PART 1  GENERAL

1.1  DESCRIPTION

A. Section includes requirements for cleaning and lining existing cast iron and ductile iron water mains of various sizes following Contract Documents.

1.2  QUALITY ASSURANCE

A. Pipe, fittings, and valves: Meet requirements of Section 02510.

B. Cleaning and Lining
   1. Guarantee to restore cleaned and cement-mortar lined water mains to following minimum Hazen-Williams C Factor ($C_{hw}$) based on nominal pipe diameters with proper allowance being made for bends and fittings following accepted practice:

<table>
<thead>
<tr>
<th>NOMINAL PIPE DIAMETER</th>
<th>GUARANTEED HAZEN-WILLIAMS $C_{hw}$ FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inch and smaller</td>
<td>90</td>
</tr>
<tr>
<td>4 inch</td>
<td>90</td>
</tr>
<tr>
<td>6 inch</td>
<td>100</td>
</tr>
<tr>
<td>8 inch</td>
<td>110</td>
</tr>
<tr>
<td>10 inch</td>
<td>115</td>
</tr>
<tr>
<td>12 inch</td>
<td>120</td>
</tr>
<tr>
<td>14 inch</td>
<td>125</td>
</tr>
<tr>
<td>16 inch</td>
<td>125</td>
</tr>
<tr>
<td>20 inch</td>
<td>125</td>
</tr>
<tr>
<td>Above 20 inch</td>
<td>130</td>
</tr>
</tbody>
</table>

1.3  SUBMITTALS

A. Submit following Section 01330.
   1. Temporary bypass water service system following Section 02510.
   2. Method of covering access excavations during non-working periods.
   3. Proposed method for disposal of debris and water used for cleaning.
   4. Cement mortar lining mix data including dry weights of cement; sand; admixture name, type and quantity, if used; volume of water per cubic yard.

B. Submit certificate of compliance following Section 01450 for following materials:
   1. Sand.
2. Cement.
   a. Include certification that facility where cement was produced complies with ANSI/NSF Standard 61.

1.4 DELIVERY, STORAGE AND HANDLING

A. Ship cement to Project site in full sacks and store so it is kept dry. Do not use cement from broken sacks for lining operations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pipe and Fittings: Following Section 02510.

B. Temporary Bypass System:
   1. Temporary bypass and fire hydrant piping to maintain water service and fire protection.
   2. Check valves 3 inches to 10 inches in diameter for temporary installation during disinfection.
   3. Notched meter covers for temporary use when temporary piping is in service.

C. Cleaning and Lining: AWWA C602 except as modified herein.
   1. Sand: ASTM C144 and kept clean and free of foreign materials during transportation and storage on site.
   2. Cement: Type II, manufactured at facility certified for compliance with ANSI/NSF Standard 61, and in sacks bearing NSF approval stamp.
   3. Proportions of cement and sand in mortar: 1 part cement to 1 part sand.

D. Equipment.
   1. Cleaning:
      a. Drag cleaning, hydraulic jet, abrasive pig, metal scraping, or power boring type. Knocker type not allowed.
   2. For placing cement mortar lining:
      a. Applicator head that in one course centrifugally projects mortar against surface of pipe sections and long radius bends, without injurious rebound, and with sufficient velocity to cause mortar to be densely packed and to adhere in place.
         1) Rate of travel of machine and rate of discharge of mortar against wall of pipe: Entirely mechanically controlled to produce a smooth, uniform thickness of lining throughout interior of pipe.
         2) Attachment with rotating or drag steel trowels: Follows applicator head and trowels cement mortar lining to a smooth, hard surface of uniform thickness.
         3) Operation of trowels: Continuous during application of cement mortar and forward movement of applicator head.
4) Machine:
   a) Moves ahead of lining so nothing comes in contact with troweled surface until it has attained its final set.
   b) Control of forward movement and of mechanical placing of mortar: Assure uniform thickness of mortar lining following AWWA C602.

PART 3 EXECUTION

3.1 WORK PERFORMED BY THE COMMISSION

  A. Shutdowns: See Section 02510.

  B. Notify all property owners in advance of work.

  C. Notify the Customer Care Team when Contractor is removing and reinstalling meters for temporary by-pass system.

  D. Take and analyze water samples: See Section 02510.

3.2 PREPARATION

  A. Temporary Bypass Water Service System:
   1. Follow Section 02510 and as specified herein.
      a. Provide check valves 3 inches to 10 inches in diameter as close as possible to existing water source, for temporary installation during disinfection as approved by Contract Manager.
      b. Do not install bypass between November 15 and March 1 in any calendar year.

  B. Access Openings.
   1. Provide access at locations required to complete work and approved by Contract Manager.
   2. Excavate, provide sheeting and shoring, dewater, and backfill following Section 02315.
   3. Provide sediment control following Section 01570.
   4. Make access openings in pipe with space to admit and withdraw equipment with least delay and without causing damage to existing pipe.
   5. After shutdown, dewater pipe and drain low spots. Provide measures as required to prevent water from entering work sections and maintain in a dry condition.
   6. Remove pipe at access points by cutting with power operated pipe cutting machines, capable of making fast, true and smooth cuts so valves or pipe sections removed may be replaced in true alignment.
      a. Where difficulties due to obstructions make it impossible to use preceding method of cutting pipe, other methods may be used provided they meet approval of Contract Manager and same results are attained.
7. Measure outside diameter of cut pipes to properly determine class of pipe in each cut.
a. Class of pipe will determine proper sized sleeves or couplings to be used in reconnection.
8. Replace exposed lead or poured joints with mechanical joint fittings or couplings at Contract Manager’s direction.

3.3 CLEANING AND LINING

A. Perform cleaning and lining: AWWA C602 and following herein.
   1. Cleaning.
      a. Clean interior surfaces of pipe and fittings to be lined by machine where practicable and by hand where access by machine is not possible.
      b. Remove obstructions in pipeline that prohibit passage of cleaning or lining equipment.
      c. Remove loose scale, tuberculation, oil, grease, remains of old coating materials, and accumulations of debris.
      d. Remove accumulations of water on bottom of interior of pipe.
      e. Handle cleaning water in closed discharge hoses to prevent water and residue from causing damage.
      f. Dispose of residue from cleaning and other construction operations as well as water from dewatering operations, in a manner satisfactory to Contract Manager and authority having jurisdiction over area where work site is located.
      g. Filter solids-laden water through an approved desilting device.
   2. Lining.
      a. Place lining with machines in 1 course specified herein.
      c. Nominal lining thickness for old and new gray cast iron and ductile iron:

<table>
<thead>
<tr>
<th>Pipe Diameter, in.</th>
<th>Lining Thickness, in.</th>
<th>Tolerance, in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-10</td>
<td>3/16</td>
<td>-1/16, +1/8</td>
</tr>
<tr>
<td>12-20</td>
<td>1/4</td>
<td>-1/16, +1/8</td>
</tr>
<tr>
<td>24-36</td>
<td>5/16</td>
<td>-1/16, +1/8</td>
</tr>
<tr>
<td>&gt;36</td>
<td>5/16</td>
<td>-1/16, +3/16</td>
</tr>
</tbody>
</table>

d. Correct lining not within this tolerance at Contract Manager’s direction.
   e. Place cement mortar lining so as not to seal or otherwise reduce effectiveness of existing air valves and blowoffs.
   f. Perform cement mortar lining of sharp bends, fittings, and areas closely adjacent to valves or other points where machine access is impossible or impractical and correct defective areas by hand.
   g. Hand mortar work: Equal to machine placed work and use same materials.
      1) If necessary, moisten pipe prior to placement of mortar.
      2) Use steel trowels except where curvature of bends prohibit their use.
3) Complete handwork in section of pipeline within 24 hours after machine work in that section is complete.

4) Provide smooth transition from handwork to machine-placed mortar.

h. Remove bends, fittings and pipe that cannot be lined by hand. Provide new bends, fittings and pipe.

i. Feather edges between newly lined areas and unlined areas.

j. Clean and line mains up to side valves and sections of pipe removed for access.

k. Remove cleaning debris and lining material from existing service connections on lined main.
   1) Clear service connections that are 2-inch or less in diameter and on pipes less than 24-inch diameter by backflushing with air or water within 2 hours of placing lining.
   2) On pipes 24-inch and larger, temporarily plug or cover service connections prior to lining, and remove plugs or covers after lining.
      a) Service connections may be flushed with Contract Manager’s prior approval.

l. Do not damage lining when clearing service connections.

4) Use in-house valve to blow back if curb stop is inoperable.

i. Immediately after completing lining of length of pipe between access openings or at end of day's run, close that section of pipe at each end and cover access openings to prevent circulation of air to maintain moist condition.

m. With Contract Manager’s approval, 24 hours after placing lining, fill section between bulkheads or gate valves with system water for curing lining.

n. Cure pipe lining for minimum of 48 hours before recharging and disinfecting.

B. Disinfection.

1. Before newly lined water main sections are disinfected, perform following:
   a. Reinstall sections of pipe removed for access or install valves as approved by Contract Manager to include replacement of lead or poured joints when directed.
   b. Install fittings and mechanical couplings as required so that there is no visible leakage.
   c. Coat scarred exterior surfaces of pipe and fittings, and coat exterior surfaces of mechanical couplings, including bolts and nuts, following Section 02510.
   d. New pipe, fittings, and valves installed in existing mains: Clean and spray or swab with minimum 1 percent solution of chlorine just before installation.
   e. Provide corporation stops in water mains for disinfection.
   f. Provide new taps as required for water house connections following Section 02510.
   g. Provide means to flush.
   h. Replace lined-through valves with new valves.
   i. Provide temporary check valves between cleaned and uncleaned pipe for disinfection purposes.

2. To disinfect, introduce distribution system water to cleaned and lined mains.
a. Testing of water from cleaned and lined water mains: same as for temporary bypass system.

3. Discharge of Chlorinated Water: See Section 02511.

C. Returning Lined Main to Service.

1. When disinfection is completed and line is approved for service, Contract Manager will notify Contractor to restore line to service.
   a. Remove corporation stops used for disinfection and install plugs.
   b. Coat plug assemblies.
   c. After pipe access openings are closed and before backfill, fully recharge main and eliminate visible leakage.

2. After approval of Contract Manager.
   a. Backfill excavated areas.
   b. Reactivate house connections and remove temporary bypass piping system.
   c. Reinstall removed meters at same location from which they were removed with water flow in correct direction and using new gaskets compatible with meter.

3. After permanent service is restored and temporary bypass piping is removed, restore disturbed areas.
   a. Seed and sod following Section 02920.
   b. Restore pavement following Section 02950.
   c. Deliver valves and fire hydrants removed from lined section of water main and not reused to the Commission's warehouse.

4. Meters improperly installed will be removed and correctly installed by the Commission. A cost of $500 per incident will be deducted from payment to Contractor.

D. Field Quality Control.

1. Inspection.
   a. Provide CCTV inspection of completed lining sections at Contract Manager’s direction.
   b. Use equipment approved for use in potable water system.
   c. Correct defective lining at Contract Manager’s approval.

2. Removal of Test Section.
   a. At Contract Manager’s direction, excavate, cut, and remove test section of pipe not less than 2 feet, nor more than 3 feet, long for applied cement lining thickness verification and inspection.
   b. Excavate minimum of 2 feet below pipe to be inspected.
   c. If thickness is not within requirements specified herein, correct lining thickness at Contract Manager’s approval.
   d. After inspection, reinstall removed pipe section utilizing sleeves.
   e. Backfill excavation and repair paving as required.

3. Testing.
   a. The Commission may test completed sections to determine Hazen-Williams C Factor.
b. If Hazen-Williams C Factor ($C_{hw}$) determined by test is less than guaranteed minimum values herein, remand to Contract Manager for resolution.

**WSSC**