.

Mechanical joint adapter shall be of the same SDR rating as the pipe.

A stainless steel type insert is required for pipe sizes through 12 inch.

Provide the mechanical joint adapter with longer tee bolts or stainless steel thread rods with nuts at the mechanical joint.

4.6.3 Electrofusion Couplings

Polyethylene pipe may be joined using electrofusion couplings.

Fittings shall be PE3408 HDPE, Cell Class 345464C per ASTM D3350.

Electrofusion couplings shall conform to ASTM F1055.

Fittings shall have a pressure rating equal to the pipe.

All electrofusion couplings shall be suitable for pressure use per AWWA C906 with nominal burst value or 3.5 times the working pressure of the fitting.

4.6.4 Connectors - Flange Adapters

Flange adapters shall be ductile iron manufactured to ASTM A536 standards

Bolt circles and bolt holes shall meet ANSI B16.1

Adapter flanges shall meet or exceed the test requirements of, ASTM D2241, and ASTM D1599.

4.6.5 Connectors - Pipe Couplings

Couplings used to join two pieces of ductile iron pipe or PVC pipe shall be sized to match the outside diameter of the pipeline.

Transition couplings shall be used to join pipes of different outside diameters.

The coupling sleeve shall be manufactured of ductile iron conforming to ASTM A536 and coated with 14 mils of epoxy. Bolts shall be manufactured of high corrosion resistant metal and shall conform to ANSI A21.11 (AWWA C11). Gaskets shall be wedge-type and manufactured of virgin SBR. Installation of couplings shall be in accordance with manufacturer's recommendations.

4.6.6 Valves

Shall be manufactured in accordance with AWWA Standards and shall open by turning counter-clockwise (left).

Valve ends shall be mechanical joint.

Valves shall be equipped with a 2" square operating nut.

Valves shall be Class 200.

Gate Valves shall be installed on all lines 12" in diameter and smaller, and butterfly valves shall be installed on all lines greater than 12 inches in diameter.

Unless otherwise approved, in-line gate valves and butterfly valves shall be located as indicated on the construction plans but at not more than 500-foot intervals in all water mains.

4.6.7 Gate Valves

Gate valves twelve (12) inches and smaller shall be resilient seat gate valves and shall be designed for 250 psi minimum working pressure meeting AWWA C509.

Gate valves shall have a clear waterway equal to the nominal diameter of the pipe.

The operating nut or wheel shall have an arrow cast in the metal indicating the direction of opening. All valves shall open by turning the operation nut counter-clock wise (open left).

Each valve shall have the manufacturer's distinctive marking, pressure rating, and year of manufacture cast on the body.

Prior to shipment from the factory, each valve shall be tested to a hydraulic pressure equal to at least 350 psi.

Sealing mechanism shall provide zero leakage at the working pressure with the flow in either direction.

4.6.8 Gate Valves - Buried

Buried gate valve shall be ductile iron body bronze mounted meeting ASTM A536 or cast iron ASTM A126, Class B, rubber encapsulated resilient seat, solid wedge, non-rising stem with operating nuts and adjustable valve boxes and covers.

Operating nuts shall be two inches [2"] square. Resilient seat gate valves shall conform to applicable sections of AWWA Standards C509.

All ferrous surfaces shall be coated inside and outside with a fusion bonded epoxy coating.

Two stem seals shall be provided and shall be of the "O-ring" type. Stem nut shall be independent of the gate.

4.6.9 Gate Valves - Above Ground Valves

Gate valves located above ground or inside structures shall be hand wheel operated, non-rising stem type with flanged ends.

4.6.10 Butterfly Valves

Butterfly Valves shall conform to AWWA C504. Butterfly valves shall be furnished with mechanical joint connections and shall be suitable for buried service installation.

All water mains 16 inches and larger shall use butterfly valves. Butterfly valves shall meet the requirements of the applicable classes of AWWA C504, Class 150A or B.

Butterfly valves shall be provided with precast concrete vaults placed over the horizontal operators. See ACWWA Standard Drawing No. W-15 for complete details.

The butterfly valve installation shall include a tap on each side of the valve for chlorination and for air release

All butterfly valves shall be adjusted to insure that they will seat completely and not leak. Valves are required to be bubble tight in both directions.

Open Left – Counterclock wise.

Valve Bodies - Valve bodies shall be constructed of ductile iron conforming to ASTM A-536 or cast iron per ASTM A126, Class B. Buried valve shall have mechanical joint ends with corrosion resistant alloy steel or stainless steel nuts and bolts. Paint the exterior of the valve with two (2) coats of bituminous paint. Above ground valves shall be flanged in accordance with ANSI B161.1, Class

125. Flanged joints shall have hot-dip galvanized or stainless steel nuts, bolts, and washers, painted to match color of pipe. Body thickness shall be in accordance with AWWA C504.

Valve Discs - Valve discs shall be constructed of Ni-Resist, Type 1 or ductile iron, ASTM A536, Grade 65-45-12 with stainless steel seating edges or cast iron ASTM A-126.

Valve Shafts - Valve shafts shall be "Stub Shaft" type or one piece extending full size through the disc bearings and shall be constructed of ASTM A276, type 304 stainless steel or high tensile steel with stainless steel shaft journals. Shaft diameters shall meet the requirements of AWWA C504 for Class 150B.

Valve Seats - Valve seats shall be of a natural rubber or a synthetic rubber compound. Valves 24 inches and smaller shall have bonded mechanically restrained seats molded in, vulcanized, and bonded in the valve body. Seat bond shall withstand 75 lbs. pull under test procedure ASTM D429, Method B. Valve seats on 30 inch diameter valves and larger shall be field adjustable and replaceable without dismantling operator, disc, or shaft and without removing the valve from the line. Adjustment shall be provided by heavy corrosion resistant retaining segment. Seats attached to the valve disc shall be held in place by a stainless steel, ASTM A296, Grade CF8, retaining ring. Cap screws through the rubber seat and the seat retaining ring shall be provided for adjustment of the rubber seat. The mating body seat shall be constructed of type 304 stainless steel.

Valve Bearings - Sleeve type-self-lubricating and corrosion resistant bearings shall be used on butterfly valves. The design load of the bearing material or 1.5 of the compressive strength of the bearing or shaft material shall not be exceeded.

4.6.11 Valve Operators

Manual valve operators shall be fully enclosed worm gear or traveling nut type.

Units above ground shall be equipped with hand wheel operators and shall have an indicator arrow of valve position.

All buried butterfly valves shall be furnished with 2 inch AWWA nut operator with valve box and cover.

Operator components shall withstand a pull of 200 lb. for hand wheel operators or an input torque of 400 ft. lbs for operating nuts.

4.6.12 Backflow Prevention Valves

Check valves, double check valve assemblies and reduced pressure backflow preventers preventing reverse flow shall be installed as required by Section 4.20 and as required by the Authority Engineer.

Specific models shall be submitted to the Authority for review and approval.

4.6.13 Combination Air Release and Vacuum Relief Valves

Shall be installed at each high point on all water mains 12" in diameter and larger and at all other locations as directed by the Authority Engineer. Air Release and Vacuum Relief Valves shall be located in precast concrete vaults in accordance with the details in ACWWA STD DETAIL W-13. They shall automatically release air from the lines when the lines are being filled with water, and shall admit air into the lines when water is being withdrawn in excess of the inflow. Valves shall be designed for a minimum water working pressure of 150 psi, shall have stainless steel floats, and all working parts shall be brass, stainless steel, or other non-corrosive materials. Pipe and fittings used in the valve system shall be galvanized steel, standard weight, and connections shall be threaded. Gate valves shall be bronze, threaded and shall have hand wheels.

Specific models shall be submitted to the Authority for review and approval.

4.6.14 Valve Boxes

All buried gate valves shall be provided with a cast iron valve box as detailed in ACWWA Standard Drawing No.W-7.

The valve box shall be of a design which will not transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve.

4.6.15 Valve Marker Posts

Used on all surface features – manholes, valve boxes, blow off, ARV's per ACWWA Standard Drawing G-2.

Marker posts shall be installed to locate all buried gate valves not on extended property lines or as directed by the Authority Engineer in accordance with ACWWA Standard Drawing G-2. Fire hydrant auxiliary gate valves shall not be marked unless specifically directed by the Authority Engineer.

4.6.16 Fire Hydrants

Fire Hydrants shall conform to AWWA C502, and shall be installed in accordance with the details per ACWWA Standard Drawing W-9. Approved manufacturers include Mueller Company.

Hydrants shall have a 6" bell connection, two 2 1/2" hose connections and one 4 1/2" pumper connection. Threads on the pumper and hose connections shall conform to the "National Standard Screw Threads for Fire Hose Couplings and Fittings" published by the Insurance Services Office.

Hydrants shall have a minimum 5 1/4" main valve opening, and the operating nut shall be a pentagonal 1 1/2". They shall have a bronze coupling and bronze to bronze seating.

Fire Hydrants shall be designed to operate under 150 psi working pressure and shall open counter-clockwise (left).

Per ACWWA Standard Drawing W-9 indicate the acceptable makes and models.

4.6.17 Vaults and Manholes

Vaults and manholes shall be installed as shown on the standard details and as directed by the Authority Engineer. Vaults and manholes may be either precast or cast-in-place concrete and shall be designed for AASHTO H-20 traffic loading.

The vaults shall be cast with a removable lid section for future access. For cast-in-place vaults and manholes, design details must be submitted to and approved by the Authority Engineer prior to start of construction.

Precast manholes shall be constructed in accordance with ASTM C478. Unless otherwise specified, all concrete shall have a minimum 28-day compressive strength of 4000 psi.

The vault and individual components, i.e. the lid, etc shall be designed to handle all applicable traffic loads.

All joints, pipe openings, or other places where infiltration could occur shall be sealed with "Ram-Nek" or other approved mastic waterproof sealant.

4.6.18 Manhole and Vault Steps

Steps shall be aluminum ALCOA No. 12653B or cast iron Neenah R-1980—J

Alternate - steps shall be comprised of #4, grade 60 deformed reinforcing bar encased in a polypropylene copolymer plastic with a tread width of 14 inches. The steps shall be M.A. Industries No. PS2-PF Double Face.

Step shall be cast into the vault or manhole wall at the same time the vault or manhole section is cast.

Steps shall be located as shown on the standard details and positioned to allow 18" minimum to 24" maximum spacing from the surface to the first step and 12" spacing thereafter.

4.6.19 Manhole and Vault Rings and Covers

The standard 24" diameter ring and cover shall be J—Mark No. J-1161 or approved equal. Rings and covers for meter vaults shall be as specified on the

details in Section 3.010.12. The word "WATER" shall be boldly cast onto all covers. The covers shall have a center hole that is 4-inches in diameter to accept the AMR/AMI device.

All traffic lids and roofs shall be designed for AASHTO H-20 loading.

Openings through concrete vault roof shall be 36 inches in diameter. Additional reinforcement shall be added around the opening at 45 degrees to the edges. Lids shall be cast in the sections. Sections will be cast such that their weight does not exceed 7,500 lbs.

4.6.20 Flushing [BLOW OFF] Valve Assemblies

Installation of blow-off assemblies shall be in accordance with the details for Blow off assemblies listed below:

- a) ACWWA Standard Drawing W-10 – Fire Hydrant Blowoff
- b) ACWWA Standard Drawing W-11 – 12" & smaller pipe
- c) ACWWA Standard Drawing W-12 – 16" & larger pipe

Flushing valve assemblies shall be installed at all dead ends, at all low points along mains 12" in diameter or larger, and at other locations as directed by the Engineer.

4.6.21 Tie-Rods and Clamps

Installation of tie-rods and clamp assemblies shall be in accordance with the details listed below: ACWWA Standard Drawing W-27 – Clamp Details

Shall be installed in accordance with the details on all vertical bends, fire hydrant runs, plugs, valves on stub lines, reducers and at other locations where required by the Authority Engineer.

Where rodding is required, a minimum of one length of pipe shall be rodded either side of the fitting.

Buried tie-rods and clamps shall be coated with polyethylene wrap.

4.6.22 Thrust Blocks

Installation of tie-rods and clamp assemblies shall be in accordance with the details listed below:

ACWWA Standard Drawing W-26 – Concrete Kickblock Details

Shall be installed in accordance with the details at all tees, plugs, bends, fire hydrants and at other locations where required by the Authority Engineer.

Concrete for thrust blocks shall have a minimum 28 day compressive strength of 3000 psi.

4.6.23 Pipeline Marker Tape

All buried non-metallic pipelines shall be marked with a 3" wide metallic-colored (detectable) tape placed in the trench continuously 18" above the top of pipe. Color shall be in accordance with APWA standard colors for the type of pipeline being constructed.

Locations requiring metallic-colored (detectable) tape shall be defined at the time of drawing review by the Authority Engineer. See ACWWA Standard Detail G-1.

4.6.24 Polyethylene Wrapping

Installation of polyethylene wrap shall be in accordance with the details listed below:

ACWWA Standard Drawing W-23 – Polyethylene Wrap.

Polyethylene wrapping shall be installed around all ductile iron pipe, fittings, valves, fire hydrant barrels, and rods and clamps.

Polyethylene wrapping shall be in accordance with AWWA C105 and shall have a minimum 8 mil thickness.

Wrap shall include industrial standard repeatable message (Potable Water or Non-Potable Water) blue or purple in color respective to type of water.

A 2" wide 10 mil thickness of polyethylene pressure-sensitive tape shall be used to close seams or hold overlaps. Rips, punctures, or other damage to polyethylene wrapped pipe or fittings shall be repaired to the satisfaction of the Authority's Construction Observer.

4.6.25 Manufacturer's Quality Control

Manufacturers used to supply pipe and fittings shall have an established quality control program. This program must verify cell classification properties of the material. The Contractor shall certify the cell classification properties of the material. Incoming polyethylene materials shall be inspected for density, melt flow rated, and contamination.

4.7 Protection of Waterlines near Sewer Facilities

4.7.1 General

There shall be no physical connection between a public or private potable water supply system and a sewer or appurtenance which would permit the passage of

any sewage or polluted water into the potable supply. Sewers must be kept remote from public water supply, wells, or other water supply sources and structures.

4.7.2 Parallel Installation

Water mains shall be laid at least 10' horizontally from any existing or proposed sanitary or storm sewer.

4.7.3 Crossings [see also Section 5.5 of these standards]

Water mains should cross above sanitary or storm sewers and shall be laid to provide a clear separation of at least 18" between the bottom of the water main and the top of the sewer main.

- i. For all new pipes, a minimum 18' length of new pipe must be installed, centered over the existing pipe being crossed.
- ii. For new pipes crossing under an existing pipe with less than 18" of separation (minimum of 6" separation required), the new pipe must be:
 1. Contained in a carrier pipe no less than 10 feet on each side of the existing pipe, or
 2. Be encased in concrete or controlled low strength concrete (flowable fill) a minimum of 10 feet each side of the existing pipe.

The portion of the existing pipe exposed in the trench must be backfilled with controlled low strength concrete (flowable fill) to the top of the existing pipe.

If the existing pipe is a sewer pipe not constructed of SDR 35, the sewer pipe must be replaced with a minimum of 18 feet of SDR 35, centered over the crossing pipe.

- iii. For new pipes crossing over an existing pipe with less than 18" of cover (minimum of 6" separation required), the new pipe must be:
 1. Contained in a carrier pipe no less than 10 feet on each side of the existing pipe, or
 2. Be encased in concrete or controlled low strength concrete (flowable fill) a minimum of 10 feet each side of the existing pipe.

If the existing pipe is damaged during construction, the ACWWA Inspector will determine the length of existing pipe to be removed and replaced with SDR 35 pipe.

See ACWWA Standard Drawing G-4.

Stability of the water and sewer lines at a point of crossing is critical and care must be taken to insure proper bedding and compaction of both water and sewer lines.

4.7.4 Sewer Manholes

No water pipe shall pass through or come into contact with any part of a sewer or storm sewer manhole, or be closer than 10 feet horizontally to the manhole.

4.8 Excavation and Trenching

4.8.1 General

The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all excavation, backfill, fill, compaction, grading and slope protection required to complete the work shown on the drawings and specified herein. The work shall include, but not necessarily be limited to: pump stations, manholes, vaults, conduit, pipe, roadways and paving; all backfilling, fill and required borrow; grading; disposal of surplus and unsuitable materials; and all related work such as sheeting, bracing and water handling.

4.8.2 Soil Borings and Subsurface Investigations

The Contractor shall examine the site and undertake subsurface investigation, including soil borings, before commencing the work.

The Engineer will not be responsible for presumed or existing soil conditions in the work area.

4.8.3 Existing Utilities

The Contractor shall locate existing utilities in the areas of work. If utilities are to remain in place, the Contractor shall provide adequate means of protection during earthwork operations.

Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, the Contractor shall identify such lines and inform the owner of these lines as to their location and the means of maintaining the service of all utilities. Inform the Construction Observer for ACWWA of the conflict and the proposed solution.

4.8.4 Excavation - General

Excavation for pipelines, fittings and appurtenances shall be open trench to the depth and limits necessary for proper installation as shown on the approved drawings or as otherwise approved by the Authority.

Authorized earth excavation includes removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, and other materials encountered that are not classified as rock excavation or unauthorized excavation.

Unauthorized excavation consists of removal of material beyond the limits needed to establish required grade and sub-grade elevations without specific direction of the Engineer. Unauthorized excavation as well as remedial work directed by the Engineer shall be at the Contractor's expense. Such remedial work shall be performed as directed by the Engineer.

If requested by the Engineer, when excavation has reached required subgrade elevations, a Geotechnical/Soils Engineer shall make an inspection of conditions. If the subgrade is unsuitable, the Contractor shall carry excavation deeper and replace excavated material with select common fill or bedding rock, as directed by the Engineer.

If the Contractor excavates below grade through error or for his own convenience or through failure to properly dewater the excavation or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the Engineer to excavate below grade and refill the excavation using select common fill or bedding rock.

Slope sides of excavation shall comply with local codes and ordinances, and with all applicable OSHA requirements. Contractor shall shore and brace where sloping is not possible due to space restrictions or stability of the material excavated. Sides and slopes shall be maintained in a safe condition until completion of backfilling.

Tunneling may be permitted as indicated by economy of construction or necessity of preserving existing improvements. If the earth in the tunnel sloughs off, the roof shall be broken down, and the tunnel excavated as an open trench.

4.8.5 Excavation for Structures

All such excavations shall conform to the elevations and dimensions shown on the drawing within a tolerance of plus or minus 0.10 feet and extending a sufficient distance from footings and foundations to permit placing and removing formwork, installation of services, and other construction, inspection or as shown on the drawings.

In excavation for footings and foundations, care shall be exercised not to disturb the bottom of the excavation. Bottoms shall be trimmed to required lines and grades to leave a solid base to receive concrete.

4.8.6 Trench Excavation

Excavation for all trenches required for the installation of utility pipes shall be made to the depths indicated on the drawings and in such a manner and to such widths as will give suitable room for laying the pipe with the trenches, for bracing and supporting and for pumping and drainage facilities.

The bottom of the excavations shall be firm and dry and in all respects acceptable to the Authority Engineer. Excavation shall not exceed normal trench width as specified in the standard drawings. Any Excavation, which exceeds the normal trench width, shall require special backfill requirements as determined by the Authority Engineer.

Where pipes are to be laid in bedding material, select common fill or encased in concrete, the trench may be excavated by machinery to or just below the designated subgrade provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

The Contractor is responsible for all State and Federal safety requirements.

After Notice to Proceed is issued by the Authority, and all fees have been paid to the Authority, and Applicant has obtained all related permits, the Applicant may request a Pre-Construction meeting. Applicant's design engineer and utility contractor must attend the meeting.

At this meeting, the Applicant shall:

- a) Submit evidence that all applicable federal, state, and local permits, including stormwater discharge permits, have been obtained.
- b) Increase the Imprest Account balance to 10 percent of the bid cost for facilities to be conveyed to the Authority or the original balance of the account, whichever is greater, for the first \$300,000 of such cost. For utility bid costs exceeding \$300,000, 5 percent of the increment over \$300,000 must be added to the Imprest Account balance. This Imprest Account shall be drawn upon to cover administration, construction inspection, and costs of items if not completed within thirty days (30) after the punch list is issued. Any cost incurred by the Authority over the balance of the Imprest Account will be charged to the owner.

4.8.7 Limits of Excavation

Except as otherwise approved by the Authority Engineer, the maximum length of open trench shall be 500' or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller.

4.8.8 Trench Width

Excavation and trenching shall be true to line so that the overall trench width from the bottom of the trench to 12" above the top of the pipe shall not be more than 24" nor less than 12" wider than the largest outside diameter of the pipe (outside diameter of bell on bell and spigot pipe) to be laid therein, exclusive of branches. Where the trench width is wider than the maximum set forth above, Class A bedding (arch encasement) shall be installed.

4.8.9 Trenching Methods

Hand methods for excavation shall be employed in locations where directed by the Authority Engineer. In other locations, the Contractor may use motorized trench digging machinery.

4.8.10 Bracing Excavations

All excavations shall be properly supported in the manner as required by all federal and state laws and municipal ordinances and as may be necessary to protect life, materials and property. Excavations shall be so sheeted, shored and braced that the ground alongside the excavation will not slide or settle. The sheeting, shoring and bracing shall be so arranged as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

Care shall be exercised in the removing of sheeting, shoring and bracing to prevent the caving or collapsing of the excavation faces which are being supported.

4.8.11 Grading and Stockpiling

The Contractor shall stockpile satisfactory excavated materials at a location approved by the Authority Engineer until required for backfill and fill. When needed in the work, material shall be located and graded at the direction of a Geotechnical/soils Engineer. All soil materials shall be located away from the edge of excavations. All surplus and/or unsuitable excavated material shall be legally disposed of by the Contractor. Any permits that may be required for the hauling and disposing of the material shall be obtained by the Contractor prior to commencing hauling operations.

Stockpiles shall be placed and graded for proper drainage. The Contractor shall obtain and maintain all erosion control measures and required by the local jurisdictions and control grading in a manner to prevent water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm drainage will be uninterrupted in existing gutters, other surface drains or temporary drains.

4.9 Dewatering

4.9.1 General

The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work.

Dewatering shall be accomplished by methods which will insure dry excavation and preservation of the bottoms of excavations. Said methods may include well points, sump pumps, suitable rock or gravel placed below the required bedding for drainage and pumping purposes, temporary pipelines and other means, all subject to the approval of the Authority Engineer.

4.9.2 Discharge

Discharge water shall be clear, with no visible soil particles. Discharge from dewatering shall be disposed of in such a manner that it will not interfere with the normal drainage of the area in which the work is being performed, create a public nuisance, or form ponding. The operation shall not cause injury to any portion of the work completed, or in progress, or to the surface of streets, or to private property.

The dewatering operation shall comply with the requirements of appropriate regulatory agencies. Additionally, where private property will be involved, advance permission shall be obtained by the Contractor.

4.9.3 Groundwater Encountered

Dewatering for the water lines shall commence when groundwater is first encountered, and shall be continuous thereafter until the structure to be built or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

4.9.4 Disposal of Discharge

The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property or to new construction.

4.10 Pipe Bedding

4.10.1 General

Bedding procedures shall be in accordance with the details as specified below. If excessively wet, soft, spongy, unstable or similarly unsuitable material is encountered at the grade upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the Authority Engineer, and the sub-grade shall be brought to a level 6" below the

pipe with such material as the Authority Engineer may order installed to provide a firm foundation.

4.10.2 Granular Bedding Material

Shall be clean and well graded sand, squeegee, or 3/4" gravel as approved by the Authority. The three materials options shall conform to the following gradations:

a) Well-Graded Sand

<u>Sieve Size</u>	<u>Total % Passing By Weight</u>
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3/8—inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	0-30
No. 100	2-10

b) Squeegee

<u>Sieve Size</u>	<u>Total % Passing By Weight</u>
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3/8—inch	100
No. 200	0-5

c) 3/4-Inch Gravel

<u>Sieve Size</u>	<u>Total % Passing By Weight</u>
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3/4—inch	95
No. 4	0-5

Granular bedding material shall be placed in not more than 6" lifts and shall be compacted to provide full support of the pipe.

4.10.3 Installation of Bedding and Pipe

The limits of bedding material shall be from 6 inches below the bottom of the pipe to 6 inches above the top of the pipe as indicated in ACWWA standard detail G-1. Approved backfill may then be installed to grade.

After completion of the trench excavation and proper preparation of the foundation, 6 inches of bedding material shall be placed on the trench bottom for support under the pipe.

All pipe shall be installed in such a manner as to insure full support of the pipe barrel over its entire length. After the pipe is adjusted for line and grade, and the joint is made, the bedding material shall be carefully placed and tamped under the haunches of the pipe.

4.10.4 Ground Water Barrier- soil cutoff wall

Where required by the Engineer, continuity of bedding material shall be interrupted by low permeability ground water barriers to impede passage of water through the pipe bedding material. Barrier material shall be a clay or other impervious material, and shall be compacted to 95% of maximum density as determined by ASTM D698. Material may be finely divided suitable job excavated material, free from stones, organic matter and debris.

Barriers shall be compacted soil the full depth of granular material, the full trench width, and approximately 4' long.

4.11 Trench Backfilling and Compaction

All trenches shall be backfilled after pipe, fittings and appurtenances have been installed, and observed by the Authority's representative. The backfill shall be compacted in not more than 6" lifts by vibrating, tamping, or a combination thereof, to the compaction standards stated within the approved construction documents.

Suitable material is required for backfilling of the pipe trenches. Wet, soft or frozen material, asphalt chunks or other deleterious substances shall not be used for backfill. If the excavated material is not suitable for backfill, suitable material shall be hauled in and utilized, and the rejected material hauled away and disposed of properly.

All backfill material shall be subject to the approval of the Authority representative.

4.12 Compaction Tests

Compaction tests shall be taken by an approved testing laboratory. Copies of test results with both passing and failed tests will be made available to the Authority upon request.

In all cases where the tests indicate compaction is less than that required in these specifications, additional compaction and tests will be required until these specifications are met. Final acceptance of the lines by the Authority will be contingent upon satisfactory compaction results.

No hydrostatic or leakage testing of the water main will be allowed until satisfactory compaction is obtained.

4.13 Pipe Encasement

4.13.1 Concrete Encasement

Shall be installed under the following conditions:

- a) Where water lines are at a depth too shallow to sustain traffic load or any other load to which they are subjected. This depth may range from 0' to 4.5', depending on the loading conditions.

- b) At all locations where the water main may be subjected to freezing. At these locations the pipe shall be wrapped in approved insulating material prior to encasement.
- c) At locations where horizontal movement of the water mains may be experienced, such as below stream beds.
- d) At sanitary sewer crossings.
- e) At any other location designated by the Engineer. All concrete encasements shall be reinforced in accordance with the details herein and shall be of a length to completely span the condition encountered.

4.13.2 Steel Pipe Casing

Shall be used where bores are required under rights-of-way by the local authority. All pipe casings shall conform to Standard details.

4.14 Horizontal Directional Drilling

4.14.1 General

The work specified in this section consist of furnishing and installing an underground pipeline (force main, water main, or reuse main) using the horizontal directional drilling (HDD) method of installation, also commonly referred to as directional boring or guided horizontal boring.

This work shall include all services, equipment, materials, and labor for the complete and proper installation, testing, disinfection, and environmental protection and restoration.

4.14.2 Submittals

Drilling Logs & As-builts: The Contractor shall maintain a daily project log of drilling operations and a guidance system log. A copy of this log shall be submitted to the Authority representative with the final As-Built drawings at completion of the project. As-built drawing submittals shall meet all requirements as detailed in these standards.

4.14.3 Pipe Materials

Only approved piping materials shall be used for directional drilled pipeline installations.

4.14.4 Horizontal Directional Drilling Procedures

Safety: The Contractor shall adhere to all applicable state, federal, and local safety regulation and all operations shall be conducted in a safe manner.

Though the installation process may be licensed or proprietary in nature, the Contractor shall not change any material, thickness, design, values, or procedural matters stated in the submittals, without the prior knowledge and approval of the Engineer.

The Contractor shall submit, in writing, full details about component materials, their properties, and installation procedures and abide by them fully during the entire course of the Work.

The Contractor shall be responsible for his means and methods of directional drilling construction to ensure successful installation of the product lines. The Contractor shall ensure that safety of the Work, the Contractor's employees, the public, and adjacent property, whether public or private.

Install the product pipelines casing and screen assembly by means of HDD and in accordance with ASTM F 1962-11. HDD entry and exit angles shall be in general accordance with the Contract Drawings and compatible with the equipment capabilities.

4.15 Final Clean Up

After backfill and compaction has been completed, the right-of-way shall be restored to original conditions to the satisfaction of the Authority. At the completion of the work, all rubbish, unused materials, concrete forms and other like material shall be removed from the jobsite. All excess excavation shall be disposed of as specified and the areas shall be left in a state of order and cleanliness.

4.15.1 Restoration

Unsurfaced Areas: Surface shall be, as a minimum, restored to a condition equal to that prior to construction. All Streets shall be restored in accordance with the regulations and requirements of the agency having control or jurisdiction over the street, roadway, or right-of-way.

Surfaced Areas: Roadway surface cuts shall be, as a minimum, restored to a condition equal to that prior to construction. All gravel or paved streets shall be restored in accordance with the regulations and requirements of the agency having control or jurisdiction over the street, roadway, or right-of-way.

Easements, Cultivated or Agricultural Areas: In easements, cultivated or agricultural areas, topsoil shall be removed from the area of general disturbance and stockpiled. After installation of all pipelines, appurtenances and structures, and completion of backfill and compaction, the stockpiled topsoil shall be redistributed evenly over disturbed areas. Care should be taken to conform to the original ground contour or final grading plans.

4.16 Safety Precautions

4.16.1 OSHA Standards

Comply with all requirements of the most recent issue of the Occupational Safety and Health Act (OSHA) defined in the Federal Register, and all other rules and regulations. In the case of conflict between these specifications and OSHA rules and regulations, OSHA will take precedence. The Contractor's attention is directed to the latest provisions of Subpart P, Section 1926 of the OSHA Safety and Health Standards for Construction.

4.17 Installation of Pipe

4.17.1 General

Pipe shall be installed in accordance with the manufacturer's recommendations, these specifications, and the approved construction documents.

4.17.2 Alignment and Grade

The water line shall be laid to the required lines and grades as shown on the approved drawings.

Whenever obstructions not shown on the approved plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plans is required, the Contractor must submit the proposed changes to the Design engineer and to the Authority for review and acceptance.

4.17.3 Inspection before Installation

All pipe and fittings shall be carefully examined for cracks and other defects before installation. Defective pipe or fittings shall be laid aside for inspection by the Authority representative who will prescribe corrective repairs or rejection.

4.17.4 Preparation for Installation

The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight fitting cap or plug to prevent the entrance of foreign matter into the pipe.

4.17.5 Lowering of Pipe Materials into Trench

Proper tools and equipment shall be provided and used by the Contractor for the safe and convenient performance of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece in such a manner as to prevent damage to the water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

If damage occurs to any water main material in handling, the damage shall be immediately brought to the Authority's Representative attention.

4.17.6 Cutting of Pipe

The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.

4.17.7 Direction of Laying

Pipe shall be laid with the bell or coupling ends facing in the direction of laying, unless otherwise specified by the Authority. Where the pipe is laid on a grade of 10% or greater, the laying shall proceed upward with the bell or coupling ends of the pipe upgrade if the progression of work allows.

4.17.8 Permissible Deflection of Joints

Where possible, vertical deflections shall be made at pipe joints and vertical bends shall be eliminated. Wherever it is necessary to deflect the pipe from a straight vertical or horizontal line, whether to avoid obstructions, plumb stems or construct long-radius curves, the amount of deflection shall not exceed the maximum limits recommended by the manufacturer and specifically approved by the Authority.

4.17.9 Corrosion Protection Systems

Insulation of Joints: Whenever it is necessary to join pipe or fittings with dissimilar metal, a method of insulating against the passage of electric current shall be provided and shall be approved by the Authority.

Polyethylene Wrapping: Where specified under Section 4.2.8, all pipe and fittings shall be wrapped with polyethylene wrapping (including copper service lines). PVC piping materials are exempt for the requirement for PE wrapping.

4.17.10 Assembly of Mechanical Joints

Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations.

The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece by the manufacturer.

4.17.11 Assembly of Push-On Joint Pipe

The pipe manufacturer's instructions and recommendations for proper jointing operations shall be followed.

4.18 Pipe Inspections and Tests

4.18.1 Pipe Testing Prior to Installation

Pipe used in any work under these specifications shall meet the requirements for testing as established by ASTM, AWWA and ANSI Standards. When required by the Authority Engineer, these tests shall be made by the Contractor and shall be witnessed by a reputable testing laboratory. The Contractor shall deliver the pipe selected for testing to the place and at the time designated by the testing laboratory and written test reports shall be furnished to the Authority Engineer.

All pipe shall be subject to inspection at the factory, trench or other point of delivery by the Authority Representative.

The Authority Representative reserves the right to reject any and all pipe sections that may contain visual imperfections or imperfections of any type that may be considered by the Engineer as detrimental to the operation and life of the pipe.

4.18.2 Pipe Testing after Installation - Hydrostatic Pressure Test

All sections of newly laid pipe shall be subjected to a hydrostatic pressure test. The hydrostatic test pressure shall be 150 pounds per square inch minimum based on the elevation of the lowest point in the line or section under test and carried to the elevation of the test gauge.

Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and test pressure applied. Any cracked or defective pipe, fittings, valves or hydrants discovered as a consequence of this pressure test shall be removed and replaced by the Contractor and the test shall be repeated until results satisfactory to the Authority Representative are obtained. Duration shall be at a minimum of one (1) hour for each test.

All necessary equipment and personnel to complete the test shall be furnished by the Contractor, accurately calibrated and the testing methods shall be approved by

the Authority. The Authority shall witness all pressure tests. At least twenty-four (24) hours notice shall be given by the Contractor to the Authority Representative prior to making the test.

4.18.3 Leakage Test

Permissible Leakage = 20 gal./in. dia./mile of pipe/day

If any test of laid pipe discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and repair the defective joints or pipes until the leakage is within the specified allowance.

4.18.4 Disinfection

Each section of completed potable water supply line shall be disinfected with chlorine and then flushed before acceptance by the Authority.

All disinfection work shall be performed by the Contractor in accordance with AWWA C651. Chlorine dosage shall be at least 50 parts per million, and shall be retained in the line at least 24 hours, after which time the residual at the end of the line and at other representative points in the line shall be at least 10 parts per million. If the residual at the end of 24 hours is less than 10 parts per million, the entire operation shall be repeated.

All valves in the lines being sterilized shall be opened and closed several times during the contact period to insure total chlorination. After completion of sterilization, the system shall be flushed with clean water until the residual chlorine content is not greater than 1 part per million. Only ACWWA personnel shall operate valves in contact with the ACWWA Water System.

4.18.4.1 Continuous Feed Method

The continuous feed method of chlorination (in accordance with AWWA C651 Section 4.4) shall be used for disinfection. Before the main is chlorinated, it shall be filled with potable water to eliminate air pockets and flushed to remove particulates. Chlorine shall be pumped into the line at the source of fresh water at a rate resulting in a chlorine concentration of at least 50 parts per million. The below table should meet these requirements under normal conditions, however is the contractor's responsibility to achieve:

Chlorine required to produce an initial 50-ppm concentration per 100 feet of pipe

Pipe Diameter (in.)	100% Chlorine (lb.)	1% Chlorine Solution (gal.)

4	0.026	0.32
6	0.060	0.72
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
16	0.434	5.20

Discharges of chlorinated water from blow-off assemblies or other appurtenances shall be contained or discharged in a manner compliant with the Colorado Department of Public Health and Environment and AWWA C655. De-chlorination discharge options:

- Chemical de-chlorination treatment with approved best management practices;
- On-site containment, which is not connected to the storm sewer system or any surface waters;
- Tanker collection and transport for proper offsite treatment and disposal;
- Discharge to sanitary sewer, only with approval of the General manager;

4.18.5 Clear Water Testing/BacT Test

ACWWA will be responsible for arranging testing by the appropriate State or County Health Department and for presenting certified test results to the Engineer/Inspector prior to acceptance of the lines.

4.18.6 Pipe Inspection and Tests Acceptance

Acceptance of the lines will not be granted until all tests are successful and all items listed for correction by the Engineer have been accomplished. The final acceptance will be confirmed by a letter noting acceptance by the Engineer and is contingent upon receipt and approval of as-built drawings.

4.19 Water Service Line Installation

4.19.1 General

Water service shall be located a minimum of 10' from sewer service, and will be generally located on the uphill side of the sewer service. Service lines shall be installed perpendicular to the main water and shall enter the property a minimum distance of 5' from the nearest lot Line.

No water taps will be made prior to hydrostatic testing and acceptance of the water mains.

Water service lines shall be installed in accordance with the details and as directed by the Authority Representative.

4.19.2 Metering

Water Meters - All water meters are supplied and installed by the Authority.

4.20 Cross Connection Control

4.20.1 General

ACWWA is responsible for protecting its public water system from contamination due to backflows thorough the water service connections, otherwise known as “cross connections”. ACWWA needs the assistance and cooperation of the public and property owners to assure this responsibility is met and may request access to a property or facility to assess the need for cross connection control or to conduct an on-site inspection of existing devices.

The most effective method of protecting the public water supply from cross connection is with a properly designed air gap. Unfortunately, an air gap is not practical in many applications. When an air gap cannot be applied, a “reduced pressure zone” RPZ backflow prevention assembly should be used. ACWWA requires the installation of these devices in specific circumstances and encourages their use on all commercial building/facilities.

In certain situations, the Authority has adopted a policy of backflow and cross-connection control by containment. Cross-connection control by containment requires that all service lines which by degree of hazard require a backflow prevention device have this device installed in the meter pit as shown on the details.

ACWWA will require system users to install and maintain backflow prevention devices on potentially hazardous service connections. All service connections within the water system must comply with the CDPHE requirements within the Colorado Cross-Connection Control Manual.

Each cross-connection may require a different type of backflow prevention device, commensurate with the degree of hazard posed by the cross-connection. Approval for the devices needs to be given by the water system operator or water system engineer.

At the time the applicant submits plans, the Authority will review the plans for building height, type of occupancy and whatever other information is deemed necessary to determine the degree of hazard.

At any time that a change in building occupancy or plumbing revision occurs, the Authority shall be notified so that a review can be made to see if the degree of hazard has changed.

4.20.2 Degree of Hazard

The degree of protection deemed necessary shall be in accord with the degree of hazard. The following protection shall be required as a minimum:

DEGREE OF HAZARD	PROTECTION REQUIRED
Severe	Approved Reduced Pressure Principle Backflow Prevention Device
Moderate	Approved Double Check Valve Assembly
Non-Hazardous	Approved Internal Plumbing Control

Internal plumbing control which is necessary for the protection of the "on premises user" is not equivalent to cross-connection control by containment and shall be considered a necessary adjunct to a complete and viable cross-connection program. It is the responsibility of the water user to prevent cross-connections within the facility which uses the water.

Exceptions to protection as required above are as follows:

- f) Irrigation service line protection alternative shall consist of a single check valve located 6" above the highest sprinkler head with a vacuum relief valve located either side of the check valve and shall be as detailed in Section 3.010.12, sheet 9 of 9.
- g) Building fire line protection shall consist of a single check valve arrangement as specified by the Engineer.

The following table contains a listing of the type of connections to the water service with associated degrees of hazard.

APPLICATION OF BACKFLOW PREVENTION DEVICES IN CROSS-CONNECTIONS AND WHERE CONTAMINATION IS POTENTIALLY HAZARDOUS TO THE POTABLE WATER SUPPLY

TYPE OF CONNECTION	DEGREES OF HAZARD		
	Severe	Moderate	Non-Hazardous
Direct Water Connections subject to pressure –			
a. Pumps, tanks and lines handling:			
1. Sewage and lethal substances	X		
2. Toxic substances*	X		
3. Non-toxic substances**		X	
b. Water connection to steam and steam boiler:			
1. Boiler or steam connection to toxic substances*	X		
2. Boiler or steam connection to non-toxic substances** [boiler blow-off through approved air gap]		X	
c. Hot water heating boilers, generators or pressure vessels:			
1. Connection to toxic substances*	X		
2. Connection to non-toxic substances**		X	
Direct or Indirect Water Connections not subject to pressure –			
a. Low inlet to receptacles containing toxic substances*	X		
b. Low inlet to receptacles containing non-toxic substances**		X	
c. Lawn sprinkler systems (chemical injection prohibited)	X		
d. Coils or jackets used as heat exchangers in compressors, degreasers or other equipment:			
1. In sewer Lines	X		
2. In toxic substances*		X	
3. In non-toxic substances**			X
e. Flush valve toilets and urinals	X		
f. In toilet and urinal tanks	X		
g. Valve outlets or fixtures with hose attachments which may constitute a cross-connection:			
1. Toxic substances*	X		
2. Non-toxic substances**		X	
h. Water connected into domestic water tanks		X	
i. Plumbing drainage lines	X		
j. Reclaimed or recycled water	X		

- * TOXIC SUBSTANCE: Any substance (liquid, solid, or gaseous) which, when introduced into the water supply system, creates or may create a danger to the health and well being of the consumer
- ** NON-SUBSTANCE: Any substance of a non-poisonous nature that is potable or edible and that may create a moderate or minor hazard to the domestic water system.

Examples of cross—connections involving non-toxic substances:

- (a) Connections of food processing lines such as syrups, lard, beer, etc.
- (b) Connections to steam and steam boilers where the steam does not come in contact with poisonous materials.
- (c) Steam clean-up connection in food plants, apartment house boilers, or pressing boilers, where toxic compounds are not used.
- (d) Connections to enclosed circulating systems, such as radiant heating systems and refrigerated water systems, where toxic compounds are not used.

4.20.3 Approved Backflow Prevention Devices

A list of approved reduced pressure backflow valves and double check valves has been established by the "Foundation for Cross—Connection Control and Hydraulic Research". All devices installed in the Authority must be included on this list.

The following approved devices can be used for backflow prevention:

- Vacuum breaker
- Double-check valve assembly
- Reduced pressure principal backflow assembly
- Air gap

The Colorado Department of Public Health and Environment accepts the use of backflow preventers that have received approval by either University of Southern California Foundation of Cross-Connection Control and Hydraulic Research or the American Society of Sanitary Engineers (ASSE).

4.21 Responsibilities of the Contractor

4.21.1 Construction Notification

The Contractor shall be responsible for notifying the Authority 48 hours prior to start of any construction. If work is suspended for any period of time after Initial start-up, the Contractor must notify the Engineer 24 hours prior to re-start.

4.21.2 Water Outage

At all points of connection of new water mains to existing mains the Contractor will be responsible for excavating and verifying location of the existing lines prior to installation of any new construction.

If it is necessary to shut down any portion(s) of the existing water system to make such connection, the Authority will be responsible for notifying all users to be affected by water outage at least 24 hours prior to such outage.

All existing water main valves shall be operated only by authorized Authority personnel.

The duration of water outage to the existing customers shall be minimized and if directed by the Authority Representative, the Contractor shall provide temporary water supply to customers by means of tank trucks, temporary connections to charged facilities, etc.

4.21.3 Responsibility to Repair

Prior to trenching operations, the Contractor shall notify the Owner(s) in writing whose existing above ground or underground utilities are within 10' of trenching operations. Should any such utility be damaged in the trenching operations, the Contractor shall immediately notify the Owner of the utility, and unless authorized in writing by the Owner of the utility, the Contractor shall not attempt to make repairs.

Duplicate copies of any written authorization given to the Contractor to make repairs shall be filed with the Authority Representative and shall be so worded as to save harmless the Owner of any responsibility whatsoever relative to the sufficiency of the repairs.

In the event that during construction it is determined that any underground utility conduit, including sewers, water mains, gas mains and drainage structures, and any above ground utility facilities are required to be relocated, the Contractor shall notify the utility Owner(s) well in advance of his approach to such utility so that arrangements with the Owner(s) of the affected utility can be completed without delay to the work.

4.21.4 As-Built Information

The Contractor is responsible for maintaining field As-built information and pertinent drawings to include all distances between valves and fittings, all changes, and all important notes. Final acceptance of the lines by the Authority will be contingent upon the receipt of said As-built information.

4.21.5 Probationary Period

The Contractor will be held responsible for the proper functioning of the lines for a minimum of one (1) year from the date of probationary acceptance of the lines by the Authority. Any malfunction during this period of guarantee shall be remedied by the Contractor to the satisfaction of the Authority.

END OF SECTION

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Section V. Sewer Line Construction

5.1 Pipe

All materials included in this specification shall conform to the latest editions of applicable ASTM, AWWA and ANSI standards. Pipe classes indicated shall be considered minimums.

It shall be the responsibility of the Design Engineer to design the pipe system in accordance with the latest appropriate design standards and for the actual site conditions. Proof of design may be requested by the Authority as part of the drawing review process.

5.2 Polyvinyl Chloride (PVC) Pipe

5.2.1 General

All PVC pipe furnished under this specification shall be manufactured in strict accordance with ASTM D3034 for 4" through 15" diameter pipe. 18" and larger diameter pipe shall meet the requirements of ASTM F679 or UNI—BELL.

5.2.2 Pipe Materials - 15 Inch Diameter and Smaller

In accordance with ASTM D3034, SDR 35 or SDR 26.

Joints: Integral bell and spigot, in accordance with ASTM D3212.

Minimum uniform pipe stiffness at five percent deflection shall be 46 psi.

Cell Classification: 12454 B or C, as defined by ASTM D1784.

Fittings: SDR 35 or SDR 26 minimum wall thickness (as specified).

Gaskets: Factory fabricated rubber compression type with solid cross section in accordance with ASTM F477. Lubricant for joining pipe as approved by pipe manufacturer.

5.2.3 Pipe Materials – 18 inch and larger

In accordance with ASTM F679, SDR 35.

Joints: Integral bell and spigot, in accordance with ASTM D3212.

Minimum Pipe Stiffness: 46 psi when tested in accordance with ASTM D2412.

Cell Classification: Minimum 12454C, as defined by ASTM D1784.

Fittings: Wall thickness no less than wall thickness of equivalent size of pipe.

Gaskets: Factory fabricated rubber compression type with solid cross section conforming to ASTM F477.

Lubricant for joining pipe as approved by pipe manufacturer.

5.2.4 Material

Class 12454 B or C materials per ASTM D1784, ASTM D2412, ASTM D3034, SDR 35 or SDR 26.

5.2.5 Laying Length

The minimum standard length of pipe shall be thirteen (13) feet. All PVC pipe shall bear the NSF-DW seal.

5.3 Ductile Iron Pipe

All ductile iron pipe furnished under this specification shall be manufactured in strict accordance with AWWA C151 and shall conform to the following additional requirements

5.3.1 Pipe Material

This specification shall cover all sizes of ductile iron pipe 36" in diameter and smaller and shall conform to ASTM A746.

Determine proper thickness class to use based on laying conditions and depth of backfill.

Minimum pressure Class: 150.

Joints: Push on with rubber gaskets conforming to AWWA C111. Lubricant for joining pipe as approved by pipe manufacturer.

Fittings: Ductile iron conforming to AWWA C110 lined and coated same as pipe.

5.3.2 Lining for Ductile Iron Pipe

Polyethylene

- a) 40 mil nominal ultraviolet resistant compound consisting of a blend of high and low density polyethylene powder conforming to ASTM D1248 carbon black and inert filler.
- b) Bond to interior of pipe and fittings by heat.
- c) Preheat pipe in furnace (to ensure uniformity of heat distribution) to an adequate temperature to provide uniform fusing of polyethylene powders and to provide bonding to pipe and fittings.

- d) Lining shall cover interior surface from plain or beveled end to rear of gasket socket.
- e) Coat ends and exterior of ends to a point 1 inch outside gasket position with minimum 8 mil dry film thickness coal tar epoxy.

5.3.3 Ceramic Epoxy

- a) 40 mil nominal lining consisting of ceramic particle reinforced novolac epoxy.
- b) Line interior of bell and exterior of spigot in joint sealing areas with 6 to 10 mils specified lining.
- c) Surface Preparation: SP10 near white abrasive blast.
- d) Pinhole Detection: 2,500 volts minimum over 100 percent of lined surfaces.

Polyethylene Wrap and Tape for Ductile Iron Pipe Exterior Corrosion Resistance.

Polyethylene Wrap: 8 mils, minimum thickness, conforming to AWWA C105.

Adhesive Tape: Thermoplastic pressure sensitive; minimum thickness of 8 mils; minimum width of 1 inch.

Shall be installed around all ductile iron pipe. Polyethylene wrapping shall be in accordance with AWWA C105 and shall have a minimum 8 mil thickness and shall be installed around all ductile iron pipe, fittings, valves, and rods and clamps. Polyethylene wrapping shall be in accordance with AWWA C105 and shall have a minimum 8 mil thickness. Wrap shall include industrial standard repeatable message (Sewer or Force Main) and Green in color.

A 2" wide 10 mil thickness of polyethylene pressure-sensitive tape shall be used to close seams or hold overlaps. Rips, punctures, or other damage to polyethylene wrapped pipe or fittings shall be repaired to the satisfaction of the Construction Observer.

5.3.4 Steel Casing Pipe

Steel casing pipe shall meet requirements as specified in Section 4.5 Steel Casing.

5.4 Manholes

5.4.1 General

Cast-in-place manholes shall be installed as shown on the standard details and as directed by the Engineer. Manholes may be either precast or cast in place and shall be designed for AASHTO H-20 traffic loading. Design details must be submitted to and approved by ACWWA prior to the start of construction.

Cast-in-place manholes shall be constructed with epoxy coated #4 rebar and barrel section seams shall be taped.

Precast concrete manholes shall be Type 2 Cement and conform to specification for Precast Reinforced Concrete Manhole Sections, ASTM Designation C478, except as otherwise specified herein.

Cast iron manhole frames and covers shall conform to standard specification for grey iron castings ASTM A48, Class 30B.

Each section of precast manholes shall be marked with manufacturer's name or trademark, ASTM designation, manufacturing serial number, date of manufacture, manhole total length, and installation assistance marks.

Manholes shall be installed at the end of each sewer line, at all changes in grade, size, or alignment, and at all intersections. They shall be installed at distances not greater than 400'.

5.4.2 Standard Manholes

For sewer mains 24 inches and smaller, manholes shall have a minimum 48 inch inside diameter.

For sewers mains between 24 inches and 36 inches, manholes shall have a 60 inch inside diameter.

For sewer mains larger than 36 inches in diameter, a 72 inch inside diameter manhole shall be provided.

Where a second sanitary sewer line enters a manhole, the invert on the second sewer line shall enter the manhole at least 0.2 ft higher than the invert of the main sewer line and shall enter the line of flow of the main sewer line with as near a full sweep 90 degree bend as possible. In no case shall a second line be allowed to intersect with this main line at an angle less than 90 degree with the outlet portion of the main line.

If alignment and slope allow, the sewer line shall be laid through the manhole. A drop of 0.1' will be required from invert to outlet where the sewer main cannot be laid throughout the manhole.

When the distance between sewer invert and top of the manhole cover is less than 8'6", a flat top manhole shall be constructed.

5.4.3 Manhole Base

Cast-in-place base shall be a minimum of 8" thick and the overall outside dimensions shall be 2 feet greater than the inside dimension of the manhole constructed thereon. The mix shall have not less than 4,000 pounds compressive

strength per square inch in 28 days. Reinforcing steel or wire mesh shall be in accordance with the standard details. The Contractor shall be responsible for taking and testing cylinders as required by the Construction Observer.

5.4.4 Manhole Steps

Steps shall be aluminum ALCOA No. 12653B or cast iron Neenah R-1980—J.

Alternate - steps shall be comprised of #4, grade 60 deformed reinforcing bar encased in a polypropylene copolymer plastic with a tread width of 14 inches. The steps shall be M.A. Industries No. PS2-PF Double Face.

Step shall be cast into the vault or manhole wall at the same time the vault or manhole section is cast.

Steps shall be located as shown on the standard details and positioned to allow 18" minimum to 24" maximum spacing from the surface to the first step and 12" spacing thereafter.

5.4.5 Manhole Connections

Pipe connections to manholes: In general, sewer service lines will not be allowed to connect to manholes. Certain exceptions may be made by the Authority on a case by case consideration. One service line shall be allowed to connect to a manhole located on the end of a sewer main in a cul-de-sac. The service line must be installed prior to placing the manhole base. No sewer service shall connect to the main line closer than 5 feet to the uphill manhole.

All PVC connection to manholes shall be sealed using Flexible watertight rubber boots for the jointing of any sewer pipe to any precast manhole base, barrel section, inlet box, or vault shall conform to the specifications contained herein and to the Standard Detail Drawings. Flexible connectors shall meet the requirements of ASTM C923. This specification covers the minimum performance and material requirements for resilient connectors used for connections between reinforced concrete manholes conforming to ASTM C478 and pipes, between wastewater structures and pipes, and between precast reinforced concrete pipe and laterals.

5.4.6 Manhole Marker Post

Manhole Marker Post – Shall be installed whenever a manhole is located outside of a traveled street or walkway in accordance with the details in ACWWA Standard Detail G-2 Fiberglass Marker Post.

5.4.7 Cleanouts

Cleanouts - cleanouts shall not be installed in public streets unless so directed by the Authority. All cleanouts shall be constructed as specified by the Authority, and shall be installed on sewer service lines under the following guidelines.

- a) Cleanouts shall be installed at all changes in direction requiring bends.
- b) Not more than 100' of continuous sewer line shall be installed without at least one cleanout.
- c) Cleanouts shall be located such that all portions of the lines can be cleaned by rodding.

5.4.8 Miscellaneous Manhole Items

A manhole will be considered a junction manhole when three or more sewer lines connect into the structure or when a force main discharges into the structure.

A receiving manhole is defined as the manhole before the wet well of a pump station.

Criteria: manholes requiring coatings. All precast concrete junction and receiving manholes shall have an interior coating specifically designed to resist hydrogen sulfide based corrosion. The coating shall be Agra Sure Grip, SpectraShield, SewperCoat, or other concrete protective liners approved by the ACWWA.

In addition, all manholes shall have an exterior joint wrap material applied, such as "Rub-R-Nek" or other approved equal.

5.4.9 Precast Concrete Sewer Manholes

General

- a) The minimum wall thickness shall be 5 inches. Precast concrete manholes shall be constructed with a precast monolithic base structure as shown on the standard drawings. The minimum base thickness shall be 8 inches.
- b) Precast concrete top slabs shall be used where cover over the top of the pipe is less than 4 ft. Lift rings or non-penetrating lift holes shall be filled with non-shrink grout after installation of the manhole sections.
- c) Concrete surfaces shall have oil, curing compounds, dust, dirt, and other interfering materials removed by brush or sand blasting and shall be fully cured prior to the application of any coatings.
- d) Junction manholes and wet wells shall be coated with calcium alumina mortar, Agra Sure Grip, SpectraShield or approved equivalent in accordance with manufacturer's installation instructions.

Material

- a) Concrete for manholes shall be Type II, 4000psi curing for 28 days. Barrel, top, and base sections shall have tongue and groove joints.
- b) All joining material shall be a cold adhesive preformed flexible joint sealant, conforming to ASTM C990, such as Ram-Nek, or approved equal.
- c) Sections shall be cured by an approved method for at least 28 days prior to shipping.

Design Specifications

- a) Riser Sections:
 - 1) Minimum 48 inches in diameter.
 - 2) Fabricate in accordance with ASTM C478.
 - 3) Minimum Wall Thickness: 5 inches or 1/12 of the inside diameter whichever is greater.
 - 4) Top and bottom shall be parallel.
 - 5) Joints shall be tongue-and-groove type.
- b) Cone Sections:
 - 1) Provide eccentric cones for manholes with a diameter of 60 inches or less. Eccentric cones may be used for manholes with a diameter greater than 60 inches with approval of or as directed by ACWWA.
 - 2) Same wall thickness and reinforcement as riser section.
 - 3) Top and bottom shall be parallel.
- c) Base Sections and Base Slab:
 - 1) The base section shall have a base slab that is integral with sidewalls.
 - 2) Fabricate in accordance with ASTM C478.
- d) Manhole Extensions:
 - 1) Concrete grade rings shall have a maximum height of 6 inches.
 - 2) Fabricate in accordance with ASTM C478.
 - 3) Grade rings must be sealed against water intrusion.
 - 4) Brick and steel grade rings are not permitted.
- e) Source Quality Control:
 - 1) All test specimens shall be mat tested and meet permeability test requirements of ASTM C14.
 - 2) Conduct tests at point of manufacture prior to delivery of any section.
 - 3) Sections to be tested will be selected at random from stockpiled material to be supplied for the project.

5.5 Protection of Water Lines Near Sewer Facilities

5.5.1 General

There shall be no physical connection between a public or private potable water supply system and a sewer or appurtenance which would permit the passage of any sewage or polluted water into the potable supply. Sewers must be kept remote from public water supply, wells, or other water supply sources and structures.

5.5.2 Parallel Installations

Sanitary or storm sewers shall be installed at least 10 feet horizontally from any existing or proposed water main.

5.5.3 Crossings

Where sewer lines cross water mains or come within 10 horizontal feet of each other, the sewer pipe shall be a minimum of 18 inches clear distance vertically below the water main. If this clear distance is not feasible, the crossing must be designed and constructed to protect the water main.

- i. For new pipes crossing under an existing pipe with less than 18" of separation (minimum of 6" separation required), the new pipe must be:
 1. Contained in a carrier pipe no less than 10 feet on each side of the existing pipe, or
 2. Be encased in concrete or controlled low strength concrete (flowable fill) a minimum of 10 feet each side of the existing pipe.

The portion of the existing pipe exposed in the trench must be backfilled with controlled low strength concrete (flowable fill) to the top of the existing pipe.

- ii. For new pipes crossing over an existing pipe with less than 18" of cover (minimum of 6" separation required), the new pipe must be:
 1. Contained in a carrier pipe no less than 10 feet on each side of the existing pipe, or
 2. Be encased in concrete or controlled low strength concrete (flowable fill) a minimum of 10 feet each side of the existing pipe.

If the existing pipe is damaged during construction, the ACWWA Inspector will determine the length of existing pipe to be removed and replaced with SDR 35 pipe.

Stability of the water and sewer lines at a point of crossing is critical and care must be taken to insure proper bedding and compaction of both water and sewer lines.

5.6 Excavation and Trenching

5.6.1 Excavation

General - Excavation for sewer main and appurtenances shall be open trench to the depth and limits necessary for proper Installation as shown on the approved drawings or as otherwise approved by the Engineer. Tunneling may be permitted as indicated by economy of construction or necessity of preserving existing improvements. If the earth in the tunnel sloughs off, the roof shall be broken down, and the tunnel excavated as an open trench.

Limits of Excavation - Except as otherwise approved by the Engineer, the maximum length of open trench shall be 600' or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller.

Trench Width - Excavation and trenching shall be true to line so that the overall trench width from the bottom of the trench to 12" above the top of the pipe shall not be more than 24" nor less than 12" wider than the largest outside diameter of the pipe (outside diameter of bell on bell and spigot pipe) to be laid therein, exclusive of branches. Where the trench width is wider than the maximum set forth above, Class A bedding (arch encasement) shall be installed.

Trenching Methods - Hand methods for excavation shall be employed in locations where directed by the Engineer. In other locations, the Contractor may use motorized trench digging machinery or employ hand methods.

Bracing Excavations - All excavations shall be properly supported in the manner as required by state laws and municipal ordinances and as may be necessary to protect life, materials and property. Excavations shall be so sheeted, shored and braced that the ground alongside the excavation will not slide or settle. The sheeting, shoring and bracing shall be so arranged as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength. Care shall be exercised in the removing of sheeting, shoring and bracing to prevent the caving or collapsing of the excavation faces which are being supported.

Grading and Stockpiling - The Contractor shall control grading in a manner to prevent water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm and wastewater can be uninterrupted in existing gutters, other surface drains or temporary drains.

5.7 Dewatering

5.7.1 General

The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work.

Dewatering shall be accomplished by methods which will insure dry excavation and preservation of the bottoms of excavations. Said methods may include well points, sump pumps, suitable rock or gravel placed below the required bedding for drainage and pumping purposes, temporary pipelines and other means, all subject to the approval of the Authority Engineer.

5.7.2 Discharge

Discharge water shall be clear, with no visible soil particles. Discharge from dewatering shall be disposed of in such a manner that it will not interfere with the normal drainage of the area in which the work is being performed, create a public nuisance, or form ponding. The operation shall not cause injury to any portion of the work completed, or in progress, or to the surface of streets, or to private property.

The dewatering operation shall comply with the requirements of appropriate regulatory agencies. Additionally, where private property will be involved, advance permission shall be obtained by the Contractor.

5.7.3 Groundwater encountered

Dewatering for the sewer lines shall commence when groundwater is first encountered, and shall be continuous thereafter until the structure to be built or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

5.7.4 Disposal of discharge

The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property or to new construction.

5.8 Pipe Bedding

5.8.1 General

Bedding procedures shall be in accordance with the details in Section 4.09.4 and as specified below. If excessively wet, soft, spongy, unstable or similarly unsuitable material is encountered at the grade upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the Engineer, and the sub-grade shall be brought to a level 6" below

the pipe a with such material as the Engineer may order installed to provide a firm foundation.

Where ledge rock, boulder and large stones are encountered, they shall be removed to provide a clearance of at least 6" below and around the pipe and fittings before backfilling to pipe grade.

5.8.2 Granular Bedding Material

Granular Bedding Material - Shall be clean and well graded sand, squeegee, or 3/4" gravel, and shall conform to the following gradation:

a) Well-Graded Sand

<u>Sieve Size</u>	<u>Total % Passing By Weight</u>
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3/8—inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10
No. 200	0-5

b) $\frac{3}{4}$ - Inch Gravel

<u>Sieve Size</u>	<u>Total % Passing By Weight</u>
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3/4—inch	95-100
No. 4	0-5

Granular bedding material shall be placed in not more than 6" lifts and shall be compacted by slicing with a shovel or by hand operated mechanical vibrators.

5.8.3 Class A Bedding (Arch Encasement)

Class A bedding shall be defined as that method of bedding in which the upper half of the pipe is encased in concrete. It shall not be required unless improper trenching or unexpected trench conditions require its use as determined by the Engineer.

5.8.4 Class B Bedding

Class B bedding shall be defined as that method of bedding in which the pipe is set on compacted granular bedding material. Granular bedding material shall be placed and compacted under the pipe and around the sides of the pipe to 6" above the pipe. Class B bedding shall be required for PVC.

5.8.5 Class B Bedding Alternative

The same requirements shall apply as in Class B bedding except that granular material shall be placed to a depth of 6" above the pipe. This may be used at the Contractor's option or shall be required by the Engineer if the Contractor fails the compaction test on the backfill material hand-placed to 1' above the pipe.

5.8.6 Class C Bedding

Class C Bedding shall be defined as that method of bedding in which the pipe is set on compacted granular bedding material supporting the lower quadrant of the pipe barrel. The trench shall be excavated to a depth below the established grade equal to 1/8 of the outside pipe diameter, but not less than 4". Compacted granular material shall be placed under the pipe and around the sides of the pipe to a minimum of 1/6 of the outside pipe diameter from the bottom of the pipe barrel. Class C bedding shall be required for ductile iron and reinforced concrete pipe.

5.8.7 Ground Water Barrier

Where required by the Authority Engineer, continuity of bedding material shall be interrupted by low permeability ground water barriers to impede passage of water through the pipe bedding material. Barrier material shall be a clay or other impervious material, and shall be compacted to 95% of maximum density as determined by ASTM D698. Material may be finely divided suitable job excavated material, free from stones, organic matter and debris.

Barriers shall be compacted soil the full depth of granular material, the full trench width, and approximately 4' long.

5.9 Trench Backfilling and Compaction

All trenches shall be backfilled after pipe, fittings and appurtenances have been installed, and observed by the Authority's representative. The backfill shall be compacted in not more than 6" lifts by vibrating, tamping, or a combination thereof, to the compaction standards stated within the approved construction documents.

Suitable material is required for backfilling of the pipe trenches. Wet, soft or frozen material, asphalt chunks or other deleterious substances shall not be used for backfill. If the excavated material is not suitable for backfill, suitable material shall be hauled in and utilized, and the rejected material hauled away and disposed of properly.

All backfill material shall be subject to the approval of the Authority representative.

5.10 Pipe Encasement

5.10.1 Concrete Encasement

Shall be installed under the following conditions:

- a) Where water lines are at a depth too shallow to sustain traffic load or any other load to which they are subjected. This depth may range from 0' to 4.5', depending on the loading conditions.
- b) At all locations where the water main may be subjected to freezing. At these locations the pipe shall be wrapped in approved insulating material prior to encasement.
- c) At locations where horizontal movement of the water mains may be experienced, such as below stream beds.
- d) At sanitary sewer crossings.
- e) At any other location designated by the Engineer. All concrete encasements shall be reinforced in accordance with the details herein and shall be of a length to completely span the condition encountered.

5.10.2 Steel Pipe Casing

Shall be used where bores are required under rights-of-way by the local authority. All pipe casings shall conform to Standard details.

5.11 Final Clean Up

After backfill and compaction has been completed, the right-of-way shall be dressed smooth and left in a neat and presentable condition to the satisfaction of the Engineer.

5.12 Safety Precautions

OSHA Standards

Comply with all requirements of the most recent issue of the Occupational Safety and Health Act (OSHA) defined in the Federal Register, and all other rules and regulations. In the case of conflict between these specifications and OSHA rules and regulations, OSHA will take precedence. The Contractor's attention is directed to the latest provisions of Subpart P, Section 1926 of the OSHA Safety and Health Standards for Construction.

5.13 Compaction Tests

Compaction tests shall be taken by an approved testing laboratory. Copies of test results with both passing and failed tests will be made available to the Authority upon request.

In all cases where the tests indicate compaction less than that required in these specifications, additional compaction and tests will be required until these specifications are met. Final acceptance of the lines by the Authority will be contingent upon satisfactory compaction results.

No hydrostatic or leakage testing of the water main will be allowed until satisfactory compaction is obtained.

5.14 Installation of Pipe

5.14.1 General

Pipe shall be installed in accordance with the manufacturer's recommendations and these specifications.

5.14.2 Alignment and Grade

The sewer line shall be laid to the required lines and grades as shown on the approved plans and in such a manner as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the line.

Whenever obstructions not shown on the approved plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plans is required, the Engineer shall have the authority to change the plans and order a deviation from any line and/or grade.

5.14.3 Inspection before Installation

All pipe and fittings shall be carefully examined for cracks and other defects while suspended and before installation. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the Engineer, who will prescribe corrective repairs or rejection.

5.14.4 Preparation for Installation

The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight.

All pipes shall be subject to inspection at the factory, trench or other point of delivery by the Engineer. The purpose of the inspection shall be to cull and reject any pipe that, independent of the physical tests herein specified, fails to conform to the requirements of these specifications, or that may have been damaged during transportation and/or subsequent handling.

The Engineer reserves the right to reject any and all pipe sections that may contain visual imperfections or imperfections of any type that may be considered by the Engineer as detrimental to the operation and life of the pipe.

5.14.5 Pipeline Testing After Installation - Air Testing

Air testing shall comply with ASTM C828. Procedures for air testing shall be submitted to the Engineer for review before testing is started.

Leakage shall not exceed 0.003 cfm per square foot of internal pipe wall at an average pressure of 3 psi. The time elapsed for a one psi drop in air pressure shall not be less than:

$$T = 0.472d; \text{ where: } t = \text{time in minutes}$$

d = pipe diameter in Inches

Leaks shall be located by air testing short sections of pipe. Leaks shall be repaired and the section of sewer between manholes retested.

5.14.6 Pipeline Testing After Installation - Deflection

Where required by the Engineer, PVC sewer pipe shall be checked for excessive deflection after backfilling is complete and prior to acceptance of the installation. All gravity sewer mains shall be tested by pulling a mandrel through the pipe, or by other methods acceptable to the Authority. Pipe with diameter deflection exceeding 7.5% of the inside diameter shall be uncovered, the bedding and backfill replaced to prevent excessive deflection, and the pipe retested. The Engineer may require the remaining portion of pipe to be tested when excessive deflection is encountered.

5.14.7 Final Acceptance

Final acceptance of the lines will not be granted until all tests are successful and all items listed for correction by the Engineer have been accomplished. The final acceptance will be confirmed by a letter noting acceptance by the Engineer and is contingent upon receipt and approval of as-built drawings.

5.14.8 Pipeline Marker Tape

All buried non-metallic pipelines shall be marked with a 3" wide metallic-colored (detectable) tape placed in the trench continuously 18" above the top of pipe. Color shall be in accordance with APWA standard colors for the type of pipeline being constructed.

Locations requiring metallic-colored (detectable) tape shall be defined at the time of drawing review by the Authority Engineer. See ACWWA Standard Detail G-1.

5.15 Sanitary Sewer Service Line Installation

Sanitary sewer service line installation shall comply with ACWWA's standard details.

Services lines shall be constructed on the shortest and straightest route possible. At no time shall the service line be any closer than 5' to the side property line and no service line may be constructed through or in front of any adjoining property. Cleanouts shall be installed as required by ACWWA's standard details.

5.16 Responsibilities of the Contractor

5.16.1 Construction Notification

The Contractor shall be responsible for notifying the Authority at least 24 hours prior to start of any construction. If work is suspended any period of time after initial start-up, the Contractor must notify the Engineer 24 hours prior to re-start.

5.16.2 Responsibility to Repair

Prior to trenching operations, the Contractor shall notify the Owner(s) in writing whose existing above ground or underground utilities are within 10' of trenching operations. Should any such utility be damaged in the trenching operations, the Contractor shall immediately notify the Owner of the utility, and unless authorized in writing by the Owner of the utility, the Contractor shall not attempt to make repairs. Duplicate copies of any written authorization given to the Contractor to make repairs shall be filed with the Engineer and shall be so worded as to save harmless the Owner of any responsibility whatsoever relative to the sufficiency of the repairs.

In the event that during construction it is determined that any underground utility conduit including sewers, water mains, gas mains and drainage structures, and any above ground utility facilities are required to be relocated, the Contractor shall notify the utility Owner(s) well in advance of his approach to such utility so that arrangements with the Owner(s) of the affected utility can be completed without delay to the work.

5.16.3 As-Built Information

The Contractor is responsible also for maintaining field As-built information and pertinent drawings to include all distances between valves and fittings, all changes, and all important notes. Final acceptance of the lines by the Authority will be contingent upon the receipt of the As-built information.

5.16.4 Probationary / Warranty Period

The Contractor will be held responsible for the proper functioning of the lines for a minimum of one (1) year from the date of probationary acceptance of the lines

by the Authority. Any malfunction during this period of guarantee shall be remedied by the Contractor to the satisfaction of the Authority.

END OF SECTION