



SECTION 02050
WATER/WASTEWATER GENERAL INFORMATION

PART 1 GENERAL

1.01 SCOPE

- A. These specifications shall apply to all sewer and water utility construction which is or which will become a part of the Knoxville Utilities Board's water distribution and wastewater collection systems. These specifications shall also apply to private water and wastewater systems that are under OWNER'S jurisdictions for inspection. The areas in which work will be performed are various locations in Knox, Jefferson, and Sevier Counties and the City of Knoxville, Tennessee. Any failure to comply with these specifications shall be cause for the Knoxville Utilities Board to refuse acceptance of such distribution or collection lines for operation and maintenance.
- B. The project consists of providing all material, labor, tools, equipment, and incidentals needed to complete construction, testing, and placing into service all water and sewer mains or other appurtenances shown and listed on the plans and contract documents.

1.02 DEFINITIONS

- A. OWNER: Knoxville Utilities Board.
- B. CONTRACTOR: Person, firm or corporation with whom the OWNER has entered into the Agreement.
- C. RESIDENT PROJECT REPRESENTATIVE (RPR): Authorized representative of the OWNER who is assigned to the site or any part thereof.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. PROTECTION OF LIVES AND HEALTH
 - 1. In accordance with generally accepted construction practices, the CONTRACTOR will be solely and completely responsible for conditions at the job site, including the safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The CONTRACTOR shall follow all applicable OSHA Standards and provide documentation of OSHA compliance upon request of the OWNER, RPR, or TOSHA.
 - 2. Pipe and materials shall be stored in a safe location, away from roadways, and properly barricaded for the safety of vehicular and pedestrian traffic. No



smoking, fire, or use of any fire- or explosion-producing tools or equipment will be permitted on the properties of oil companies or other concerns prohibiting same on their premises or at any locations where such may endanger said premises of the current operations thereon.

3. No discharge of wastewater to waterways will be allowed during construction unless a schedule has been approved by the Tennessee Division of Water Pollution Control and the U.S. Environmental Protection Agency pursuant to the terms of the NPDES permit prior to commencing the Work.
4. Under no circumstances will spent oil wastes be discharged anywhere on the site.
5. CONTRACTOR shall comply with all applicable laws, regulations, and requirements which may or may not be included in these technical specifications, including, but not limited to, Contractor Licensing Act of 1994, as amended, and the Tennessee State Safety, Health, and Labor Standards.
6. CONTRACTOR shall provide proof he holds a valid Contractor's license in the state of Tennessee with a Municipal and Utility Construction (MU) classification of sufficient monetary limit to bid on and/or perform water distribution and wastewater collection system installation and construction for the Knoxville Utilities Board. The license number shall be provided to OWNER prior to construction.
7. CONTRACTOR shall obtain all licenses and permits prior to the start of work. Copies of each permit shall be submitted to the Knoxville Utilities Board. CONTRACTOR shall be responsible for obtaining permission to work in the right-of-way from the following agencies, including, but not limited to the City or County Engineering or Highway Department having jurisdiction and the Tennessee Department of Transportation.

1.04 RIGHTS-OF-WAY AND EASEMENTS

- A. All work on water and wastewater mains to be dedicated to the OWNER shall be on public rights-of-way and/or on easements secured by the OWNER or by CONTRACTOR/developer and transferred to the OWNER. Easement areas shall be restored to as near original condition as possible, and to the satisfaction of OWNER.

1.05 PROTECTION OF PUBLIC AND PRIVATE PROPERTY

- A. Take special care in working areas to protect public and private property. The CONTRACTOR shall immediately notify the OWNER and/or RPR, and the property owner when damage property occurs. At OWNER'S discretion, CONTRACTOR shall replace or repair in a timely manner at his own expense any damaged water or sewer mains, power and communication lines, or other



public utilities, roads, curbs, gutters, sidewalks, fences, drain pipes, and drainage ditches. It shall be the responsibility of CONTRACTOR to replace damaged vegetation or to compensate the property owner for replacement value for those areas located outside the easement limits. Leave the site in a condition satisfactory to OWNER.

- B. Take reasonable care during construction to avoid damage to vegetation. Take special precautions (including the provision of barricades and the temporary tying back of shrubbery and tree branches) for the protection and preservation of such vegetation throughout all stages of construction. Where the area to be excavated is occupied by trees, brush, or other uncultivated vegetable growth, clear such growth from the area, and dispose of it in a lawful and satisfactory manner. Trim any limbs or branches of trees broken during construction operations with a clean cut, and paint with an approved tree pruning compound. Treat damaged tree trunks with appropriate tree dressing.
- C. CONTRACTOR shall examine the site and become familiar with any construction requirements, such as work related to drainage ways, erosion control, and easements. Any such work shall be considered incidental to the WORK, and no additional payment will be allowed. Sodding, fabric mats, or other methods of re-establishing vegetation may be required by OWNER if difficulty persists in re-establishing vegetation, and shall be considered incidental to construction.

1.06 OBSTRUCTIONS ENCOUNTERED DURING CONSTRUCTION

- A. The locations of existing utilities, public or private, are approximate only. CONTRACTOR is to contact owners of all underground utilities through Tennessee One-Call in accordance with Section 01725, Underground Utility Damage Prevention Act, Protection of Utilities.
- B. Carefully protect from damage all utilities in the vicinity of the work at all times. If it is necessary to repair, remove, and/or replace any such utility in order to complete the work properly; do so in compliance with the rules and regulations of the particular utility involved. Any such work shall be considered incidental to the construction repairs of utility lines, and no additional payment will be allowed.
- C. CONTRACTOR shall report damages to the OWNER at 865.524.2911 and proceed as directed and report to other utility owners as required.

1.07 SUBSTITUTIONS

- A. The contract is based on the standards of quality established in the contract documents.



- B. All products proposed for use, including those specified by required attributes and performance shall require approval by OWNER before being incorporated into the work. CONTRACTOR may review approved products at www.kub.org/standards, Section 02080, Water/Wastewater Materials.
- C. Do not substitute materials, equipment, or methods unless such substitution has been specifically approved for this work by OWNER. Where the phrase "or equal" or "or approved equal" occurs in the plans or specifications, do not assume that materials, equipment, or methods will be approved as equal unless the item has been specifically approved for this work by OWNER. The decision of OWNER shall be final.

1.08 CONSTRUCTION CLEANING

- A. Daily, and more often if necessary, inspect the site and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage. Dispose of all materials in accordance with all applicable laws and regulations and, when applicable, with Section 02321, paragraph 3.13.
- B. Maintain the site in a neat and orderly condition at all times.

1.09 WARRANTY

- A. CONTRACTOR shall warranty all materials, equipment, and workmanship for a period of one year from the date of Substantial Completion of the Work as determined by the Certificate of Substantial completion issued by the OWNER. If during this time period any material, equipment, or item of construction proves defective, CONTRACTOR shall make the repairs at his own expense to the satisfaction of OWNER. If OWNER must perform emergency repairs during the guarantee period, CONTRACTOR shall be liable for the costs incurred by OWNER, including labor, equipment and materials. Guarantees shall be covered by CONTRACTOR's performance bond where applicable. Neither the final acceptance, final payment, nor other provision relieves CONTRACTOR of the responsibility for faulty material, equipment or workmanship.

1.10 OWNER'S REPRESENTATION DURING CONSTRUCTION

- A. The RESIDENT PROJECT REPRESENTATIVE (RPR), who is the OWNER'S agent at the site, will act as directed by and under the supervision of OWNER and will confer with OWNER regarding RPR's actions. The RPR's dealings in matters pertaining to the on-site work shall, in general, be with OWNER and CONTRACTOR, keeping OWNER advised as necessary. The RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of CONTRACTOR.



PART 2. PRODUCTS

2.01 All products and materials utilized in the execution of the work described herein shall meet or exceed the specified characteristics provided herein. All products and materials must be equal to those specified in Section 02080, Water/Wastewater material available for review at www.kub.org/standards or available for review at KUB/Procurement 4505 Middlebrook Pike.

PART 3. EXECUTION (NOT USED)

END OF SECTION



**SECTION 02230
CLEARING AND GRUBBING**

1.01. SCOPE

- A. This work consists of clearing, grubbing, removing, and disposing of all debris and of all vegetation, buildings, and foundations not removed by others that are within designated construction areas, except for such objects that the OWNER designates to remain. The work shall also include preserving and protecting from injury or defacement all vegetation and objects designated to remain.
- B. The OWNER will designate all trees, shrubs, plants, and other items that are to remain. Paint required for cut or scarred surfaces of trees or shrubs selected for retention shall be an asphaltum base paint prepared especially for tree surgery and approved by the OWNER.

1.02 SUBMITTALS

- A. Action Submittals: Drawings clearly showing clearing, grubbing, and stripping limits.

1.03 SCHEDULING AND SEQUENCING

- A. Prepare Site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls shown on the approved erosion and sediment control plans, and as required in Section 01570, Erosion Control.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Clear the entire construction area of all weeds, brush, briars, bushes, trees, stumps, and other protruding obstructions not designated to remain, except within any areas which the OWNER may designate to remain undisturbed.
- B. Perform all clearing and grubbing operations in accordance with the applicable provisions for erosion control as shown on the Drawings and as required by all regulatory authorities.

- C. Completely dispose of all materials resulting from clearing and grubbing off the Site in compliance with all applicable laws and regulations and, when applicable, with Section 02321, Excavation, Bedding and Backfill for Utilities, paragraph 3.4.

3.01 LIMITS

- A. As follows, but not to extend beyond Project limits:
 - 1. Excavation excluding trenches 5 feet beyond top of cut slopes.
 - 2. Trench Excavation: 10 feet maximum beyond trench top of cut, regardless of actual trench width.
 - 3. Fill:
 - a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
 - b. Stripping: 5 feet beyond toe of permanent fill.
 - 4. Waste Disposal:
 - a. Clearing: 5 feet beyond perimeter.
 - b. Scalping and Stripping: Not required.
 - c. Grubbing: Around perimeter as necessary for neat finished appearance.
 - 5. Structures: 15 feet outside of new structures.
 - 6. Roadways: Clearing 30 feet from edge of roadway shoulders or back of curb.
 - 7. Overhead Utilities:
 - a. Clearing and Grubbing: Entire width of easements and rights-of-way.
 - b. Scalping and Stripping: Wherever grading is required.
 - 8. Other Areas: As shown on Drawings or directed by OWNER.

3.03 TEMPORARY REMOVAL OF INTERFERING PLANTINGS

- A. Remove and store, as specified in Section 02930, Replacement of Trees, Plants, and Ground Covers, shrubs and trees that are not designated for removal but do interfere with construction or could be damaged by construction activities.
- B. Photograph and document location, orientation, and condition of each plant prior to its removal. Record sufficient information to uniquely identify each plant removed and to assure accurate replacement.



3.04 CLEARING

- A. Clear areas within limits shown or specified.
- B. Fell trees so that they fall away from facilities and vegetation not designated for removal.
- C. Cut stumps not designated for grubbing flush with ground surface.
- D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.05 GRUBBING

- A. Grub areas within limits shown or specified.

3.06 SCALPING

- A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.
- B. Scalp areas within limits shown or specified.

3.07 STRIPPING

- A. Do not remove topsoil until after scalping is completed.
- B. Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil.

3.08 TREE REMOVAL OUTSIDE CLEARING LIMITS

- A. Remove the following within Project Limits:
 - 1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.
 - 2. Trees designated by OWNER.
- B. Cut stumps off flush with ground, remove debris, and if disturbed, restore surrounding area to its original condition.

END OF SECTION



SECTION 02310

FINISH GRADING

PART 1. GENERAL

1.01 SCOPE

- A. The work called for by this section shall include, but shall not necessarily be limited to finish grading and the spreading and shaping of topsoil to match the existing contours or to the satisfaction of the OWNER.
- B. Refer to other sections for work related to that specified under this heading. Coordinate this work with that specified by other sections for timely execution.

PART 2. PRODUCTS

2.01 TOPSOIL

- A. Use stripped topsoil that has been stockpiled as specified elsewhere. If the quantity of topsoil on the job is inadequate, furnish enough additional topsoil. Topsoil furnished shall be natural, fertile, friable soil possessing characteristics of representative productive soils in the vicinity. It shall be obtained from naturally, well drained areas. It shall not be excessively acid or alkaline nor contain toxic or regulated substances that may be harmful to plant growth or human health. Topsoil shall be without admixture of subsoil and shall be cleaned and reasonably free from clay lumps, stones, stumps, roots, or similar substances 2 inches or more in diameter, debris, or other objects that are a hindrance to planting operations. Such material shall be subject to testing.

PART 3. EXECUTION

3.01 GENERAL

- A. Do not begin work until the earth is dry enough to be tillable.
- B. Inspect subgrades to see that they generally conform to the standards called for elsewhere in these specifications, particularly with regard to the approximate depths required for the work. After work is completed, inspect it to ensure that all finish grading complies with design requirements and any and all approved permits.
- C. Place finished grade stakes wherever necessary to bring the work accurately to the elevations required by the drawings.

- D. Finish grade all areas outside the building line to the depths required for the work as follows:
1. Grade uniformly with rounded surfaces at the tops and bottom of abrupt changes of planes.
 2. Hand grade steep slopes and areas that are inaccessible for machine work.
 3. Protect graded areas from undue erosion, and repair and regrade areas where erosion does occur.
 4. Refill areas where noticeable settlement has occurred.
 5. Finish grade areas that are to receive topsoil up to 4 inches below the finished contour elevations called for by the drawings or, over rock, to 12 inches below these elevations.
- E. Place topsoil uniformly over disturbed areas that do not receive other work as follows:
1. Obtain approval of the finish grading from the OWNER before starting to place topsoil.
 2. Scarify the subgrade to a depth of 3 inches.
 3. Place the topsoil to a depth of 4 inches when lightly rolled or, on rock, to a depth of 12 inches.
 4. Level the topsoil to that it slopes uniformly and has no water pockets.
 5. Carefully rake the topsoil by hand to remove all clods, roots, sticks, stones over 1 inch in diameter, and other foreign materials from the surface.
- F. Dispose of excess excavated materials and debris away from the site in accordance with all applicable laws and regulations, the approved erosion and sediment control plans and Section 02321, Excavation, Bedding, and Backfill for Utilities, paragraph 3.13.

END OF SECTION



SECTION 02315

GENERAL EXCAVATION

PART 1. GENERAL

1.01 SCOPE

- A. General excavation shall consist of removing and lawfully and satisfactorily disposing of all materials taken from within the limits of the work contracted: i.e., the material lying between the original ground line and the established excavation limits.
- B. Conduct all excavation operations in accordance with the applicable requirements of erosion and sediment control as shown on the Drawings and Specifications and as required by local authorities.
- C. Complete all clearing and grubbing operations for excavation areas as per Section 02230, Clearing and Grubbing before starting excavation operations. The CONTRACTOR shall be responsible for and shall take all necessary precautions to protect and preserve any and all existing structures, culverts, pipelines, conduits, wires, subdrains, or parts thereof that may be affected by its operations. CONTRACTOR shall satisfactorily repair or replace any damaged part of any such structure, culvert, pipeline, conduit, wire, or subdrain that may result from its operations or negligence during the life of the contract at its own expense.
- D. Strip and properly stockpile all topsoil in cut and fill areas.
- E. At all times during construction, maintain the area so that it will be well drained.

1.02 CLASSIFICATION

- A. Without regard to the materials encountered, all general excavation shall be unclassified. It shall be distinctly understood that any reference to rock, earth, or any other material on the drawings is not to be taken as an indication of classified excavation or the quantity of rock, earth, or any other material involved.
- B. The bidder must draw own conclusions as to the conditions to be encountered.

1.03 WEATHER LIMITATIONS

- A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.

- B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.04 SUBGRADES

- A. Where rock is encountered in the excavation, remove it to the depth below grade required by the drawings, with no points of rock projecting above this depth. Leave the final surface of the rock so that complete drainage will be provided and so that no water will be pocketed at any point.
- B. In cut sections, compact subgrades for all areas to be paved, including structure grade slabs to 100 percent of maximum density, as determined by AASHTO Specification T-99 to a minimum depth of 6 inches. When the material in place does not contain enough moisture for proper compaction to be obtained, thoroughly scarify, and break the subgrade to a minimum depth of 6 inches, increase the moisture content and then compact the subgrade. For material that is unstable because of moisture but is otherwise suitable for the subgrade, either scarify, allow to dry, and compact or else remove and use for refill or embankment. Manipulation to speed drying will be permitted.

1.05 PRESPLITTING

- A. Presplit, at the designated slope lines, all rock and shale formations within excavation limits that are conducive to excavation by drilling and blasting. Perform presplitting before blasting and excavating the interior of the specified cross section at any particular location.
- B. Presplitting, to obtain smooth faces in the rock and shale formations, shall be performed by (1) drilling holes at uniform intervals, of between 2 feet and 4 feet, along the slope lines designated on the drawings or by the OWNER, (2) loading and stemming the holes with appropriate explosives and stemming material and (3) detonating the holes simultaneously. Adjust the intervals of the drill holes, as deemed necessary by the OWNER; within the specified range in order to obtain the smoothest faces possible.
- C. When accurate drilling can be maintained, the holes for presplitting may be drilled to the specified full depth of the excavation or to the specified bench elevations. For depths that are to be drilled with more than one lift of holes, each additional lift of holes may be offset a distance of 1 foot per lift outside the designated slope lines to allow for the proper positioning of the drilling equipment in subsequent lifts. No payment will be allowed for any extra material excavated because of the drill holes being offset outside the designated slope lines.

- D. Charge the holes with explosives of a size, kind, and strength and at a spacing suitable for the formations being presplit, and do so with stemming material that passes a 3/8 inch standard sieve and that has the qualities necessary for proper confinement of the explosives.
- E. The presplit faces shall be free of all loose or crushed pieces and shall not deviate more than 6 inches inwardly from the designated slope lines or offset drill holes, nor more than 1 foot outwardly, except where seams, broken formations, or earth pockets may cause unavoidable irregularities. Discontinue presplitting if the OWNER determines that the materials encountered have become unsuitable for being presplit.
- F. Locate holes drilled for blasting the interior of the cross sections 3 feet or more from the presplit faces, charge with the proper quantity of explosives so as not to damage the presplit faces, and detonate separately from the presplitting charges.

1.06 USE OF EXCAVATED MATERIALS

- A. Insofar as practicable, use all suitable material removed from excavation in the formation of embankments, subgrade, or shoulders; as backfill for structures; or for other purposes either as shown on the Drawings or directed by the OWNER.
- B. Salvage topsoil from within the limits of excavation and embankment, and store it in stockpiles. Before removing topsoil, clear the area of all weeds, brush, stumps, stones, and other debris. Remove topsoil only from areas to be excavated and filled. Take care to avoid mixing subsoil or other unsuitable material with the topsoil. Locate stockpiles at locations approved by the OWNER. The CONTRACTOR may elect to spread the topsoil directly on the areas designated to receive the topsoil without stockpiling.
- C. Rocks and boulders may be placed in embankments provided the embankments are deep enough to provide 12 inches or more soil cover over such rocks or boulders in grassed areas. Do not place boulders larger than 1 cubic yard beneath structure areas.
- D. Do not waste excavated material in excess of that required for normal embankment construction within construction limits except when and as specifically directed or approved by the OWNER.
- E. Material wasted beyond the construction limits shall be managed in accordance with all applicable laws and regulations and with Section 02321, Excavation, Bedding, and Backfill for Utilities by the CONTRACTOR at no cost to the OWNER.



PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

NOT USED

END OF SECTION

**SECTION 02321
EXCAVATION, BEDDING,
AND BACKFILL FOR UTILITIES**

PART 1. GENERAL

1.01 SCOPE

- A. The Work called for by this section shall consist of clearing and grubbing in accordance with Section 02230, Clearing and Grubbing, loosening, loading, removing, and disposing of, in the specified manner, all wet and dry materials (including rock) encountered that must be removed for construction purposes; furnishing, placing, and maintaining the protective system necessary for the proper protection and safety of the Work, the workmen, the public, and adjacent property and improvements; the dewatering of trenches and other excavations; the preparation of satisfactory pipe zone; the placement of tracer wire or nondetectable marking tape; the backfilling and tamping of trenches, foundations, and other structures; the preparation of fills and embankments; the removal of unsuitable material from outside the normal limits of excavation and, where ordered by OWNER, their replacement with suitable materials; and all other grading or excavation work incidental to or necessary for the Work. This Work shall be performed as specified below. Work required under this section will not be measured and paid for as a separate pay item, unless stated otherwise in the contract.

1.02 SUBMITTALS

- A. Action Submittals: Manufacturer's descriptive literature for nondetectable marking tapes.
- B. Informational Submittals:
1. Flowable Fill: Certified mix design and test results; include material types and weight per cubic yard for each component of mix.
 2. Excavations twenty feet or greater in depth: Should the CONTRACTOR excavate twenty feet deep or greater, a protective system designed by a registered professional engineer shall be submitted prior to start of work. CONTRACTOR shall provide a drawing which identifies the type and location of protective system to be used with supporting data provided as necessary.

1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall provide adequate survey control as required, or as requested by RPR or Project Manager.
- B. When custom designed protective systems are used, the design must be performed by a Registered Professional Engineer as required by OSHA 29 CFR 1926.650(b) and 29 CFR 1926.652(c)(4).

1.04 SAFETY

- A. Contractor shall comply with all aspects of 29 CFR 1926.650; 1926.651; and 1926.652 with applicable appendices.
 - 1. Before starting construction, ensure utilities are marked as per the most recent Tennessee Underground Utility Damage Prevention Act.
 - 2. CONTRACTOR will designate a competent person who will remain onsite while excavation activities are conducted. The excavation competent person shall have sufficient training that meets or exceeds Local, State and Federal requirements.
 - 3. When excavations are greater than five feet in depth CONTRACTOR shall install a protective system meeting or exceeding OSHA 29 CFR 1926.652, Requirement for Protective System.
 - 4. Ensure means of egress from trench excavations via stairway, ladder, ramp or other safe means of egress that are four feet or more in depth so as to require no more than twenty five feet of lateral travel for employees per OSHA.
 - 5. A competent person must conduct daily inspections of excavations and the adjacent areas. Protective systems shall be ~~made~~ inspected by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions according to OSHA CFR 1926.651(k)(1-2).
 - 6. CONTRACTOR shall maintain and make all documents relative to soil classification, protective system selection, inspections, and required training available for the OWNER to review upon request.

- B. Refer to KUB Standards and Specifications Section 0700, General Conditions for minimum required personnel protective equipment.

PART 2. PRODUCTS**2.01 PIPE MARKING**

- A. Tracer Wire: Solid copper wire of #12-gauge (or larger).

- B. Warning Tape:
 - 1. Inert polyethylene, non metallic, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.
 - 2. Thickness: 5 mils minimum.
 - 3. Width: 4 inches minimum.
 - 4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
 - 5. Manufacturers and Products:
 - a. Reef Industries; Terra Tape.
 - b. Mutual Industries; Non-detectable Tape.
 - c. Presco; Non-detectable Tape.
 - 6. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities.

Color*	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines
*As specified in NEMA Z535.1, Safety Color Code.	

2.02 TRENCH STABILIZATION MATERIAL

- A. Base Rock: TDOT Mineral Aggregate Base Class A, Aggregate Grading D as specified in Section 903.05 of the TDOT Standard Specifications for Road and Bridge Construction.
- B. Granular Backfill: TDOT #57 stone as specified in Section 903.22 of the TDOT Standard Specifications for Road and Bridge Construction.

2.03 PIPE ZONE MATERIAL

- A. Crushed stone, TDOT #7 as specified in Section 903.22 –SIZES OF COARSE AGGREGATE AASHTO M 43, of the TDOT Standard Specifications for Road and Bridge Construction; Class B aggregate.
- B. Excavated materials suitable for use shall consist of sand, clay, or soil free from large rocks, silt, roots, organic matter, or trash. Excavated materials shall be approved by the OWNER (see Part 3, Execution, Section 3.10, Pipe Zone).

2.04 EARTH BACKFILL

- A. Soil, clay, or other excavated material suitable for use as backfill.
- B. Free from roots or organic matter, refuse, boulders and material larger than 6 inches in diameter, or other deleterious materials.

2.05 FLOWABLE FILL

- A. Select and proportion ingredients to obtain compressive strength between 50 psi and 150 psi at 28 days in accordance with ASTM D4832.
- B. Materials:
 1. Cement: ASTM C150, Type I or Type II.
 2. Aggregate: ASTM C33, Size 7.
 3. Fly Ash (if used): ASTM C618, Class C.
 4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.06 SOURCE QUALITY CONTROL

- A. Perform gradation analysis in accordance with ASTM C136 for:
 - 1. Imported earth backfill, including specified class.
 - 2. Trench stabilization material.
 - 3. Pipe zone material.
- B. Certify Laboratory Performance of Mix Designs: Flowable fill.

PART 3. EXECUTION

3.01 PREPARATION OF THE SITE

- A. Before starting construction, ensure utilities are marked as per the most recent Tennessee Underground Utility Damage Prevention Act.
- B. Remove from the Site all vegetation growth (except as hereinafter excluded), debris, or other objectionable matter as well as any buildings or other structures that the Drawings or OWNER specifically indicate are to be removed. Dispose of this refuse material in a manner that complies with all applicable Laws and Regulations.
- C. In certain areas it may be desirable for existing trees, shrubs, or other vegetation on the Site to be preserved for the permanent landscape. Such vegetation may be shown on the Drawings, specifically listed in the Specifications, marked on the Site, or identified by OWNER. CONTRACTOR shall not damage or remove such growth without written permission from OWNER.
- D. If the area to be excavated is occupied by trees, brush, or other vegetation growth, clear such growth and grub the excavated area in accordance with Section 02230, Clearing and Grubbing and remove all large roots to a depth of not less than 2 feet below the bottom of the proposed construction. Dispose of the growth removed in compliance with all applicable laws and regulations. Fill all holes or cavities created during this Work that extend below the subgrade elevation with suitable material, and compact to the same density as the surrounding material.
- E. Trees, cultivated shrubs, etc., that are situated within public rights-of-way or construction easements through private property, but not directly within the excavation area, shall remain undisturbed unless it is necessary to remove them so that the Work can be performed safely and unless their removal is specifically ordered by OWNER. Take special precautions to protect and preserve such growth throughout all stages of the construction.
- F. If excavation is to be completed under any pavement or concrete, the pavement or concrete must be cut or sawed to straight, clean lines before excavation begins.

3.02 UNSUITABLE MATERIALS

- A. Wherever muck, quicksand, soft clay, swampy ground, or other material unsuitable for foundations, subgrade, or backfilling is encountered beneath the level of the lines, grades, or cross sections on the Drawings, remove it and continue excavation until suitable material is encountered, or as directed by OWNER. The material removed shall be disposed of in the manner described in this section. Then refill the areas excavated for this reason with material approved by OWNER up to the level of the lines, grades, or cross-sections shown on the Drawings. The first 6 inches of this refill shall be No. 7 (TDOT) crushed stone for bedding, as specified below.

3.03 ROCKS AND BOULDERS

- A. Any material that is encountered within the limits of the required excavation that cannot be removed except by drilling or blasting, including rock, boulders, masonry, hard pan, chert, shale, street and sidewalk pavements, or similar materials shall be considered as unclassified excavation, and no separate payment will be made therefore unless specifically outlined in the contract.
- B. Should rock be encountered in the excavation, remove it by blasting or other mechanical methods. Refer to Section 02311, Control Blasting.
- C. Excavate rock over the horizontal limits of excavation and to a depth of not less than 6 inches below the outside bottom of pipe and 6 inches between the side of the pipe and trench wall for pipe up to 30 inches in diameter, and not less than 12 inches below and beside for larger pipes if rock extends to such depth. Then backfill the space below grade with No. 7 (TDOT) crushed stone or other approved material, mechanically compact to the proper grade, and make ready for construction.

3.04 EXCAVATION FOR TRENCHES FACILITIES AND STRUCTURES

- A. Unclassified excavation for pipelines shall consist of the excavation necessary for the construction of all piping and their appurtenances (including manholes, inlets, outlets, headwalls, collars, concrete saddles, and pipe protection) that are called for by the Drawings. It shall include clearing and grubbing where necessary, backfilling and tamping pipe trenches and around structures, and disposing of waste materials, all of which shall conform to the applicable provisions set forth elsewhere in these specifications.
- B. CONTRACTOR may, if it chooses, use a motor powered trenching machine. If they do, however, they shall be fully responsible for the preservation or repair of existing utility service connections and the adequate compaction of backfill material.
- C. Unless the construction of lines by tunneling, jacking, or boring is called for by the Drawings or specifically authorized by OWNER, make excavation for pipelines in open cut trenches true to the lines and grades shown on the Drawings or established by OWNER on the ground. Cut the banks of trenches between vertical parallel planes equidistant from the pipe centerline.

- D. When approved in writing by OWNER, the banks of trenches from the ground surface down to a depth not closer than 1 foot above the top of the pipe may be excavated to nonvertical and nonparallel planes, provided the excavation below that depth is made with vertical and parallel sides equidistant from the pipe centerline.
- E. Trench Width:
1. Minimum Trench Width:
 - a. Single Pipes:
 - 1) Outside Diameter Less than 4 inches: trench 4 inches greater on each side of the pipe.
 - 2) Outside Diameter 4 inches to 12 inches: trench 6 inches greater on each side of the pipe.
 - 3) Outside Diameter Greater than 12 inches to 24 inches: trench 8 inches greater on each side of the pipe.
 - 4) Outside Diameter Greater than 24 inches: trench 24 inches on each side of pipe.
 - b. Multiple Pipes in Single Trench: 18 inches greater than aggregate width of pipes plus space between.
 - c. Increase trench widths by thicknesses of sheeting.
 2. Maximum Trench Width: Shall not be greater than the minimum trench width plus 12 inches nor less than the width required to insert trench boxes. No additional compensation will be allowed to CONTRACTOR for trenches wider than minimum widths stated above including restoration, asphalt, and concrete structures.
 3. If a motor powered trenching machine is approved by OWNER, the dimensions listed above shall be modified to conform to the trench width of the trenching machine pipe diameter and pipe material being used. CONTRACTOR shall be required to meet backfill compaction requirements regardless of trenching method that is approved by OWNER.
- F. Perform all Work so as to cause the least possible inconvenience to the public. Construct temporary bridges or crossings when and where OWNER deems necessary to maintain vehicular or pedestrian traffic.
- G. Where materials are deposited along open trenches, place them so that no damage will result to the Work or to adjacent property in the event of rain or surcharge loading from such deposits.
- H. Open Trench Safety:
1. During Working Hours: Maximum length of open trench shall be 100 feet. The CONTRACTOR shall use protection measures at all times to protect workers and the public from falling into trenches. Open trench lengths greater than 100 feet must be approved by the OWNER.
 2. During Nonworking Hours: The CONTRACTOR shall make every effort to backfill trenches by the end of the work day. If the trench is left open, the CONTRACTOR shall use proper protection measures to protect the public from falling into trenches.

3. Proper protection measures for nonworking hours include steel plates or barriers:
 - a. Steel plates must be a minimum thickness of 1" and able to withstand H-20 traffic loading without any movement and be fabricated to meet ASTM A36 or A572. Steel plates shall extend at least 12 inches beyond the edges of the excavation. Asphalt cold patch shall be installed 12 inches around the entire edge of the steel plate to allow for traffic to smoothly transition on and off the plate and to keep the plate from moving out of position. If plates are used, proper road signage must be installed to alert drivers.
 - b. Concrete barriers or water filled interlocking barriers, that are not leaking or damaged, and caution tape placed around the entire trench or excavation.
 - c. Additional safety measures may be required at the OWNERS request to include concrete barriers, cones, barrels, fencing, illumination, and manned by flagmen.

3.05 PROTECTIVE SYSTEMS

- A. Special care shall be taken to avoid damage wherever excavation is being done. Sufficiently sheet, shore, and brace the sides of all excavations to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the specified trench widths. Use solid sheets in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have enough strength and rigidity to withstand the pressures exerted, to keep the walls of the excavation properly in place, and to protect all persons and property from injury or damage. Separate payment will not be made for sheeting, shoring, and bracing, which are considered an incidental part of the excavation work.
- B. Wherever employees may be exposed to moving ground or cave-ins, CONTRACTOR shall comply with 29 CFR 1926 Subpart P-Excavations to select the proper excavation protective system.
- C. Excavation below the level of the base or footing of any foundation, roadway or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when: A support system such as underpinning, is provided to ensure the safety of employees and the stability of the structure or A Licensed Tennessee Professional Engineer has approved the determination that such excavation work will not pose a hazard to employees. Sidewalks, pavements and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.
- D. Sheeting, shoring, or bracing materials shall not be left in place unless this is called for by the Drawings, ordered by OWNER, or deemed necessary or advisable for the safety or protection of the new or existing work or features. Remove these materials in such a manner that the new structure or any existing structures or property, whether public or private, will not be endangered or damaged and that cave-ins and slides are avoided.
- E. All holes and voids left in the Work by the removal of sheeting, shoring, or bracing shall be filled and compacted as specified herein.

3.06 DEWATERING OF EXCAVATION

- A. CONTRACTOR shall provide and keep in operation enough suitable pumping equipment whenever necessary or whenever directed to do so by OWNER. CONTRACTOR shall give special attention to excavations for those structures that, prior to proper backfilling, are subject to flotation from hydrostatic uplift. Dewatering shall occur only in accordance with applicable Laws and Regulations, approved permits, and industry best management practices. Refer to Section 01570 Erosion Control. Water shall not be discharged to sanitary sewers, unless approved by OWNER in advance.

3.07 BORROW EXCAVATION

- A. Whenever the backfill of excavated areas or the placement of embankments requires more material than is available from authorized excavations, or whenever the backfill material from such excavations is unsuitable, then CONTRACTOR shall obtain additional material from other sources. This may require the opening of borrow pits at points accessible to the work. In such cases, CONTRACTOR shall make suitable arrangements with the property owner and pay all incidental costs, including any royalties, for the use of the borrowed material.
- B. Before a borrow pit is opened, the quality and suitability of its material shall be approved by OWNER. Testing of the material for suitability shall be at CONTRACTOR's expense.
- C. All state and local regulations concerning borrow pits, drainage and erosion control shall be strictly followed.
- D. Furnish OWNER with copies of a written agreement with the owner of the property on which the borrow sites are located, approval of the owner(s) of any utilities within the proposed borrow area, and approvals from regulatory agencies.
- E. In all instances, excavate, and maintain borrow pits in a manner satisfactory to the owner of the property.
- F. Material used from the borrow pit shall be clean backfill with no organic material or rocks greater than 6 inches in diameter.
- G. The taking of materials from borrow pits for use in the construction of backfill, fills, or embankments shall be considered an incidental part of the work; no separate payment shall be made for this.

3.08 GENERAL BACKFILLING METHODS

- A. Backfilling operations shall be performed so as not to disturb or injure any pipe or structure against which the backfill is being placed. If any pipe or structure is damaged or displaced during backfilling, CONTRACTOR shall open up the backfill and make whatever repairs are necessary. This work shall be done at no cost to OWNER.

- B. Backfilling and clean-up operations shall closely follow pipe laying. See Section 02050, Wastewater General Information and Section 01740, Surface Restoration Special Provisions for cleanup requirements. Failure to comply with these provisions will result in OWNER requiring that CONTRACTOR's other activities be suspended until backfilling and clean-up operations follow pipe laying more closely. In this event, extension of contract completion date will not be warranted.
- C. Backfilling operations around facilities and structures shall be conducted in the same manner as specified for pipelines except that even greater care is necessary to prevent damage to the utility structure.
- D. Consolidating by flooding will not be permitted under or adjacent to paved or unpaved traffic areas. If tests for in-place density consistently fail to meet the requirements, OWNER may require CONTRACTOR to change his method of compaction.
- E. Polyethylene pipe backfill materials and practices should be in compliance with ASTM D2774, "Standard Practice for Installation of Thermoplastic Pressure Piping".

3.09 TRENCH STABILIZATION MATERIAL INSTALLATION

- A. Rebuild trench bottom with imported trench stabilization material when trench excavation exceeds elevation of trench zone as directed by OWNER.
- B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.
- C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

3.10 PIPE ZONE

- A. Pipe zone for pipe used on wastewater installations shall consist of an envelope of No. 7 (TDOT) crushed stone from 6 inches below pipe bell to 12 inches above pipe crown for full trench width.
- B. In general, crushed stone bedding is not required for gas and water pipe, or electrical conduit installations. However, when rock, unsuitable materials, pipe under paved surfaces, or a trench edge within three feet of the pavement, bedding shall consist of an envelope of No. 7 (TDOT) crushed stone, or sand as approved by the Owner for steel pipe, from 6 inches below the pipe bell to 6 inches above crown for full trench width.
- C. Hand grade and mechanically compact each lift to provide a firm, unyielding surface.
- D. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe.

- E. Polyethylene pipe shall be laid and continuously supported on undisturbed or well compacted soil. Do not use blocks or allow pipe to rest on rocks or large clods of dirt because this will set up shearing stresses in the pipe during backfilling. Prior to beginning backfilling, the entire trench shall be examined to make sure the pipe is continuously supported at all points on undisturbed or well-compacted soil.
- F. The bedding material shall be shaped for bell and spigot pipe at proper intervals to provide uniform bearing under the entire length of the pipe.
- G. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.
- H. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.
- I. Restrain pipe as necessary to prevent their movement during backfill operations.
- J. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes installed in same trench.
 - 1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
 - 2. Pipe Over 10-Inch Diameter: Maximum 8-inch lifts.
- K. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a rod to ensure that voids are completely filled before placing each succeeding lift.
- L. After the full depth of the pipe bedding material has been placed as specified, compact the material by a minimum of three passes with a vibratory plate compactor only over the area between the sides of the pipe and the trench walls.
- M. Do not use power-driven impact compactors to compact pipe bedding material.

3.11 BACKFILL ABOVE PIPE BEDDING

- A. General:
 - 1. Process excavated material to meet specified gradation requirements.
 - 2. Adjust moisture content as necessary to obtain specified compaction.
 - 3. Do not allow backfill to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
 - 4. Do not use power driven impact type compactors for compaction until at least 12 inches of backfill is placed over top of pipe.
 - 5. Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.
 - 6. Backfill around structures with same class backfill as specified for adjacent trench, unless otherwise shown or specified.

- B. Unimproved and Unsurfaced areas:
 - 1. Backfill with excavated material. For trenches 5 feet or less, tamp material in 18 inch lifts or as directed by the Owner. For trenches greater than 5 feet, tamp material in lifts as directed by the Owner.
 - 2. Leave trench with backfill material neatly mounded across the entire trench width 1 inch of mound above the adjacent ground surface for each foot of trench depth.
 - 3. In lawn, garden, or similar type areas, maintain trench level with the existing adjacent grade. See Paragraph, Maintenance.
- C. Under paved surfaces or trench within 3 feet of pavement edge: Use the latest version of KUB's "Paving Detail Sheet, D-1" for the backfill materials, compaction equipment, and lift requirements.
- D. Flowable Fill Backfill:
 - 1. Place above pipe bedding where required to expedite trench backfill or to protect pipe.
 - 2. Do not allow dirt or foreign material to become mixed with concrete during placement.
 - 3. Allow sufficient time for concrete to reach initial set before additional backfill material is placed in trench.
 - 4. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.
 - 5. Fill trench section as shown on Drawings.

3.12 PIPE MARKING

- A. Tracer Wire for Pipe:
 - 1. Place within 6 inches of pipe where practical and directly above if possible.
 - 2. Do not wrap around pipe or connectors except at the riser. Never wrap tracer wire around pipe or fittings.
 - 3. Install so electrical continuity is maintained throughout the pipe system.
 - 4. Connections:
 - a. Make as few connections as possible in tracer wire.
 - b. Make by stripping the insulation back 1 inch and joining the two ends using an approved mechanical connector. Twisting of copper wire will not be acceptable.
 - c. Wrap exposed wire thoroughly with electrical tape.
 - 5. Coil, bury, and terminate 5 feet of additional tracer wire at the ends of the pipeline. On the 5-foot tracer wire section, strip back 1 foot of insulation at the ends prior to burial. Bring ends to within 1 foot of the surface.
- B. Nondetectable Marking Tape:
 - 1. Install 1 foot above the pipe. The marking tape shall identify the utility type.

3.13 DISPOSAL OF MATERIALS

- A. Whenever practicable, all materials removed by excavation that are suitable for backfilling pipe trenches or for other purposes shown on the Drawings or directed by the OWNER shall be used for these purposes. Any surplus materials not so used shall be managed by CONTRACTOR as either consisting solely of earth, rock, concrete or asphalt paving materials (“Clean Spoil”) or, if determined by OWNER to be something other than Clean Spoil, as Waste Materials.
- B. Clean Spoil may be deposited in spoil areas at site locations found by CONTRACTOR. For all such areas, the CONTRACTOR shall complete Contractor Certification Form attached at end of the section and furnish to OWNER in advance of depositing any such Clean Spoil on any such site location. Receipt by OWNER of the Contractor Certification shall not relieve the CONTRACTOR of its responsibilities to comply fully with its obligations under the Contract Documents and all Laws and Regulations relating to such Clean Spoil.
- C. Unless otherwise provided in the Contract Documents, Waste Materials shall be properly classified by CONTRACTOR and lawfully transported to and disposed of in an appropriate permitted facility approved by OWNER. Proof of each such transport and disposal shall be provided to OWNER within 24 hours after such disposal.
- D. Once any part of the Work is completed, the CONTRACTOR shall properly manage all surplus Clean Spoil and lawfully dispose of all Waste Materials left within the constructions limits of that Work. The CONTRACTOR is responsible for the removal, hauling and final management of Clean Spoil and Waste Materials. The CONTRACTOR is responsible for locating spoil sites for depositing of Clean Spoil and appropriate landfills for disposal of Waste Materials and for obtaining all related permissions from spoil site owners and landfill operators, as appropriate, and all required permits from all governmental agencies having jurisdiction over the depositing of such Clean Spoil or disposal of such Waste Materials.
- E. The depositing of Clean Spoil and the disposal of Waste Materials in the manner described above shall be considered an integral part of the excavation work, and one for which no separate payment shall be allowed.

3.14 MAINTENANCE

- A. CONTRACTOR shall seed and maintain in good condition all excavated areas, trenches, fills, embankments, and channels until final acceptance by OWNER.
- B. CONTRACTOR shall maintain trench backfill at the approximate level of the original ground surface by periodically adding backfill material wherever necessary and whenever directed to do so by OWNER. Continue such maintenance until final acceptance of the Project or until OWNER issues a written release.

3.15 SLOPES

- A. All open slopes shall be neatly trimmed and finished to conform either to the slope lines shown on the Drawings or the directions of OWNER. Leave the finished

surfaces of bottom and sides in reasonably smooth and uniform planes like those normally obtainable with hand tools, though CONTRACTOR will not be required to use hand methods if he is able to obtain the required degree of evenness with mechanical equipment. Conduct grading operations so that material is not removed or loosened beyond the required slope.

3.16 EMBANKMENT

- A. This work shall consist of forming embankments, other than for building pads, with materials from excavation or other approved sources and in conformance with the lines, grades, and cross-section shown on the Drawings.
- B. Complete the clearing and grubbing of embankment areas in accordance with the requirements of Section 02230, Clearing and Grubbing before placing embankment thereon.
- C. Conduct all embankment operations in accordance with the requirements of the erosion control plan approved by OWNER. Refer to Section 01570, Erosion Control.
- D. Use only acceptable materials in embankment formation. Place no frozen material, stumps, logs, roots or other perishable materials in any embankment. Place no stone or masonry fragment greater than 4 inches in any dimension within 12 inches of the finished subgrade elevation.
- E. Remove topsoil from all embankment areas to a depth of approximately 6 inches, or to a greater depth wherever the soils investigation report so indicates.
- F. Form soil, soft shale, soft sandstone, weathered rock, bank gravel or creek gravel embankment by distributing the material in successive uniform horizontal layers no more than 12 inches thick (loose depth) to the full width of the cross-section. However, layers less than 12 inches in loose thickness will be required whenever necessary to obtain the specified density. Compact each layer as specified below. Shape the upper surface of the embankment so as to provide complete drainage of surface water at all times. The forming of ruts will not be permitted.
- G. In embankments constructed principally of unweathered limestone, hard shale or hard sandstone, the layer thickness shall not exceed 2 feet; the maximum dimensions of boulders or large rocks placed in the embankment shall be 2 feet vertically and horizontally. Larger pieces may be placed in the embankment face when permitted by the OWNER. Keep rocks with any dimension greater than 2 feet at least 2 feet below the subgrade elevation. Do not dump the rock into final position, but instead distribute it by blading or dozing in a manner that will ensure proper placement in the embankment so that voids, pockets and bridging will be reduced to a minimum. The slope shall conform substantially to the requirements of the Drawings.
- H. In areas where layers of rock and shale or soil are encountered and embankments are constructed of a mixture of rock and shale or rock and soil, place, manipulate and compact the material in layers no more than 8 inches thick; however, when the thickness of the rock exceeds 8 inches, the thickness of the embankment layers may be increased (except beneath building areas) as necessary due to the nature of the

- material and as approved by OWNER. In no case allow the layer thickness to exceed 2 feet. Do not dump the mixture into final position, but distribute it by blading or dozing in a manner that will ensure proper placement in the embankment so that voids, pockets and bridging will be reduced to a minimum. Then compact the mixture with suitable compaction equipment.
- I. Compact the embankment to a density of at least 98 percent of the maximum density as determined by ASTM D698 (Standard Procter).
 - J. During compaction, embankment material that does not have enough moisture for proper compaction, shall have water added and thoroughly mixed as necessary to obtain proper compaction. Embankment material containing an excess of moisture shall be allowed to dry before compacting; manipulating as necessary to speed drying.
 - K. Perform construction operations so that simultaneous rolling and placing of material in the same lane or section is prevented. To avoid uneven compaction, see that hauling equipment traverses the full width of the cross-section as much as possible. Compact each layer as necessary before depositing material for the next layer.
 - L. The density requirements shall be the controlling factor in compaction. Use only such equipment as will satisfy the density requirements at all times.
 - M. For embankment adjacent to structures, including utility structures, first construct backfill in accordance with the guidelines included within this section.
 - N. When embankment is placed around adjoining or opposite faces of a structure, compact it to the same level on all sides before proceeding to the next layer next to the structure. As precaution against wedging action, begin compaction for each layer next to the structure.
 - O. Construct embankments adjacent to structures as outlined to the height of the structure and slope far enough away from the structure to permit easy access of compacting equipment used in normal embankment construction.



CONTRACTOR CERTIFICATION FORM

I, _____, understand that the Contract Documents under which I am working (e.g., Section 02321, Excavation, Bedding, and Backfill for Utilities) establish that it is the CONTRACTOR's responsibility to manage lawfully any and all surplus material excavated during the performance of the Work. Accordingly I hereby certify that I will deposit surplus excavation or fill materials consisting solely of earth, rock, concrete, or asphalt paving materials ("Clean Spoil") that result from OWNER's Project,

_____, only at and upon the following fill site location(s): _____.

I further certify that (1) this repository site is appropriate for the above-described Clean Spoil, (2) I have cooperation from the fill site's property owner, _____, from whom I have received a written agreement that allows the placement of such Clean Spoil at and upon such Site (a copy of said agreement has been provided to OWNER, and (3) no Waste Material from OWNER's project has been disposed of at and upon such Site.

In addition, I certify that any and all applicable local, state, and federal permits have been applied for and obtained, either by the property owner or myself. Copies of all such permits have been provided to OWNER, and all work will proceed in compliance with all applicable laws, rules and regulations.

To my knowledge, no other material from any other source has been placed at and upon this location, and none will be permitted by the property owner until completion of Clean Spoil placement and grading.

I hereby certify the above and release, indemnify, and save harmless the OWNER, from any and all claims which might arise as a result of placement of Clean Spoil from OWNER's project at this or at any site. I further acknowledge that nothing in this certification, including but not limited to the receipt by OWNER of the various documents referenced herein and to be furnished by CONTRACTOR, relieves the CONTRACTOR of its responsibilities under the Contract Documents to fully comply with all legal requirements pertaining to the performance of the Work and the proper and lawful disposition of any and all surplus materials that result from any required excavation.

Acknowledged:

By: _____

By: _____

Date: _____
(CONTRACTOR)

Date: _____
(OWNER)

Address: _____

Telephone #: _____

END OF SECTION

SECTION 2372 GEOTEXTILES

PART 1 GENERAL

1.01 SCOPE

- A. This section shall apply to geotextiles used for subsurface drainage applications and for material separation to prevent mixing of a subgrade soil and an aggregate cover material, or riprap from the subsoil material.

1.02 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. American Association Of State Highway and Transportation Officials (AASHTO): M288, Standard Specification for Geotextile Specification for Highway Applications.
 2. ASTM International (ASTM):
 - a. D737, Test Method for Air Permeability of Textile Fabrics.
 - b. D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
 - c. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - d. D4533, Standard Test Method For Trapezoid Tearing Strength Of Geotextiles.
 - e. D4595, Standard Test Method For Tensile Properties Of Geotextiles By The Wide-Width Strip Method.
 - f. D4632, Standard Test Method For Grab Breaking Load And Elongation Of Geotextiles.
 - g. D4716, Test Method For Determining The (In-Plane) Flow Rate Per Unit Width And Hydraulic Transmissivity Of A Geosynthetic Using A Constant Head.
 - h. D4751, Standard Test Method For Determining Apparent Opening Size Of A Geotextile.
 - i. D4873, Guide For Identification, Storage, And Handling Of Geotextiles.
 - j. D4833, Standard Test Method For Index Puncture Resistance Of Geotextiles, Geomembranes, And Related Products.
 - k. D4884, Standard Test Method For Strength Of Sewn Or Thermally Bonded Seams Of Geotextiles.
 - l. D4886, Standard Test Method For Abrasion Resistance Of Geotextiles (Sand Paper/Sliding Block Method).
 - m. D5199, Standard Test Method For Measuring The Nominal Thickness Of Geosynthetics.

- n. D5261, Standard Test Method For Measuring Mass Per Unit Area Of Geotextiles.
- o. D6193, Standard Practice For Stitches And Seams.

1.03 DEFINITIONS

- A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.
- B. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile furnished.
- C. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile furnished.
- D. Nondestructive Sample: Sample representative of finished Work, prepared for testing without destruction of Work.
- E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
- F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D4884.



1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Manufacturer's material specifications and product literature.
 - b. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
 - c. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.
 - 2. Samples:
 - a. Geotextile: One-piece, minimum 18 inches long, taken across full width of roll of each type and weight of geotextile furnished for Project. Label each with brand name and furnish documentation of lot and roll number from which each Sample was obtained.
 - b. Field Sewn Seam: 5-foot length of seam, 12 inches wide with seam along center, for each type and weight of geotextile.
 - c. Securing Pin and Washer: One each.
- B. Informational Submittals:
 - 1. Certification:
 - a. Name of the manufacturer, product name, style number, chemical composition of the filaments or yarns and other pertinent information to fully describe the geotextile.
 - b. Certification shall state that furnished geotextile meets either the MinARV or the MaxARV requirements of the Specification as evaluated under manufacturer's quality control program.
 - c. Certification shall be attested to by a person having legal authority to bind the manufacturer.
 - 2. Field seam efficiency test results.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Geosynthetic Accreditation Institute (GAI) - Laboratory Accreditation Program (LAP).
 - 2. American Association for Laboratory Accreditation (A2LA).



1.06 DELIVERY, STORAGE, AND HANDLING

- A. Geotextile labeling, shipment, and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.
- B. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.
- C. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical property values of the geotextile.

1.07 SCHEDULING AND SEQUENCING

- A. Notify OWNER whenever geotextiles are to be placed. Do not place geotextile without OWNER's approval of underlying materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers:
 1. Carthage Mills, Cincinnati, OH.
 2. BP Amoco Chemical Civil Engineering Fabrics, Austell, GA.
 3. Linq Industrial Fabrics, Summerville, SC.
 4. Synthetic Industries, Chattanooga, TN.
 5. TC Mirafi, Pendergrass, GA.
 6. TNS Advanced Drainage Systems, Spartanburg, SC.

2.02 NONWOVEN GEOTEXTILE

- A. Pervious sheet of polyester, polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other. Nonwoven geotextile shall be composed of continuous or discontinuous (staple) fibers held together through needle-punching, spun-bonding, thermal-bonding, or resin-bonding.

- B. Geotextile Edges: Selvaged or otherwise finished to prevent outer material from pulling away from geotextile.
- C. Unseamed Sheet Width: Minimum 12 feet.
- D. Nominal Weight per Square Yard: 4.8 ounces per square yard per ASTM D5261.
- E. Nominal Thickness (mils): 1.4 mils per ASTM D5199.
- F. The geotextile shall meet the requirements of Table 1.

Table No. 1		
Physical Property Requirements for Nonwoven Geotextile		
Property	Requirement	Test Method
Water Permittivity	0.5 sec. ⁻¹ , MinARV	ASTM D4491 (Falling Head)
Apparent Opening Size (AOS)	40U.S. Standard Sieve Size	ASTM D4751
Grab Tensile Strength, Machine Direction	110 lb/in, MinARV	ASTM D4632
Grab Elongation, Machine Direction	50 percent, MaxARV	ASTM D4632
Puncture Strength	40 lb, MinARV	ASTM D4833
Trapezoid Tear Strength	50 lb, MinARV	ASTM D4533
Abrasion Resistance	[A:] percent loss, 250 cycles, MaxARV	ASTM D4886
Ultraviolet Radiation Resistance	70 percent strength retention, MinARV after 500 hours	ASTM D4355



2.03 SEWING THREAD

- A. Polypropylene, polyester, or Kevlar thread.
- B. Durability: Equal to or greater than durability of geotextile sewn.

2.04 SECURING PINS

- A. Steel Rods or Bars:
 - 1. 3/16-inch diameter.
 - 2. Pointed at one end.
 - 3. With head on other end sufficiently large to retain washer.
 - 4. Minimum Length: 12 inches.
- B. Steel Washers for Securing Pins:
 - 1. Outside Diameter: Not less than 1.5 inches.
 - 2. Inside Diameter: 1/4 inch.
 - 3. Thickness: 1/8 inch.
- C. Steel Wire Staples:
 - 1. U-shaped.
 - 2. 10 gauge.
 - 3. Minimum Length: 6 inches.

PART 3 EXECUTION

3.01 JOINTS

- A. Unseamed Joints:
 - 1. Overlap, unless otherwise shown:
 - a. Foundation/Subgrade Stabilization: Minimum 18 inches.
 - b. Riprap: Minimum 18 inches.
 - c. Drain Trenches: Minimum 18 inches, except overlap shall equal trench width if trench width is less than 18 inches.
 - d. Other Applications: Minimum 12 inches.
- B. Sewn Seams: Made wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by OWNER, also may be used instead of overlap at joints for applications that do not require stress transfer.
 - 1. Seam Efficiency:
 - a. Minimum 70 percent.
 - b. Verified by preparing and testing minimum of one set of nondestructive Samples per acre of each type and weight of geotextile installed.
 - c. Tested according to ASTM D4884.



- 2. Types:
 - a. Preferred: "J" type seams.
 - b. Acceptable: Flat or butterfly seams.
- 3. Stitch Count: Minimum three to maximum seven stitches per inch.
- 4. Stitch Type: Double-thread chainstitch according to ASTM D6193.
- 5. Sewing Machines: Capable of penetrating four layers of geotextile.
- 6. Stitch Location: 2 inches from geotextile sheet edges, or more, if necessary to develop required seam strength.

3.02 SECURING GEOTEXTILE

- A. Secure geotextile during installation as necessary with sandbags or other means approved by OWNER.
- B. Secure Geotextile with Securing Pins or Staples:
 - 1. Insert securing pins with washers through geotextile.
 - 2. Securing Pin Alignment:
 - a. Midway between edges of overlaps.
 - b. 6 inches from free edges.
 - 3. Spacing of Securing Pins:

Slope	Maximum Pin Spacing
Steeper than 3:1	2 feet
3:1 to 4:1	3 feet
Flatter than 4:1	5 feet

4. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.
5. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.
6. Where staples are used instead of securing pins, install in accordance with alignment and spacing above. Push in to secure geotextile firmly to subgrade.

3.03 PLACING PRODUCTS OVER GEOTEXTILE

- ii. Before placing material over geotextile, notify OWNER. Do not cover installed geotextile until after OWNER provides authorization to proceed.
- iii. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as specified in Article Repairing Geotextile.

3.04 INSTALLATION OF GEOTEXTILE FOR MATERIAL SEPARATION

- A. Prepare installation site by clearing, grubbing, and excavation or filling the area to the design grade. This includes removal of topsoil and vegetation.
- B. The geotextile shall be laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Adjacent geotextile rolls shall be overlapped, sewn or joined as required in the Drawings.
- C. On curves, the geotextile may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of fill or rock.
- D. Prior to covering, the geotextile shall be inspected by the OWNER to ensure that the geotextile has not been damaged during installation. Damaged geotextiles, as identified by the OWNER, shall be repaired immediately. Cover the damaged area with a geotextile patch which extends an amount equal to the required overlap beyond the damaged area.
- E. The subbase shall be placed by end dumping onto the geotextile from the edge of the geotextile, or over previously placed subbase aggregate. Construction vehicles shall not be allowed directly on the geotextile. The subbase shall be placed such that at least the minimum specified lift thickness shall be between the geotextile and equipment tires or tracks at

all times. Turning of vehicles shall not be permitted on the first lift above the geotextile.

- F. Any ruts occurring during construction shall be filled with additional subbase material, and compacted to the specified density.
- G. If placement of the backfill material causes damage to the geotextile, the damaged area shall be repaired as previously described above. The placement procedure shall then be modified to eliminate further damage from taking place.

3.05 INSTALLATION OF GEOTEXTILE FOR SUBSURFACE DRAINAGE

- A. Trench excavation shall be done in accordance with the Drawings and Section 02321, Excavation, Bedding, and Backfill for Utilities. Excavation shall be done in such a way so as to prevent large voids from occurring in the sides and bottom of the trench. The graded surface shall be smooth and free of debris.
- B. The geotextile shall be placed loosely with no wrinkles or folds, and with no void spaces between the geotextile and the ground surface. Successive sheets of geotextiles shall be overlapped with the upstream sheet overlapping the downstream sheet.
- C. All seams shall be subject to the approval of the OWNER.
- D. Should the geotextile be damaged during installation or drainage aggregate placement, a geotextile patch shall be placed over the damaged area extending beyond the damaged area a distance of 18 inches.
- E. Placement of drainage aggregate should proceed immediately following placement of the geotextile. The geotextile should be covered with a minimum of 12 inches of loosely placed aggregate prior to compaction. If a perforated collector pipe is to be installed in the trench, a bedding layer of drainage aggregate should be placed below the pipe, with the remainder of the aggregate placed to the minimum required construction depth.
- F. The aggregate should be compacted with vibratory equipment to a minimum of 95 percent Standard AASHTO density unless the trench is required for structural support.

3.06 RIPRAP APPLICATIONS

- A. Riprap installation shall be done in accordance with details of the Drawings and Section 02371, Riprap. Excavation shall be done in such a way so as to prevent large voids from occurring in the sides and bottom of the excavation. The graded surface shall be smooth and free of debris.
- B. The geotextile shall be placed loosely with no wrinkles or folds, and with no void spaces between the geotextile and the ground surface. Successive sheets of geotextiles shall be overlapped with the upstream sheet overlapping the downstream sheet. Sew joints where wave run-up may occur.
- C. All seams shall be subject to the approval of the OWNER.
- D. Limit height of riprap fall onto geotextile to prevent damage.
 - 1. Drop Height: 1 foot for greater than 200-pound rock.

3.07 REPAIRING GEOTEXTILE

- A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile.
- B. Repair Procedure:
 - 1. Place patch of undamaged geotextile over damaged area and overlap and seam at least 18 inches in all directions beyond damaged area.
 - 2. Remove interfering material as necessary to expose damaged geotextile for repair.
 - 3. Sew patches or secure them with heat fusion tacking or with pins and washers, as specified above in Article Securing Geotextile, or by other means approved by OWNER.

3.08 REPLACING CONTAMINATED GEOTEXTILE

- A. Protect geotextile from contamination that would interfere, in OWNER'S opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

END OF SECTION



SECTION 02512

WATER LINES - AIR VALVES, BLOWOFFS AND HYDRANTS

PART 1. GENERAL

- 1.1 This section covers air valves, hydrants, and blowoffs for water lines specified under Section 02513, Water lines.
- 1.2 Disposal of all air valves, blowoffs, and hydrants shall be at the discretion of the OWNER.

PART 2. PRODUCTS

- 2.1 All products and materials utilized in the execution of the work described herein shall meet or exceed the specified characteristics provided herein. All products and materials must be equal to those specified in Section 02080, Water/Wastewater material available for review at kub.org/standards or available for review at KUB/Procurement 4505 Middlebrook Pike.
- 2.2 Air valves shall be one of the following:

Manufacturer	1": KUB Item # 204222	2" KUB Item # 207480
ARI	D-040	D-040
Bermad	1" - 4405	2" - 4415
Multiplex Mfg Co.	Crispin UL-10	Crispin UL-20
Valve & Primer Corp	APCO MDL 143C	2" APCO Model 145C

PART 3. EXECUTION

3.1 AIR VALVES

- A. Air valves for water lines shall be in accordance with the Materials specifications and as shown on the Standard Drawings.
- B. Air valves shall be 1-inch size on pipelines 12 inches in diameter and smaller. For larger pipes, the air valves shall be 2-inch size.
- C. Air valves shall be located at all high points on the pipeline or as directed by the OWNER.

- D. Air valves shall be installed in precast concrete or brick manholes as shown on the Standard Drawings.
- E. A tapping saddle shall be used on all air valve installations.

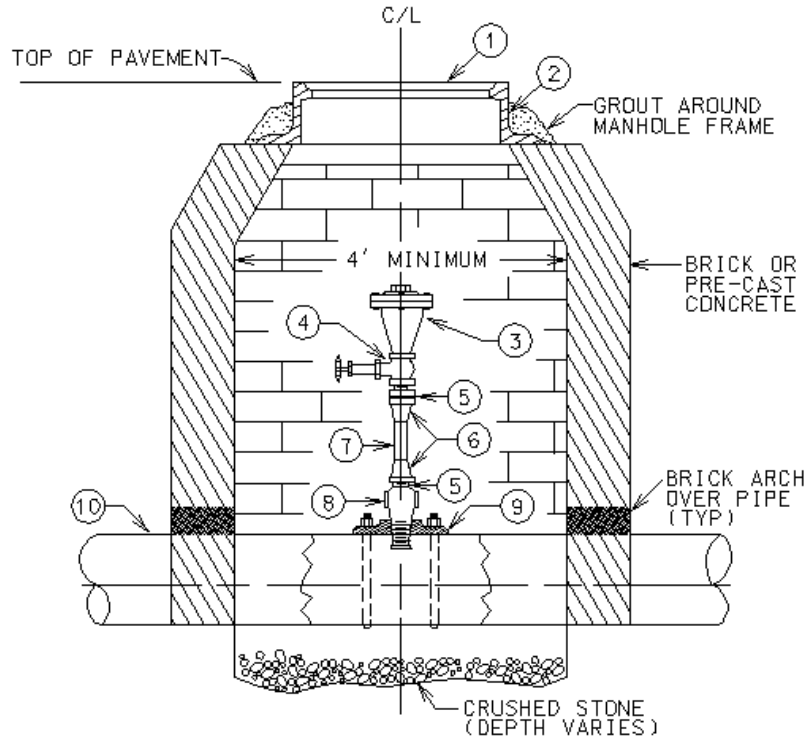


Figure 1-02512-a: Typical Installation of 1” and 2” Universal Air Valve – DI/CI Main

Notes:

- I. Tapping saddle must be used with corporation stop.
- II. Brass nipple may be substituted for item # 7 with Owner approval.

Material List for 1" Installation of Universal Air Valve

Item	Quantity	KUB Item #	Description
1	1	200020	Water Manhole Lid
2	1	200300	Manhole Frame
3	1	204224	Air Valve
4	1	207167	Brass Gate Valve
5	1	203307	All Thread Brass Nipple
6	1	203984	Female Fitting
7	1	290650	Copper Pipe
8	1	202770	1" Corporation Stop
9	1	207266	6 X 1 Tapping Saddle



		206961	8 X 1 Tapping Saddle
		205344	12 X 1 Tapping Saddle
10	1	290742	6" Ductile Iron Pipe
		295279	8" Ductile Iron Pipe
		295337	12" Ductile Iron Pipe

Material List for 2" Installation of Universal Air Valve

Item	Quantity	KUB Item #	Description
1	1	800020	Water Manhole Lid
2	1	800300	Manhole Frame
3	1	207480	2" Air Valve
4	1	205625	2" Brass Gate Valve
5	1	203216	2" All Thread Brass Nipple
6	1	203547	2" Coupling – Copper Compression x FPT
7	1	290668	2" Copper Pipe
8	1	202796	2" Corporation Stop
9	1	207043	16X 2 Tapping Saddle
10	1	295287	16" Ductile Iron Pipe

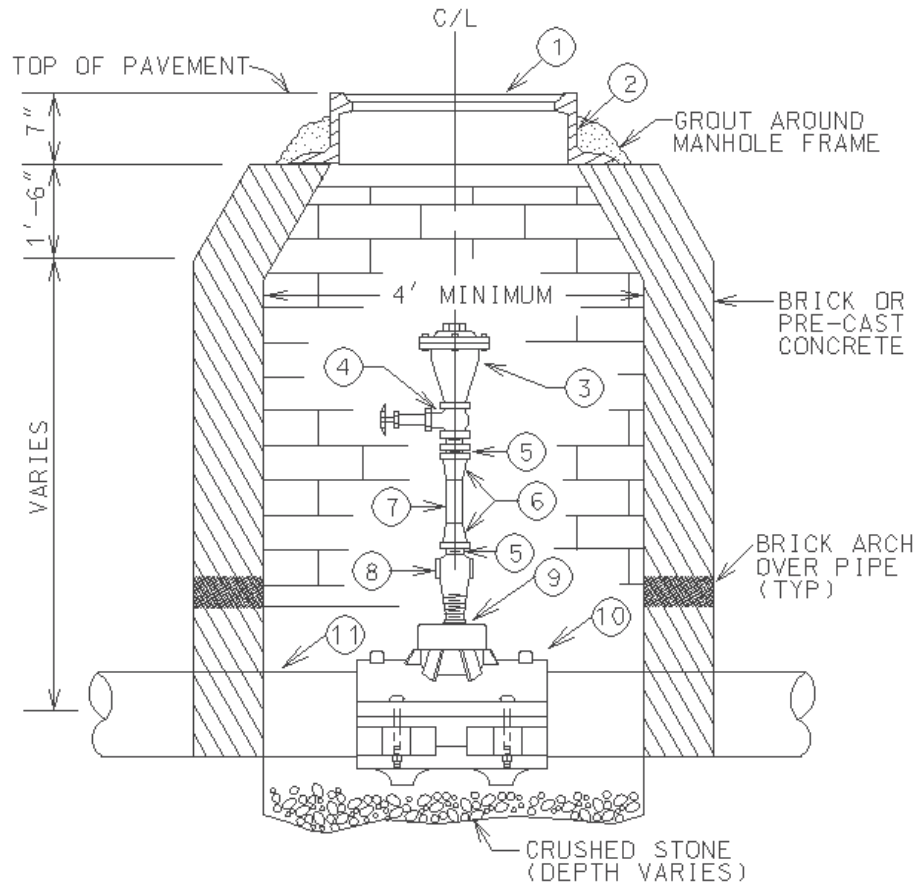


Figure 2-02512-b: Typical Installation of 1" Universal Air Valve – HDPE Main

Notes:

- I. Tapping saddle must be used with corporation stop.

Material List for 1" Installation of Universal Air Valve

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	200020	Water Manhole Lid
2	1	200300	Manhole Frame
3	1	204224	1" Air Valve
4	1	207167	1" Brass Gate Valve
5	1	203307	1" All Thread Brass Nipple
6	1	203984	1" Coupling – Copper Compression x FPT
7	1	290650	1" Copper Pipe
8	1	202770	1" Corporation Stop
9	1	200701	2 (MIPT) x 1 (FCCT) Bushing
10	1	200223	8" DIPS x 2" IPS Electrofusion Corp Saddle
		Non Stock	12" DIPS x 2" IPS Electrofusion Corp Saddle
11	1	290742	8" HDPE Pipe
		Non Stock	12" HDPE Pipe

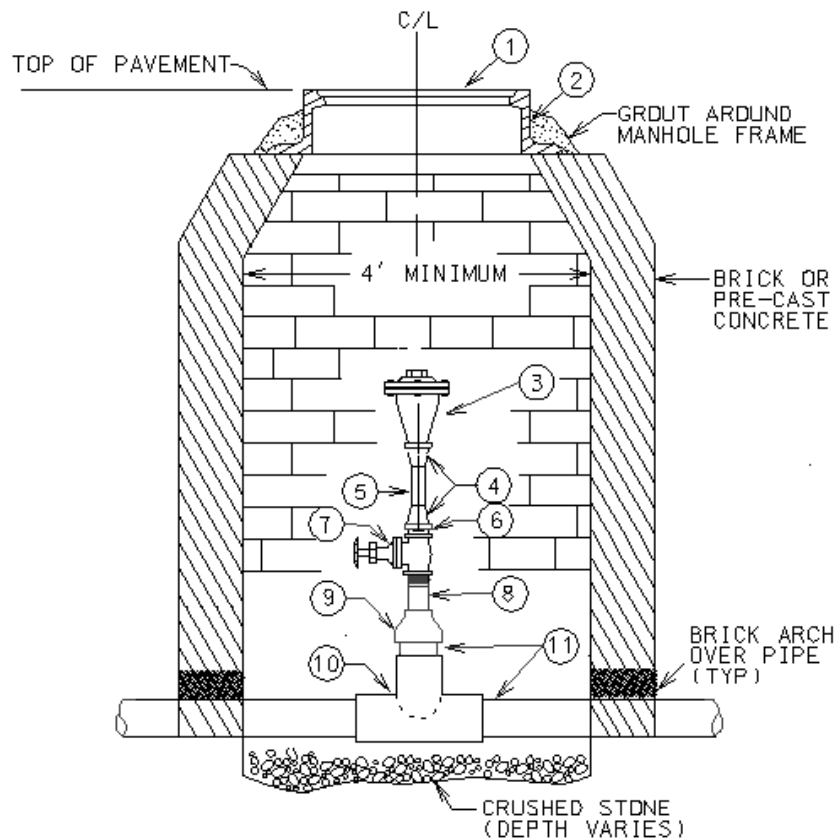


Figure 3-02512-c: Typical Installation of 1" Air Valve on 2" HDPE

Notes:

- I. Brass nipple may be substituted for item # 5 with Owner approval.

Material List for 1" Installation of Universal Air Valve

Item	Quantity	KUB Item #	Description
1	1	200020	Water Manhole Lid
2	1	200300	Manhole Frame
3	1	204224	1" Air Valve
4	2	203984	1" Female Fitting
5	1	290650	1" Copper Pipe
6	1	203307	All Thread Brass Nipple
7	1	207167	1" Brass Gate Valve
8	1	800744	1" HDPE Transition Fitting
9	1	Non-stock	2 x 1-1/4" HDPE Reducer
10	1	800714	2" HDPE Tee
11		200214	2" HDPE Pipe

3.2 BLOWOFFS

- A. Blowoffs, temporary and permanent, shall be in accordance with the Materials Specifications and as shown on the Standard Drawings, or as Directed by OWNER.
- B. Blowoff valves shall be 2 inches in size unless otherwise directed by the OWNER.
- C. Blowoffs shall be installed on all dead-end mains or as directed by the OWNER.
- D. Tracer wire shall be installed within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

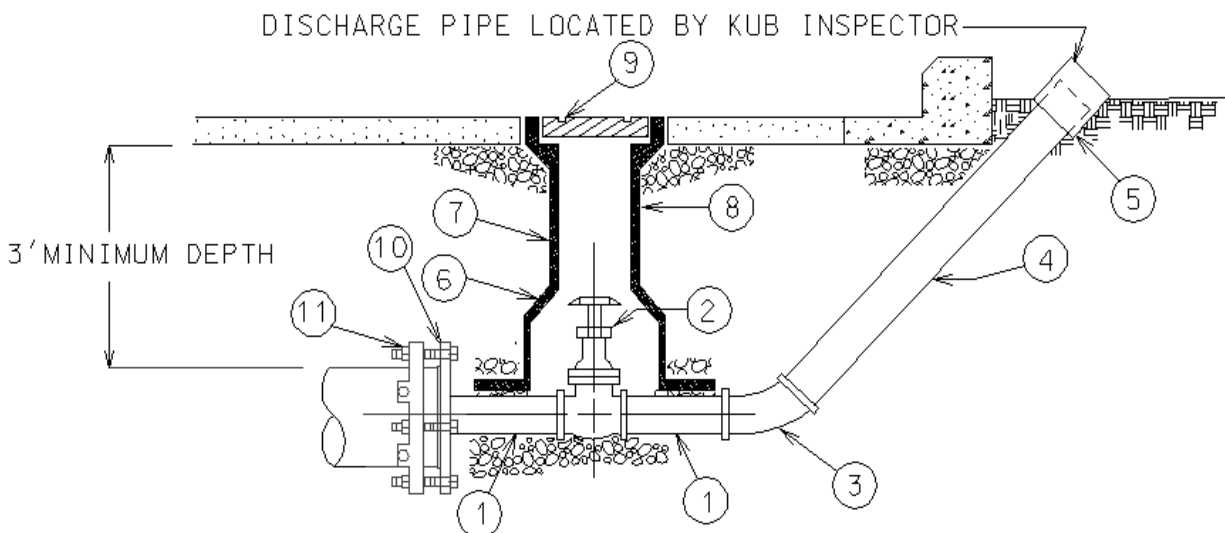


Figure 4-02512-d: Typical Blowoff Detail – 6”-12” Ductile Iron Main

Notes:

- I. Thrust restraint gaskets to be installed for a minimum of three joints of ductile iron pipe, additional restrained joint gaskets shall be used if required by the pipe manufacturer.
- II. Adjust valve box to grade.
- III. All material from main to the 45 shall be brass.
- IV. All pipe and fittings in contact with concrete thrust restraint blocks should be wrapped in plastic sheeting, minimum 6 mil thickness.
- V. Blowoff to be located outside of asphalt when practical as directed by the OWNER.

- VI. Do not allow the valve box base to rest directly on the pipe or valve. Use blocks or brick to support the valve box base.
- VII. Tracer wire shall be installed within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.



Material List for 2" Typical Blowoff

Item	Quantity	KUB Item #	Description
1	2	205260	2" x 6" Brass Nipple
2	1	205625	2" Brass Gate Valve
3	1	203448	2" Brass 45° Bend
4	1	294819	2" Galvanized Pipe
5	1	200075	2" Cap
6	1	294074	Valve Box Base
7	1	294058	Valve Box Bottom
8	1	294041	Valve Box Top Section
9	1	294041	Valve Box Water Lid
10		291765	6" X 2" Tap Plug
	1	296764	8" X 2" Tap Plug
		296806	10" X 2" Tap Plug
		291781	12" X 2" Tap Plug
11		200106	6" Megalug Joint Restraint
	1	200108	8" Megalug Joint Restraint
		200110	10" Megalug Joint Restraint
		200112	12" Megalug Joint Restraint
12	1-Lot	290783	Bricks to support valve box base (not shown)
13	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

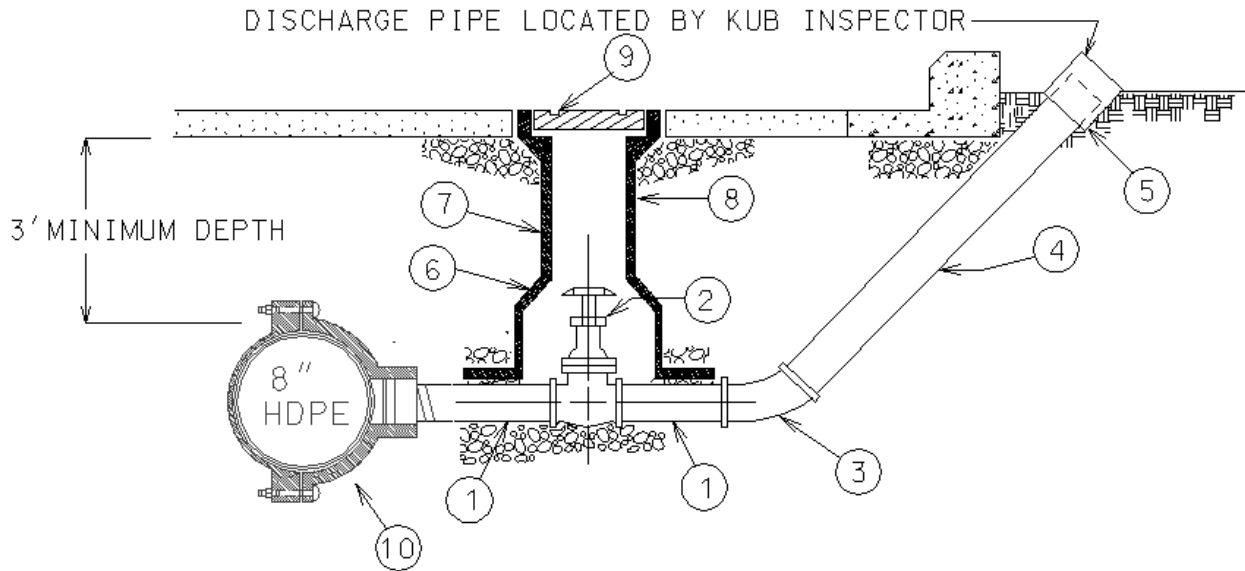


Figure 5-02512-e: 2" Blowoff - 8" HDPE Main

Notes:

- I. Adjust valve box to grade.
- II. All material from main to the 45 shall be brass.
- III. Blowoff to be located outside of asphalt when practical, as directed by the OWNER.
- IV. Do not allow the valve box base to rest directly on the pipe or valve. Use blocks or brick to support the valve box base.
- V. Tracer wire shall be installed within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall be looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for 2" Blowoff - 8" HDPE Main

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	2	205260	2" x 6" Brass Nipple
2	1	205625	2" Brass Gate Valve
3	1	203448	2" Brass 45° Bend
4	1	294819	2" Galvanized Pipe
5	1	200075	2" Cap
6	1	294074	Valve Box Base
7	1	294058	Valve Box Bottom
8	1	294041	Valve Box Top Section
9	1	294041	Valve Box Water Lid
10	1	200223	8" x 2" Electrofusion Corp Saddle
11	1-Lot	290783	Bricks to support valve box base (not shown)
12	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

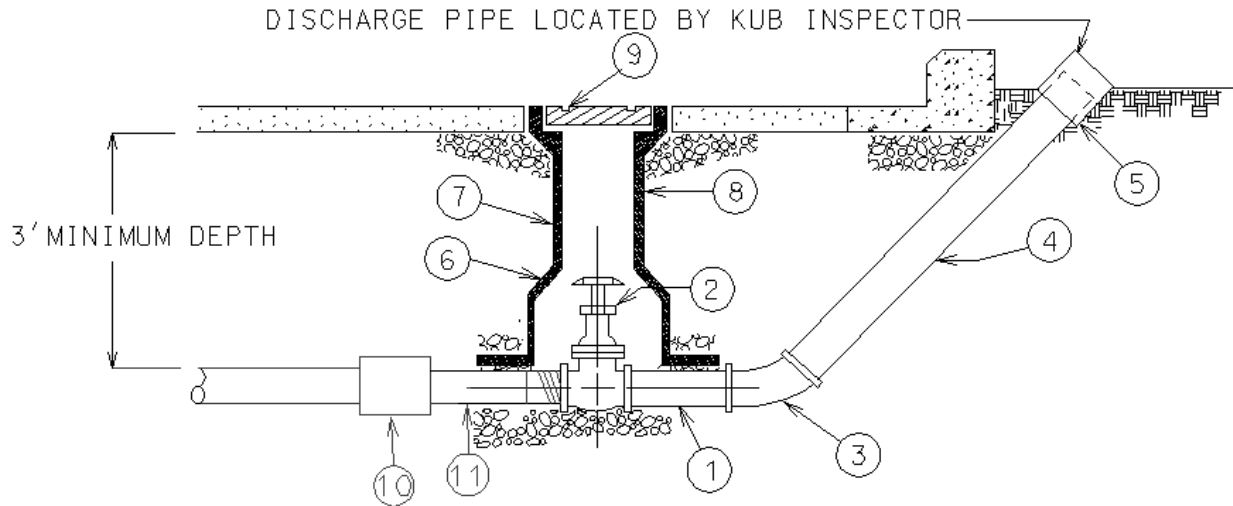


Figure 6-02512-f: 2" Blowoff - 2" HDPE Main

Notes:

- I. All material from main to the 45 shall be brass.
- II. Adjust valve box to grade.
- III. Blowoff to be located outside of asphalt when practical as directed by the OWNER.
- IV. Do not allow the valve box base to rest directly on the pipe or valve. Use blocks or brick to support the valve box base.
- V. Tracer wire shall be installed within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall be looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for 2" Blowoff - 2" HDPE Main

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	2	205260	2" x 6" Brass Nipple
2	1	205625	2" Brass Gate Valve
3	1	203448	2" Brass 45° Bend
4	1	294819	2" Galvanized Pipe
5	1	200075	2" Cap
6	1	294074	Valve Box Base
7	1	294058	Valve Box Bottom
8	1	294041	Valve Box Top Section
9	1	294041	Valve Box Water Lid
10	1	800713	2" Socket Fusion Coupling
11	1	800731	2" Transition Fitting – MPT x HDPE
12	1-Lot	290783	Bricks to support valve box base (not shown)
13	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

3.3 HYDRANTS

- A. Hydrants shall be in accordance with AWWA C502, the Materials Specifications, and as shown on the Standard Drawings. Hydrants shall open right or the clockwise direction.
- B. Hydrants shall be installed on a 6-inch branch with 6-inch gate valve. As shown on the in the standard drawings or in the project drawings.
- C. Hydrants shall be aligned vertically to the satisfaction of the OWNER. Hydrants shall be located no greater than 10 feet from the curb or edge of pavement or as directed by the OWNER.
- D. Hydrant shoes shall have 2 positive-acting noncorrodible drain valves that drain the hydrant completely by opening as soon as the main valve is closed. The drain valve shall close tightly when the main valve is open.
- E. Provide drainage at the base of the hydrant by placing coarse gravel or clean crushed stone at least 6 inches above the drain opening in the hydrant to a distance of 18 inches below the elbow. Connect no drainage system to a sanitary sewer.
- F. The gate valve shall be rodded to the tee on the main and to the hydrant shoe. Mega-lugs are acceptable substitutes to rods for ductile iron main installations.
- G. Tie rods and related hardware on all hydrants, if required, shall be stainless steel.
- H. Hydrant extensions shall be used when required to place the hydrant nozzles to the proper elevation (min. 6" above grade) as determined by the OWNER. Extensions shall be compatible with the fire hydrant being adjusted and shall have one set of shear bolts in the top flange and machine bolts in the bottom flange.
- I. Hydrants shall be placed as directed by the OWNER. Where practical the hydrant shall be located a minimum of 25 feet out of the turn radius of intersections or at property lines.
- J. Hydrants shall not be located more than 10 feet from the curb or edge of pavement, unless directed by the OWNER.
- K. Tracer wire shall be installed within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

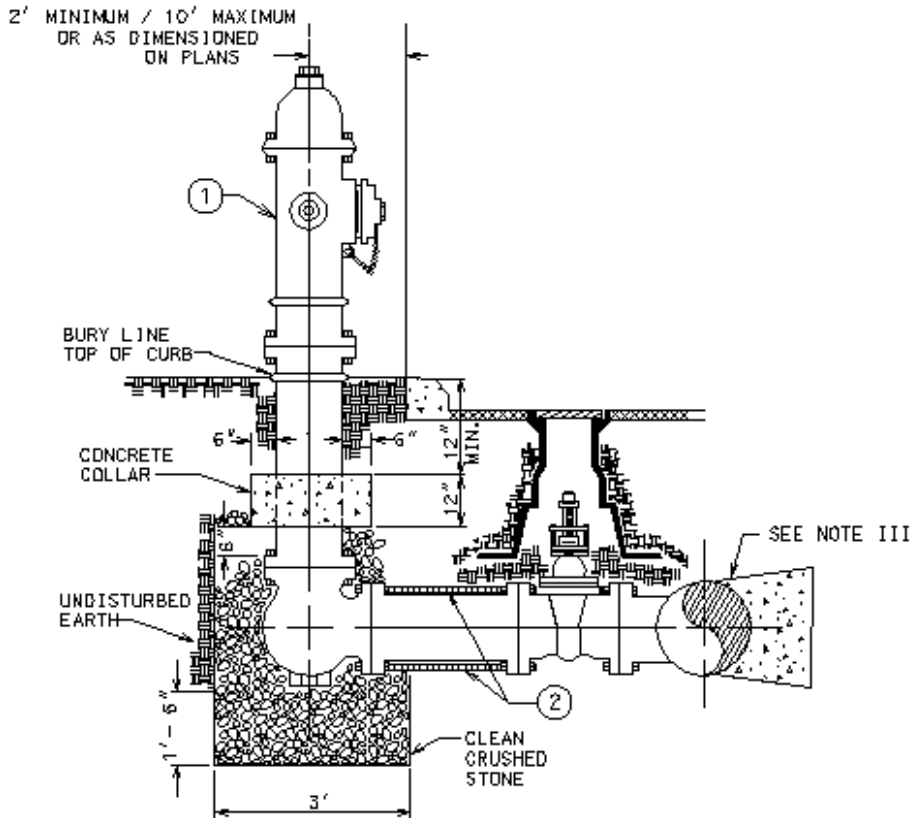


Figure 7-02512-g: Typical Installation of Fire Hydrant – Ductile Iron Mains

Notes:

- I. Concrete collar to be used if soil is loose or poor load bearing.
- II. Dig bell holes. Lay pipe on bottom of trench.
- III. The gate valve must be rodded to tee on main and separately to hydrant shoe. Place thrust blocking behind tee. (see Thrust Blocking 02513-5) Ductile Iron – Megalug; Cast Iron - Stainless Rods
- IV. Tie Rods and related hardware to be stainless steel.
- V. Hydrant type and material to be as directed by latest revision of standard specification.
- VI. Size of concrete thrust restraint to be determined by OWNER.
- VII. All hydrants shall be traffic type with bury line positioned as shown in section.
- VIII. Do not allow the valve box base to rest directly on the pipe or valve. Use blocks or brick to support the valve box base.
- IX. Tracer wire shall be installed within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Typical Installation of Fire Hydrant

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	294249	3 1/2 Foot Bury Hydrant
2	1	213280	3/4 All Thread Rod
		293118	4 1/2 Foot Bury Hydrant

12	1-Lot	290783	Bricks to support valve box base (not shown)
13	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

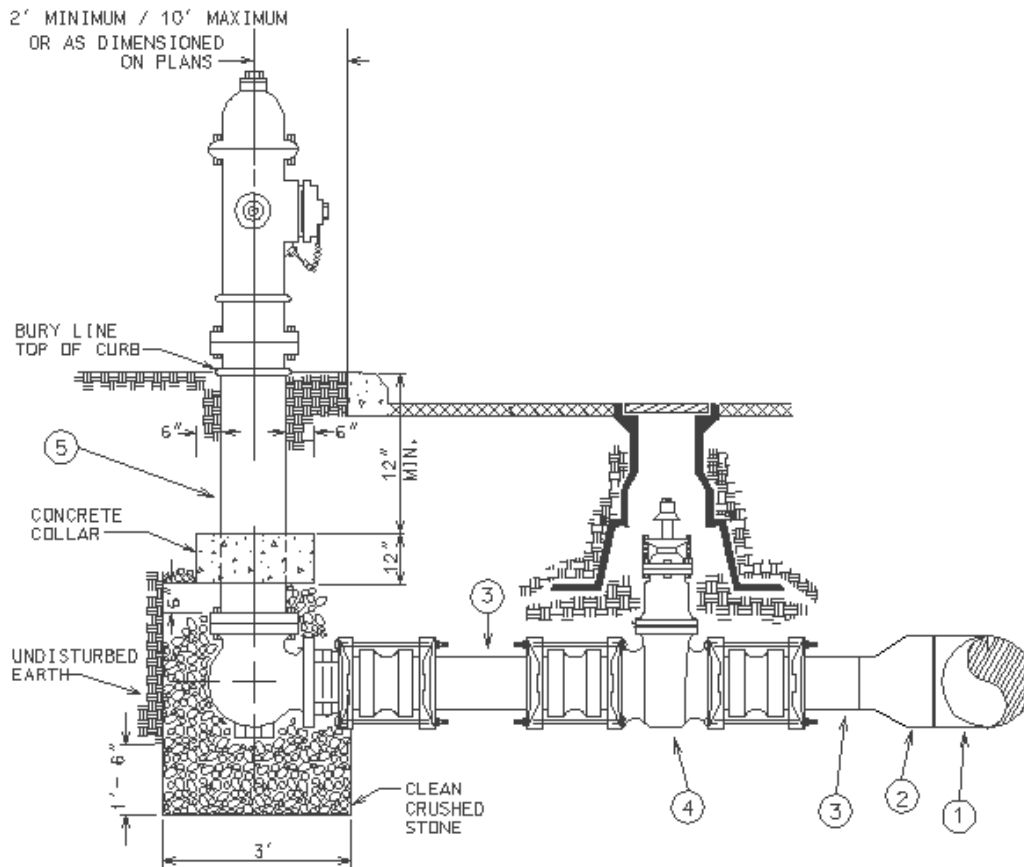


Figure 8-02512-h: Typical Installation of Fire Hydrant – HDPE Mains

Notes:

- I. Dig bell holes, lay pipe on bottom of trench.
- II. Concrete collar to be used if soil is loose or poor load bearing.
- III. Hydrant type and material to be as directed by latest revision of standard specification.
- IV. All hydrants shall be traffic type with bury line positioned as shown in section.
- V. Do not allow the valve box base to rest directly on the pipe or valve. Use blocks or brick to support the valve box base.
- VI. Tracer wire shall be installed within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Typical Installation of Fire Hydrant

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	200224	8" DIPS – HDPE Tee – Butt Fusion
2	1	200229	8"x 6" Reducer – Butt Fusion
3		200215	6" DIPS – HDPE Pipe
4	1	200706	6" Aquagrip Gate Valve
5	1	200700	3 1/2 Foot Bury Hydrant – Aquagrip
			4 1/2 Foot Bury Hydrant – Aquagrip
12	1-Lot	290783	Bricks to support valve box base (not shown)
13	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

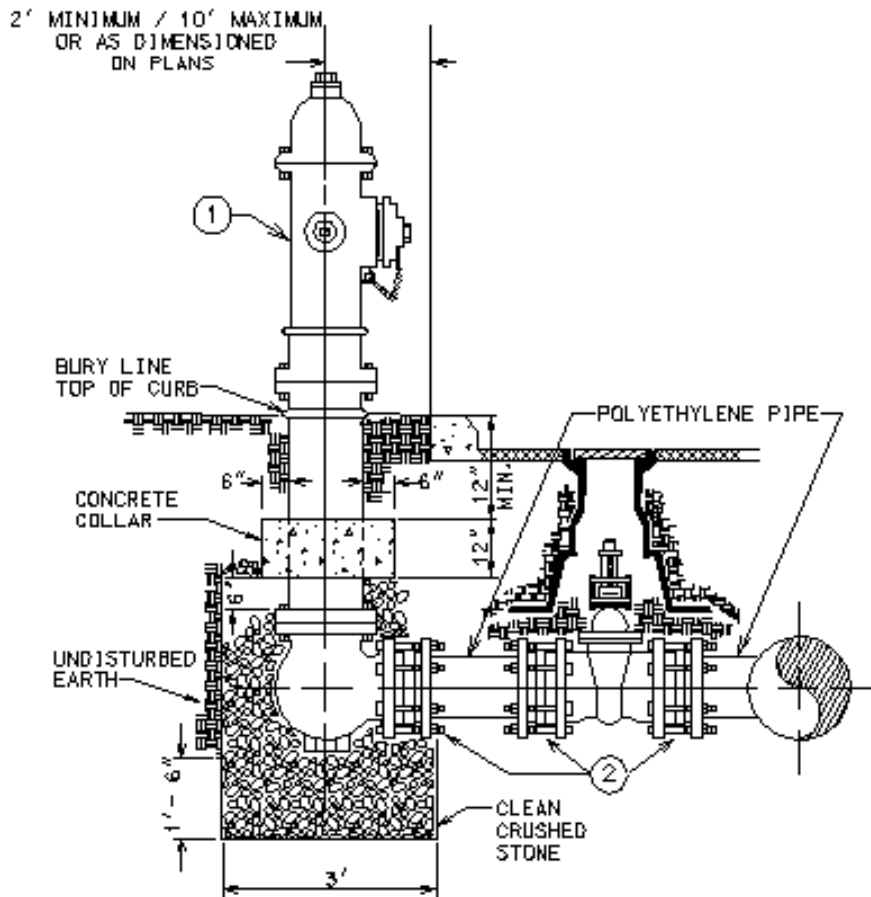




Figure 9-02512-i: Typical Installation of Fire Hydrant – HDPE Mains / MJ Adapters

Notes:

- I. Dig bell holes, lay pipe on bottom of trench.
- II. Mechanical Joint Adapters shall be used in order to restrain the hydrant and gate valve to the main.
- III. Hydrant type and material to be as directed by latest revision of standard specification.
- IV. Concrete collar to be used if soil is loose or poor load bearing.
- VII. All hydrants shall be traffic type with bury line positioned as shown in section.
- VIII. Do not allow the valve box base to rest directly on the pipe or valve. Use blocks or brick to support the valve box base.
- IX. Tracer wire shall be installed within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Typical Installation of Fire Hydrant

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	294249	3 1/2 Foot Bury Hydrant
2	2		6" MJ Adapter
		293118	4 1/2 Foot Bury Hydrant
3	1-Lot	290783	Bricks to support valve box base (not shown)
4	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

END OF SECTION

[HOME](#)



SECTION 02513
WATER LINES – INSTALLATION

PART 1. GENERAL

- 1.1 The work to be performed shall consist of the installation of water lines according to the specifications, other related standards sections and the Standard drawings.
- 1.2 Design drawings must be prepared and sealed by a Professional Engineer licensed by the State of Tennessee. Profile Drawings may be required as directed by the OWNER.
- 1.3 The CONTRACTOR shall be responsible for safely storing materials needed for the work until they have been incorporated into the completed project.

PART 2. PRODUCTS

- 2.1 The OWNER will inspect all materials at the site for conformance to the specifications. At the OWNER's discretion, the CONTRACTOR may be required to supply certified mill tests, samples, or other suitable forms of verification that the material meets the required specifications.
- 2.2 New Installation
 - A. Ductile iron pipe shall be in conformance with the latest revision of *ANSI/AWWA C151/A21.51 Standard*. The pipe shall be push-on joint with a minimum pressure class of 350 psi, cement-lined according to *ANSI 21.4/AWWA C-104*, and coated inside and outside with an asphaltic coating. Ductile iron pipe and fittings shall conform to the requirements of the Materials Specifications herein.
 - B. High Density Polyethylene (HDPE) pipe shall be HDPE 3408 and have a heat indented print line containing the information required in ASTM D3035. All HDPE pipe shall be in compliance with *NSF 61* and must be made by a pipe manufacturer that must be approved by the Owner before pipe installation. HDPE pipe must be designated for potable water use by having a minimum of three blue stripes extruded along the entire length of the pipe and also being equally spaced around the outside diameter of the pipe. Color print lines are not an acceptable method for color marking of pipe. Pipes larger than 2 inch shall be Ductile Iron Pipe Size (DIPS) in compliance with *AWWA C906* and *ASTM F 714*. Pipes 2 inch and less shall be Iron Pipe Size (IPS) in compliance with *AWWA C901* and *ASTM D3035*. HDPE pipe 2 inch and larger shall be SDR 11 and pipe smaller than 2 inches shall be SDR 9.

- C. Copper pipe (2-inch diameter) shall be Type-K copper, annealed, and meeting *ASTM B88*, latest revision. The pipe shall be furnished in 20-foot straight laying lengths, and in conformance with the Materials Specifications herein.

2.3 Maintenance / Connection to Existing Facilities

- A. PVC pipe (2-inch diameter) and fittings shall be NSF-Approved Class 250. The pipe shall be manufactured from Class 12454-B polyvinyl chloride plastic (PVC 1120) as defined by *ASTM D1784*, and in accordance with *ASTM D2241* and the Materials Specifications herein.

PART 3. EXECUTION

3.1.1 3.1 GENERAL REQUIREMENTS

- A. All water lines greater than 2 inches in diameter shall be ductile iron or HDPE pipe. Water lines 2 inches in diameter shall be approved by the OWNER and shall be copper or HDPE pipe under roadway pavement or in bores and tunnels.
- B. All ductile iron and HDPE pipe shall be installed with a blue coated 12-gauge copper clad steel tracer wire, which shall be extended above ground 3 to 4 feet in valve boxes as directed by the OWNER. The tracer wire should be laid 6 inches above the pipe and should not come in direct contact with the HDPE pipe. Tracer wire connections shall be as directed by the OWNER.
- C. Water lines shall be installed as shown in the standards unless otherwise shown on the project drawings.
- D. Timing and procedures of pipe installations, valve closings, temporary services, tie-ups, and interruption of services shall be approved by and coordinated with the OWNER. Contractor shall request OWNER approval at a minimum of 72 hours notice prior to any tie-ins to existing water lines. The OWNER may require that the work be performed during non-business hours if necessary to maintain services.
- E. Unless otherwise indicated by the drawings, all water lines shall have at least 36 inches of cover from the top of the pipe. The OWNER shall approve all exceptions.
- F. The maximum trench width for water line installations shall be 24 inches for 6- and 8-inch lines, 30 inches for 10- and 12-inch lines, 36 inches for 16- and 24-inch lines, and 54 inches for 30-inch lines. Trench widths for larger sizes shall be approved by the OWNER. Minimum trench widths must be achieved to ensure

proper backfilling around the pipe and to allow inspection of HDPE pipe sidewalls and trench bottom contour.

- G. The CONTRACTOR shall provide and use tools and facilities that are satisfactory to the OWNER and that will allow the work to be done in a safe and convenient manner. All pipe, fittings, valves, and hydrants are to be unloaded from the trucks using suitable tools and equipment. A derrick, ropes, or other suitable tools or equipment shall be used to lower all pipe, fittings, valves, and hydrants into the trench one piece at a time. Each piece shall be lowered carefully so that neither it nor any protective coating or lining will be damaged. Under no circumstances shall water line materials be dropped or dumped.
- H. Every precaution shall be taken to keep foreign material from getting into the pipe while it is being installed. No debris, tools, clothing, or other materials shall be placed in the pipe during laying operations.
- I. Whenever pipe laying is not in progress, the open ends of the pipe shall be closed either with a watertight plug or by other means approved by the OWNER.
- J. Wherever pipe must be deflected from a straight line, (in either the vertical or horizontal plane) in order to avoid obstructions or plumb stems, or wherever long radius curves are permitted, the amount of deflection shall neither exceed that necessary for the joint to be satisfactorily made, nor exceed that recommended by the pipe manufacturer and shall be approved by the OWNER. Bend fittings shall only be used when the pipe deflections are inadequate, according to manufacturer's recommendations, or as directed by the OWNER.
- K. No pipe shall be installed in water or when it is the OWNER's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, its use is considered incidental to the project.
- L. Water lines shall be designed with a 10-foot horizontal separation from any existing or proposed sewer main. If this is not practical, the water main may be placed closer than 10 feet from a sewer main, provided it is laid in a separate trench and that the elevation of the top of the sewer is at least 18 inches below the bottom of the water main, or as directed by the OWNER.
- M. Where a water main crosses over a sewer, the top of the sewer shall be at least 18 inches below the bottom of the water main. If the elevation of the lines cannot be adjusted to meet the 18-inch separation, then the water main shall be constructed with ductile iron pipe for a distance of 10 feet on either side of the sewer, with a full pipe section centered over the sewer, or as directed by the OWNER.

- N. All water distribution mains shall be flushed prior to inspection as specified below to assure complete removal of all debris and foreign material.
- P. On water lines to be abandoned, all water appurtenances shall be removed to a minimum depth of 6 inches below the proposed grade and backfilled in accordance with Section 02321 herein.

3.2 Ductile Iron Mains

- A. After a length of ductile iron pipe has been placed in the trench, the spigot end shall be centered in the bell of the adjacent pipe and then inserted to the depth specified by the manufacturer.
- B. Bell holes, when required, shall be big enough so that there is ample room for the pipe joints to be properly made. The trench shall be carefully graded so that the pipe barrel will rest on a solid foundation for its entire length. Pipe shall be laid and continuously supported on undisturbed or well-compacted soil. Pipe shall not be supported by blocks or allowed to rest on rocks or any other material that could cause shearing stresses on the pipe during backfill. All backfilling shall be in accordance with Section 02321 herein.
- C. Pipe shall be cut so that valves, fittings, or closure pieces can be inserted in a neat and workman-like manner and without any damage to the pipe. The manufacturer's recommendations shall be followed to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipes axis. For cast iron pipe, hydraulic cutters or a carborundum saw shall be used. A carborundum saw shall be used for ductile iron pipe. The OWNER may consider other methods for 12-inch diameter and larger pipe.
- D. Pipe shall be installed with the bell ends facing in the direction of laying unless otherwise directed by the OWNER.

3.3 High Density Polyethylene (HDPE)

- A. Prior to installing pipe through a bored hole, ensure that the size of the hole is of sufficient diameter to prevent pipe stress during installation. The leading end of the pipe to be inserted shall be closed to prevent the entrance of dirt and debris. After insertion, the leading end of the pipe shall be examined in the exit bell hole to ensure that the pipe has not been damaged during insertion. Damaged pipe shall be replaced after corrective measures have been taken to prevent damage to the replacement pipe.
- B. HDPE pipe shall be handled using canvas or nylon slings. If a forklift is to come in direct contact with HDPE pipe, the forks shall be padded. HDPE pipe shall be

stored in a manner, which minimizes crushing or bending. HDPE pipe should lay flat and be stacked no higher than 84 inches. HDPE pipe coils shall not be stored in a vertical position. HDPE pipe shall be transported and stored so that it does not come in contact with debris or materials that could cause damage to the pipe.

- C. Any pipes placed along the route of the proposed lines before the actual installation of the lines shall not be lowered into the trench until they have been swabbed to remove any mud, debris, etc., that may have accumulated within them. Pipe shall be placed along the route a maximum of one day ahead of pipe laying. All unnecessary material shall be removed from the bell and spigot end of each pipe. Before any pipe is laid, the outside of its spigot end and the inside of its bell shall be cleaned and left dry and oil free. HDPE pipe shall be inspected prior to fusion and prior to lowering the pipe into the trench to ensure that the pipe does not contain any debris. The pipe shall be cleaned if necessary to remove debris.
- D. Pipe shall be inspected prior to and after lowering into the trench for any damage. HDPE pipe shall be carefully inspected for cuts, gouges, deep scratches, or other defects. Any segment containing defects shall be removed and replaced. HDPE pipe shall not be used if gouges or cuts are greater than 10 percent of the wall thickness. When lowering HDPE pipe into the trench, the pipe shall not be subjected to excessive twisting and bending stresses. Allow for contraction of small diameter HDPE pipe by “snaking” the pipe from side to side in the trench.
- E. All pipe shall be joined in the exact manner specified by the manufacturers of the pipe and joining materials.
- F. HDPE fusion joints shall be allowed to cool for the required time. The CONTRACTOR shall be qualified to perform HDPE fusion by the product manufacturer and shall provide proof of qualification prior to beginning work.

3.4 HDPE PIPE JOINING – PROCEDURES AND QUALIFICATIONS

- A. HDPE pipe must be joined using a qualified joining procedure and by persons qualified on that procedure.
- B. HDPE shall be joined using butt fusion, unless otherwise approved by owner. All mains and services shall be butt fused, unless otherwise approved by owner. Fusion shall take place in weather conditions acceptable to the OWNER.
- C. Procedure Qualification - all joining methods for polyethylene pipe be qualified. The polyethylene pipe manufacturers have developed qualified procedures for heat fusion of HDPE pipe. KUB has adopted the Plexco Pipe procedure for all

saddle and butt fusion of polyethylene pipe and fittings. KUB has adopted Central Plastics Procedures for electrofusion. All heat fusion joints will be visually inspected to determine if they have the same appearance as a joint properly made under the qualified procedure.

- D. Joiner Qualification - persons making either heat fusion or mechanical joints shall be qualified using applicable joining procedures mentioned above. Each person will be required to qualify for each of the joints they are expected to make. The qualifying procedure for polyethylene pipe joiners will consist of :
 1. Training and experience with the qualified procedure.
 2. Making a specimen joint according to the qualified procedure.
 3. Visual inspection of the specimen joint to determine if it has the same appearance as a joint properly made under the qualified procedure.
 4. For heat fusion joints, three longitudinal straps, 1 inch wide, cut from the joint will be examined for defects and then deformed by back bend, root bend, or torque. If failure indicates outside the joined area, the joint is acceptable.
 5. For service saddle tee fusion, the test specimen will be secured and struck with a 3 lb. hammer.
- E. Qualification of persons making joints for each procedure will remain effective for 1 year from the date of testing, unless the OWNER requires more frequent retraining due to quality of joints completed.
- F. CONTRACTOR fusion training shall be completed by a manufacturer or manufacturer representative acceptable to the OWNER. CONTRACTOR shall provide proof of training acceptable to the OWNER.
- G. All personnel performing plastic pipe fusion shall at all times while performing the fusion have readily available on the job site proof of qualification from the manufacturer or other acceptable training company.
- H. Mechanical couplings designed for use in HDPE piping systems have qualified installation procedures developed by the manufacturers. These procedures shall be followed for installation. All field mechanical joints will be visually inspected to determine if they have the same appearance as a joint properly made under the qualified procedure. All mechanical couplings used in plastic piping systems shall be designed to resist pullout.
- I. Aqua-grip or other OWNER approved fittings shall be used for wet tie-ins.

3.5 THRUST BLOCKS / THRUST RESTRAINT

- A. Thrust blocks shall be installed on ductile iron pipe wherever the water main changes direction (at tees and bends), at dead ends, or at any other point recommended by the manufacturer or required by the OWNER. Thrust blocks shall be considered an integral part of the water line work. Where thrust blocking is inadequate or inappropriate, tie rods shall be installed. Non-fusion type HDPE joints shall be restrained using approved mechanical joint adapters listed in the approved materials for HDPE installations. Compaction standards shall be strictly enforced near HDPE fittings. Backfill material near HDPE fittings shall be crushed stone, Class A Aggregate Grading D, as specified in *Section 903.05* of the Tennessee Department of Highways' *Standard Specifications for Road and Bridge Construction, March 1, 1995* (pug mix), placed in 8-inch lifts and compacted to 100 percent of the Standard Proctor density at 2 percent less than the optimum moisture content as determined by *AASHTO T99-81*.

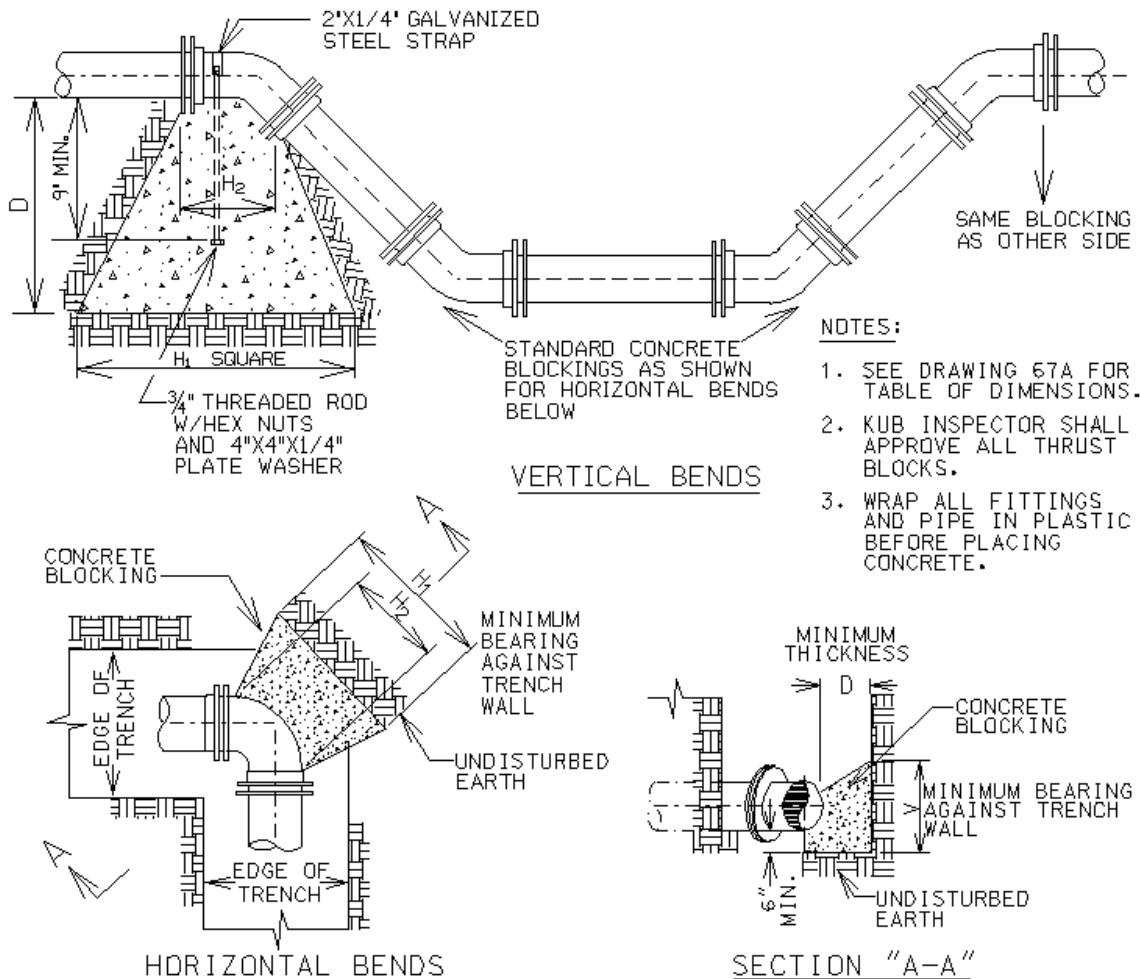
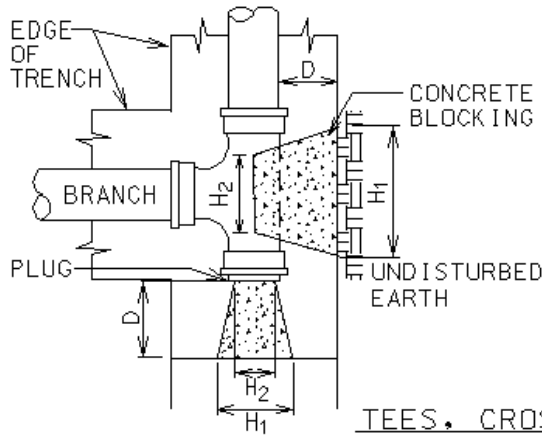


Figure 1-02513-a (Thrust Block Details)



NOTES:

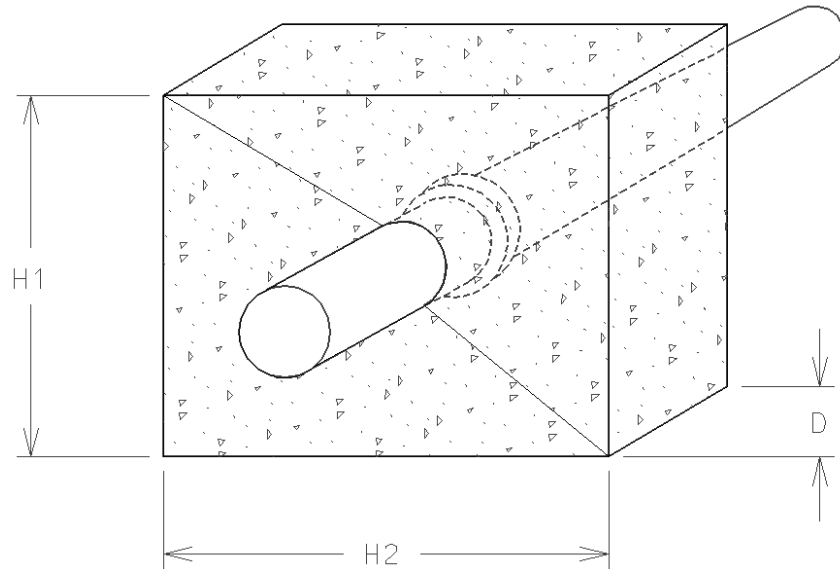
1. DIMENSIONS FOR TEES, CROSSES, AND PLUGS ARE CONTROLLED BY DIAMETER OF BRANCH MAIN.
2. KUB INSPECTOR MUST APPROVE ALL THRUST BLOCKS.
3. WRAP ALL FITTINGS & PIPE IN PLASTIC BEFORE PLACING CONCRETE.

TEES, CROSSES & BENDS

TABLE OF DIMENSIONS FOR CONCRETE BLOCKING																															
SIZE	TEES, PLUGS CROSSES					90° BENDS					45° BENDS					22½° BENDS					11¼° BENDS					SIZE					
PIPE	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	PIPE					
2&2 1/4	18	10	12	18	1.9	18	10	12	18	1.9	18	6	12	18	1.5	18	6	12	18	1.5	18	6	12	18	1.5	18	6	12	18	1.5	2&2 1/4
3&4	24	12	12	18	2.3	24	12	12	18	2.3	18	8	12	18	1.6	18	8	12	18	1.6	18	8	12	18	1.6	18	8	12	18	1.6	3&4
6	24	16	18	18	3.5	30	16	18	18	4.1	24	10	16	18	3.2	24	10	16	18	3.2	24	10	16	18	3.2	24	10	16	18	3.2	6
8	36	18	18	18	5.1	39	18	24	18	7.3	30	11	18	18	4.0	24	11	18	18	3.5	24	11	16	18	3.4	24	11	16	18	3.4	8
10	48	24	18	24	7.2	54	32	24	18	10.3	24	18	21	18	4.6	24	18	21	18	4.6	24	18	21	18	4.6	24	18	21	18	4.6	10
12	54	30	24	24	13.4	54	32	36	24	18.2	42	18	24	24	9.6	24	18	24	24	6.6	24	18	21	24	6.1	24	18	21	24	6.1	12
14	60	32	30	24	17.9	60	40	42	24	25.0	44	24	30	24	13.2	30	24	24	24	9.2	27	21	24	24	7.9	24	21	24	24	7.9	14
16	60	34	36	24	22.5	69	48	48	24	29.0	48	30	36	24	17.0	36	30	27	24	11.8	27	24	27	24	9.1	24	27	24	24	9.1	16
18	72	36	40	24	30.0	72	48	60	24	38.0	48	30	42	24	21.0	42	30	30	24	15.0	30	30	36	24	13.0	24	30	36	24	13.0	18
20	84	38	42	24	36.0	84	48	66	24	48.0	54	40	46	24	27.0	48	36	36	24	19.0	42	40	36	24	18.0	24	40	36	24	18.0	20
24	108	42	48	24	45.0	108	60	72	24	68.0	60	48	56	24	41.0	54	42	42	24	25.0	48	42	42	24	23.0	24	42	42	24	23.0	24
30	132	52	60	24	70.0	132	72	92	24	104	72	48	76	24	58.0	60	48	48	24	32.0	54	48	54	24	32.0	24	54	54	24	32.0	30
36	162	58	72	24	100	162	96	108	24	150	84	72	84	24	85.0	66	72	60	24	50.0	60	48	60	24	40.0	24	60	60	24	40.0	36

DIMENSIONS IN TABLE ARE IN INCHES.

Figure 2-02513-b (Thrust Block Details and Table of Dimensions)



HDPE Pipe Size	H1	H2	D	Cubic Ft
2"	18"	18"	24"	4.5
4"	18"	24"	24"	6.0
6"	24"	24"	24"	8.0
8"	36"	36"	24"	18.0

Figure 3-02513-c: (Concrete Thrust Restraint and Table of Dimensions - HDPE Pipe)

Notes:

- I. All pipe and fittings in contact with concrete thrust restraint blocks should be wrapped in plastic sheeting, minimum 6-mil thickness.
 - II. Concrete thrust restraints for HDPE pipe shall be installed when transitioning from HDPE pipe to sections of unrestrained slip joint pipe as shown on the project drawings or as directed by the OWNER.
- B. Megalugs and restraint joint gaskets with an OWNER approved manufacturer design may be used in place of, or in addition to concrete thrust restraints with prior approval of the OWNER.

3.6 CLEAN UP

After completing each section of water line, all debris and construction materials shall be removed from the work site. Then the surface shall be graded and smoothed on both sides of the line. The entire area shall be left clean and in a condition satisfactory to the OWNER. The CONTRACTOR shall keep clean-up operations as close to active pipe laying as practical, generally following by less than 300 feet, or as approved by the OWNER.

SECTION 02514
WATER LINES - VALVES

PART 1. GENERAL

- 1.1 This section covers valves for water lines specified under Sections 2512, 2513, 2515 and 2518.
- 1.2 Valves in water mains shall, where possible, be located on the street property lines extended, unless otherwise directed by the OWNER.
- 1.3 The direction of opening for all valves larger than 2-inch shall be clockwise (open right) as viewed from the top. Valves 2 inch and smaller shall open counter clockwise (open left).
- 1.4 The operating nut shall be maximum 48 inches below the finished grade. Valve extensions shall be used if the operating nut is over 4 feet below the finished grade.
- 1.5 Tracer wire shall be installed within the valve box or manhole, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.
- 1.6 Disposal of all valves shall be at the discretion of the OWNER.
- 1.7 Valves shall be operated by the OWNER only.

PART 2. PRODUCTS

- 2.1 All products and materials utilized in the execution of the work described herein shall meet or exceed the specified characteristics provided herein. All products and materials must be equal to those specified in Section 02080, Water/Wastewater material available for review at kub.org/standards or available for review at KUB/Procurement 4505 Middlebrook Pike.

PART 3. EXECUTION

3.0 GENERAL DRAWINGS (See Figure 1-02512-d)

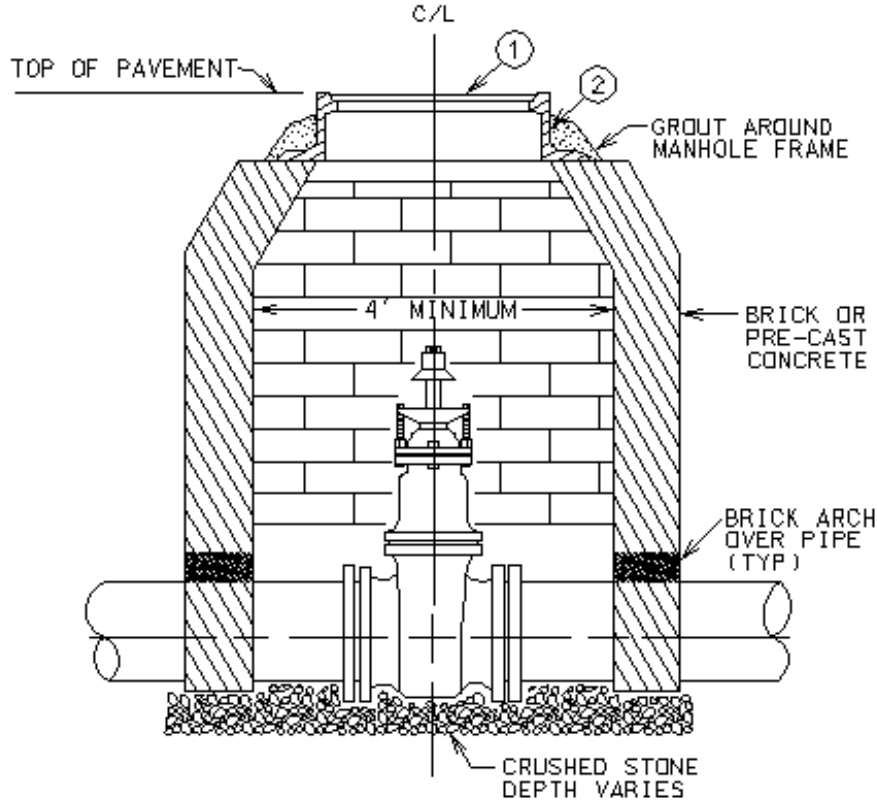


Figure 1-02514-a: Manhole for Valve Installation

Notes:

- I. Manhole used only when directed by OWNER.
- II. Tracer wire shall be installed within the valve box or manhole, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Manhole Valve Installation

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	800020	Water Manhole Lid
2	1	800300	Manhole Ring
3			Manhole Cone Section
4			Manhole Riser Sections
5	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

3.1 GATE VALVES

- A. Gate valves shall be installed on all fire lines and on distribution lines smaller than 16 inch, or as directed by the OWNER. Butterfly valves shall be installed on lines 16" and larger or as directed by OWNER.
- B. Gate valves larger than 2 inches shall be resilient seated, manufactured to meet or exceed the requirements of AWWA C509 of latest revision or AWWA C515 and in accordance with the materials specifications herein.
- C. Gate valves 2 inches or smaller shall be wedge-type brass gate valves in accordance with the Materials Specifications herein.
- D. Gate valves and HDPE valves shall be installed in valve boxes as shown on the Standard Drawings.

3.2 HDPE VALVES

- A. Valves on 2 inch HDPE shall be AWWA approved, full open HDPE ball valves with blue 2 inch square operating nuts. Valves shall be ¼ turn, left open, in accordance with KUB material specifications.
- B. Valves on HDPE larger than 2 inch shall be approved gate valves.

3.3 BUTTERFLY VALVES

- A. Butterfly valves shall be installed on lines 16" and larger or as directed by the OWNER.
- B. Butterfly valves shall meet or exceed the requirements of AWWA C504 of latest revision and shall be in accordance with the Materials Specifications herein.
- C. Butterfly valves shall be installed in valve boxes as shown on the Standard Drawings.
- D. The CONTRACTOR will be responsible to ensure the MJ adapters used to connect the HDPE main to the butterfly valve are used. The MJ adapters are to be specifically designed for the type of Butterfly valve being installed and proper clearance of the butterfly valve disc shall be provided.

3.4 TAPPING VALVES

- A. Tapping valves 12 inches and smaller shall conform to AWWA C509 of latest revision or AWWA C515 and the Materials Specifications covering gate valves except as modified for passage and clearance of tapping machine cutters.
- B. Tapping valves larger than 12 inches shall conform to AWWA C500 of latest revision and the Material Specifications covering gate valves except as modified for passage and clearance of tapping machine cutters.
- C. Tapping sleeves and valves shall be subjected to a pressure test while in place on the existing water line, prior to the existing line being tapped. The tapping sleeve and valve shall be subjected to a hydrostatic pressure equal to the normal working pressure (but not less than 200 psi) for a period of 15 minutes. The connection being tested shall maintain 100 percent of the test pressure throughout the test period. The CONTRACTOR shall supply all necessary equipment for testing sleeves. Other details of the test shall be as directed by the OWNER.
- D. Taps shall be dry or under pressure as directed by the OWNER.

3.5 VALVE BOXES

- A. Valve boxes shall be in accordance with the Materials Specifications and as shown on the Standard Drawings.
- B. Valve boxes shall be installed with the opening centered over the valve-operating nut.
- C. The bottom of the base section of the valve box shall be at or below the bottom of the operating nut on the valve.
- D. Do not allow the valve box base to rest directly on the pipe or valve. Use blocks or brick to support the valve box base.
- E. Condemn valves by removing the top section of the valve jacket, filling with gravel and repairing asphalt.
- F. Tracer wire shall be installed within the valve box or manhole, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

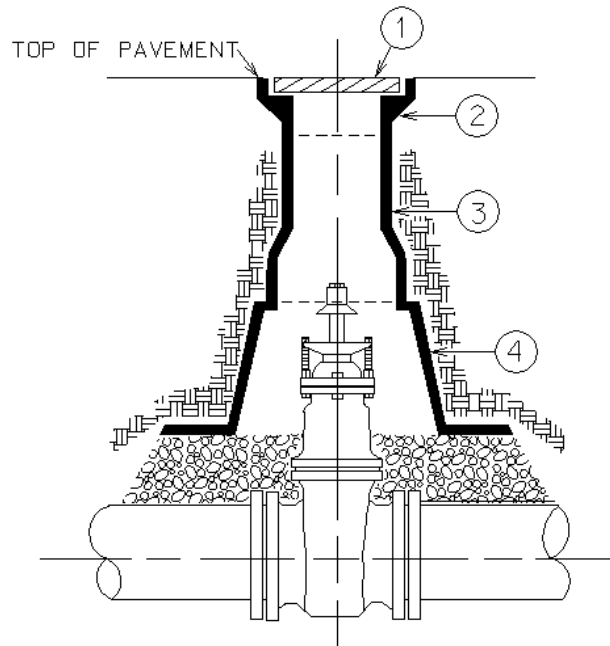


Figure 2-02514-b: Valve Box for Valve Installation

Notes:

- I. Adjust top section of valve box to grade.
- II. Base section of valve box must rest on specified material.
- III. Valve box to be centered over valve operator and installed in vertical plane.
- IV. Do not allow the valve box base to rest directly on the pipe or valve. Use blocks or brick to support the valve box base.
- V. Tracer wire shall be installed within the valve box or manhole, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall be looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List Valve Box for Valve Installation

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	294082	Water Valve Box Lid
2	1	294041	Water Valve Box Top Section
3	1	294058	Water Valve Box Bottom Section
4	1	294074	Valve Box Base
5	1-Lot	290783	Bricks to support valve box base (not shown)
6	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

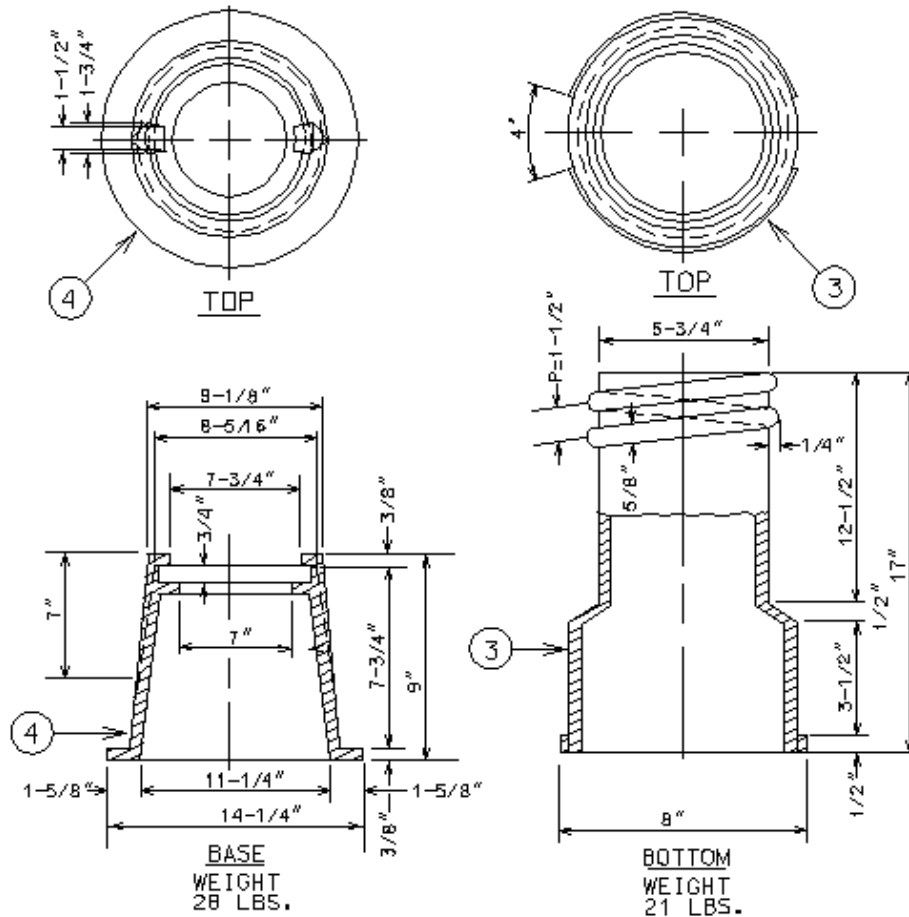


Figure 3-02514-c: Valve Box

Material List for Valve Box

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	294082	Valve Box Water Lid
2	1	294041	Valve Box Top Section
3	1	294058	Valve Box Bottom Section
4	1	294074	Valve Box Base

END OF SECTION

[HOME](#)

SECTION 02515
WATER LINE TIE-INS

PART 1. GENERAL

1.1 This section covers tie-in details for water lines specified under Sections 02512, 2513 and 2514.

1.2 Disposal of all materials removed from service shall be at the discretion of the OWNER.

1.3 REFERENCE DRAWING & MATERIAL LIST:

Description	Drawing	Page
2" Copper to 2 inch HDPE	Figure 1-2515-a	2
2" PVC to 2" HDPE	Figure 2-2515-b	3
Existing 2" HDPE to 2" HDPE	Figure 3-2515-c	4
2" HDPE to 6" / 8" / 12" PVC	Figure 4-2515-d	5
2" HDPE to 6" / 8" / 12" DI/CI/ AC	Figure 5-2515-e	6
2" HDPE to 8" / 12" HDPE	Figure 6-2515-f	7
2" HDPE to 6" / 8" / 12" DI/ CI	Figure 7-2515-g	8
8" HDPE to 8 " DI/ CI - End of Line	Figure 8-2515-h	9

PART 2. PRODUCTS

2.1 All products and materials utilized in the execution of the work described herein shall meet or exceed the specified characteristics provided herein. All products and materials must be equal to those specified in Section 02080, Water/Wastewater material available for review at www.kub.org/standards or available for review at KUB/Procurement 4505 Middlebrook Pike.

PART 3. HDPE PIPE JOINING – PROCEDURES AND QUALIFICATIONS

- A. HDPE pipe must be joined using a qualified joining procedure and by persons qualified on that procedure.
- B. HDPE shall be joined using butt fusion, unless otherwise approved by owner. All mains and services shall be butt fused, unless otherwise approved by owner. Fusion shall take place in weather conditions acceptable to the OWNER.
- C. Procedure Qualification - all joining methods for polyethylene pipe be qualified. The polyethylene pipe manufacturers have developed qualified procedures for heat fusion of HDPE pipe. KUB has adopted the Plexco Pipe procedure for all saddle and butt fusion of polyethylene pipe and fittings. KUB has adopted Central Plastics Procedures for electrofusion. All heat fusion joints will be visually inspected to determine if they have the same appearance as a joint properly made under the qualified procedure.
- D. Joiner Qualification - persons making either heat fusion or mechanical joints shall be qualified using applicable joining procedures mentioned above. Each person will be required to qualify for each of the joints they are expected to make. The qualifying procedure for polyethylene pipe joiners will consist of :
 - 1. Training and experience with the qualified procedure.
 - 2. Making a specimen joint according to the qualified procedure.
 - 3. Visual inspection of the specimen joint to determine if it has the same appearance as a joint properly made under the qualified procedure.
 - 4. For heat fusion joints, three longitudinal straps, 1 inch wide, cut from the joint will be examined for defects and then deformed by back bend, root bend, or torque. If failure indicates outside the joined area, the joint is acceptable.
 - 5. For service saddle tee fusion, the test specimen will be secured and struck with a 3 lb. hammer.
- E. Qualification of persons making joints for each procedure will remain effective for 1 year from the date of testing, unless the OWNER requires more frequent retraining due to quality of joints completed.
- F. CONTRACTOR fusion training shall be completed by a manufacturer or manufacturer representative acceptable to the OWNER. CONTRACTOR shall provide proof of training acceptable to the OWNER.
- G. All personnel performing plastic pipe fusion shall at all times while performing the fusion have readily available on the job site proof of qualification from the manufacturer or other acceptable training company.

- H. Mechanical couplings designed for use in HDPE piping systems have qualified installation procedures developed by the manufacturers. These procedures shall be followed for installation. All field mechanical joints will be visually inspected to determine if they have the same appearance as a joint properly made under the qualified procedure. All mechanical couplings used in plastic piping systems shall be designed to resist pullout.

- I. Aqua-grip or other OWNER approved fittings shall be used for wet tie-ins.

PART 4. EXECUTION

3.0 GENERAL DRAWINGS

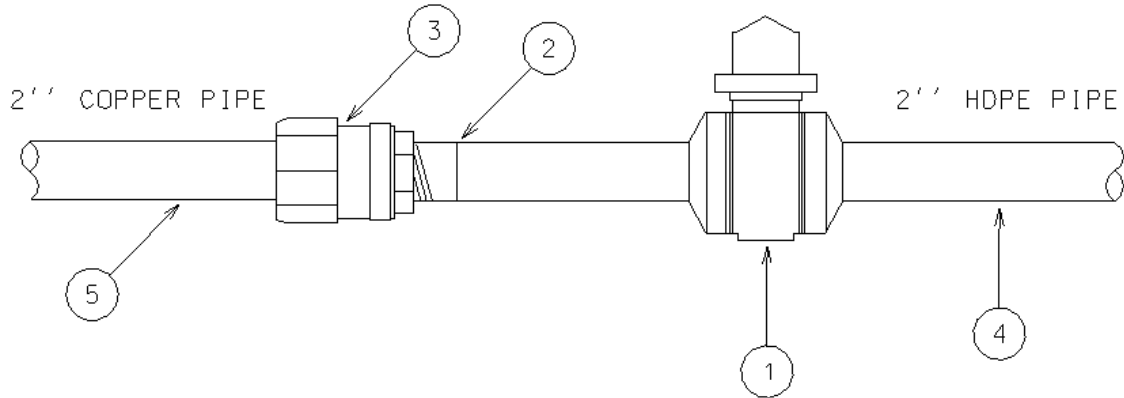


Figure 1-02515-a : Main Connection – 2 inch Copper to 2 inch PVC

Notes:

- I. Valve jacket to be installed as shown in section 2514 - 3.4.
- II. Backfill around valve shall be compacted.
- III. Tracer wire shall be installed 6 inches above the main and within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Main Connection – 2 inch Copper to 2 inch HDPE

Item	Quantity	KUB Item #	Description
1	1	200217	2" IPS AWWA - HDPE Ball Valve
2	1	800731	2" Transition Fitting – MPT x HDPE
3	1	205161	2" Brass Coupling – FPT x Compression
4		200214	2" HDPE Water Pipe
5		290668	2" Copper Water Pipe
6	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

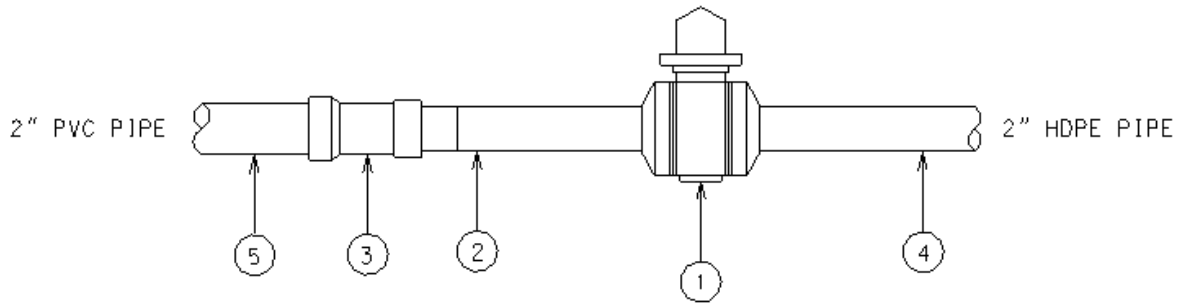


Figure 2-02515-b : Main Connection – 2 inch HDPE to 2 inch PVC

Notes:

- I. Valve jacket to be installed as shown in section 2514 - 3.4.
- II. HDPE pipe shall be restrained as required in section 2513.
- III. Backfill around valve shall be compacted.
- IV. Tracer wire shall be installed 6 inches above the main and within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Main Connection – 2 inch PVC to 2 inch HDPE

Item	Quantity	KUB Item #	Description
1	1	200217	2” IPS AWWA – HDPE Ball Valve
2	1	800731	2” Transition Fitting – MPT x HDPE
3	1	205161	2” Transition Fitting – FPT x PVC slip joint
4		200214	2” HDPE Water Pipe
5		295899	2” PVC Water Pipe
6	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

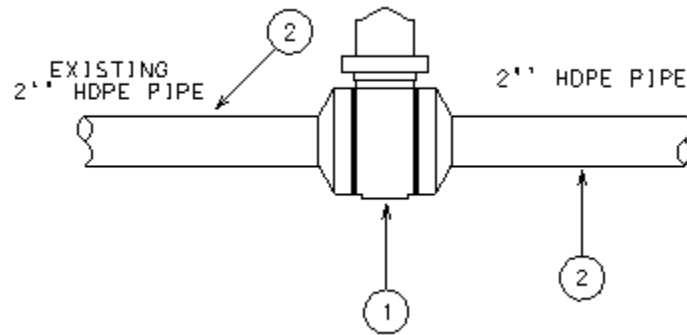


Figure 3-02515-c : Main Connection – Existing 2 inch HDPE to 2 inch HDPE

Notes:

- I. Valve jacket to be installed as shown in section 2514 - 3.4.
- II. Backfill around valve shall be compacted.
- III. Tracer wire shall be installed 6 inches above the main and within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Main Connection – Existing 2 inch HDPE to 2 inch HDPE

Item	Quantity	KUB Item #	Description
1	1	200217	2" IPS AWWA - HDPE Ball Valve
2		200214	2" HDPE Water Pipe
3	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

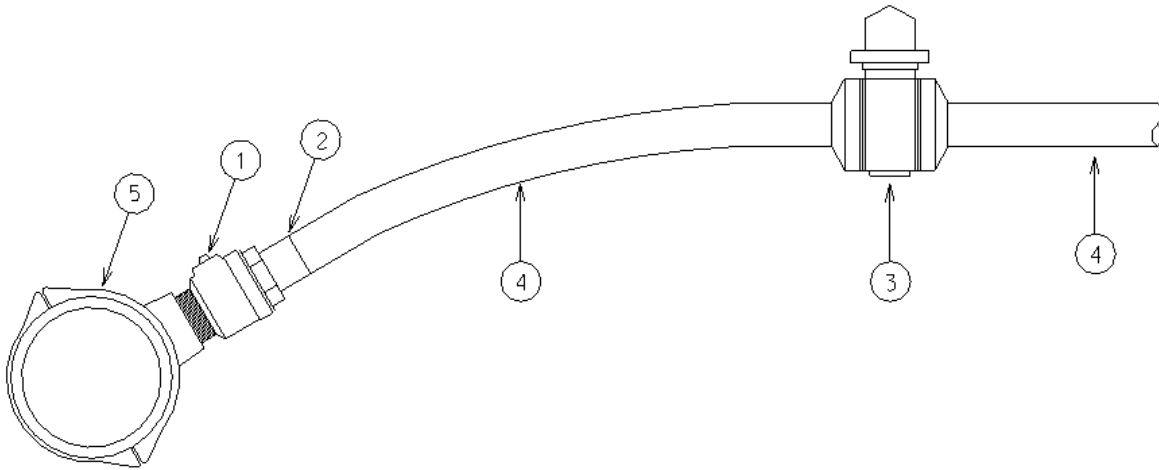


Figure 4-02515-d : Main Connection – 2 inch HDPE to 6-12 inch PVC

Notes:

- I. Valve jacket to be installed as shown in section 2514- 3.4.
- II. Backfill around tapping tee and valve shall be compacted.
- III. Tracer wire shall be installed 6 inches above the main and within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Main Connection – 2 inch HDPE to 6, 8 & 12 inch PVC

Item	Quantity	KUB Item #	Description
1	1	202796	2" Corporation Stop
2	1	800731	2" Transition Fitting – MPT x HDPE
3	1	200217	2" IPS AWWA - HDPE Ball Valve
4		200214	2" HDPE Water Pipe
5		Non-Stock	8" PVC x 2" FPT - Bronze Tapping Saddle
		200218	6" PVC x 2" FPT - Bronze Tapping Saddle
		Non-Stock	12" PVC x 2" FPT - Bronze Tapping Saddle
6	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

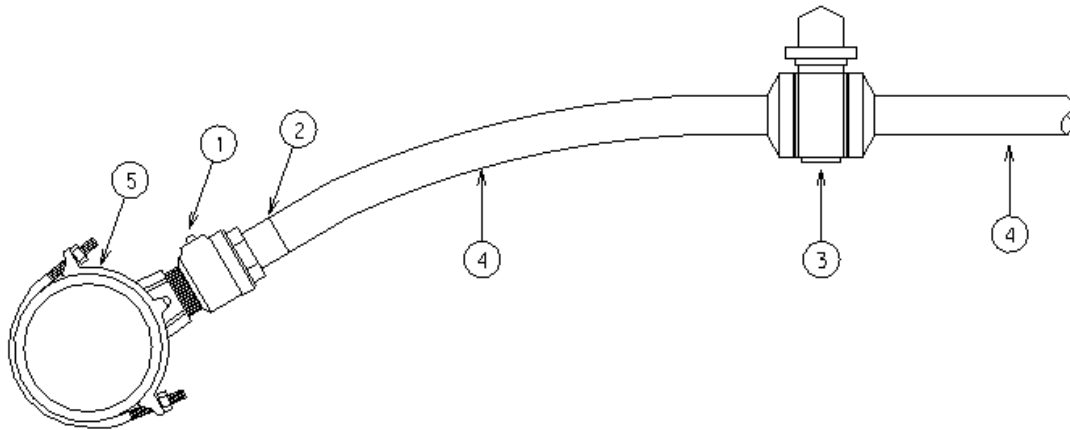


Figure 5-02515-e : Main Connection – 2 inch HDPE to 6, 8 or 12 inch DI/ CI/ AC

Notes:

- I. Valve jacket to be installed as shown in section 2514 - 3.4.
- II. Backfill around tapping tee and valve shall be compacted.
- III. Tracer wire shall be installed 6 inches above the main and within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Main Connection – 2 inch HDPE to 6, 8 or 12 inch DI/ CI/ AC

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	202796	2" Corporation Stop
2	1	800731	2" Transition Fitting – MPT x HDPE
3	1	200217	2" IPS AWWA - HDPE Ball Valve
4		200214	2" HDPE Water Pipe
5	1	210922	8" DI/CI/ AC x 2" FPT -Tapping Saddle
		207043	6" DI/CI/ AC x 2" FPT -Tapping Saddle
		Non stock	12" DI/CI/ AC x 2" FPT -Tapping Saddle
6	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

3.3 HDPE MAIN CONNECTIONS / VALVES

- A. HDPE main connections shall be as shown in this section or as directed by the OWNER.

- B. HDPE full port ball valves shall be used on 2 inch HDPE lines. Valves shall be AWWA and NSF 61 approved.

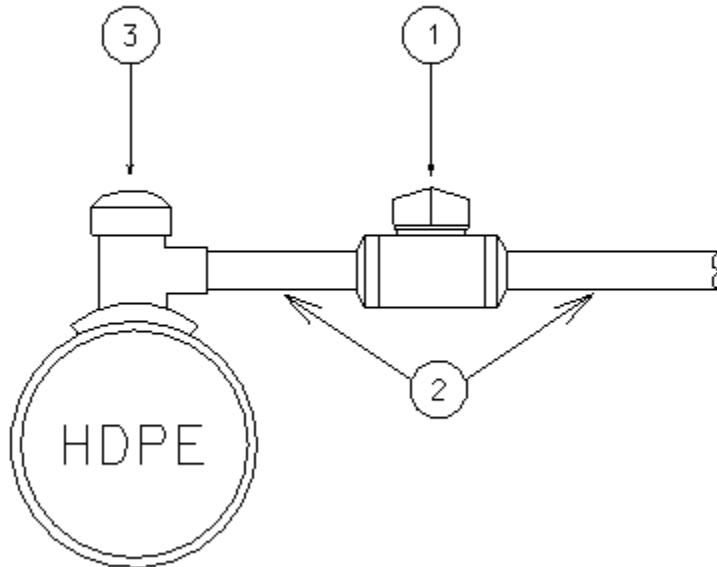


Figure 6-02515-f : Main Connection – 2 inch HDPE to 8 or 12 inch HDPE

Notes:

- J. Valve jacket to be installed as shown in section 2514 - 3.4.
- II. Backfill around tapping tee and valve shall be compacted.
- III. Hand tighten the cap on the tapping tee. **DO NOT** use a wrench to tighten the cap.
- IV. Tracer wire shall be installed 6 inches above the main and within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Main Connection – 2 inch HDPE to 8 inch HDPE

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	200217	2" IPS AWWA - HDPE Ball Valve
2	2	200214	2" HDPE Water Pipe
3	1	200221	8" DIPS x 2"IPS High Volume Tap Tee
		Non-Stock	12" DIPS x 2"IPS High Volume Tap Tee
4	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

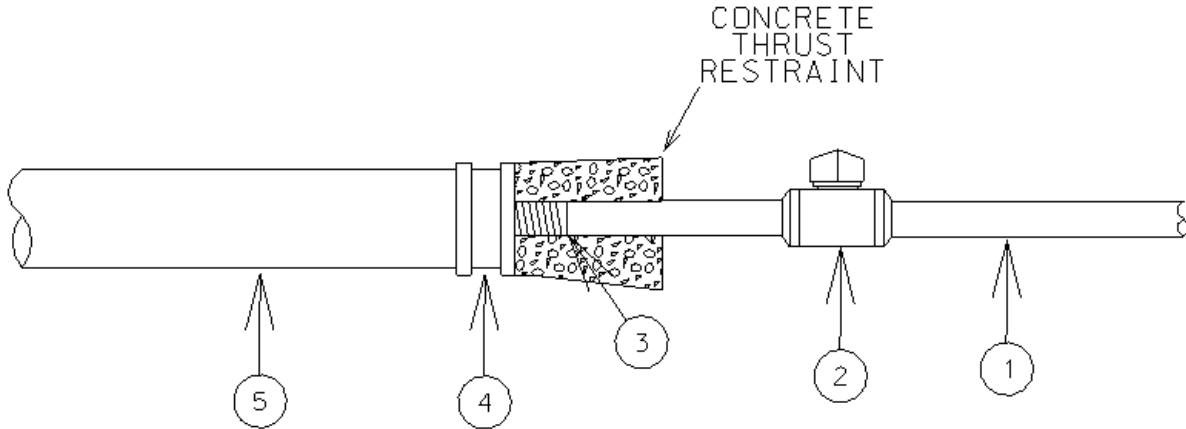


Figure 7-02515-g : Main Connection – 2 inch HDPE to 6, 8 or 12 inch DI / CI - End of Line

Notes:

- I. Valve jacket to be installed as shown in section 3.7.
- II. All pipe and fittings in contact with concrete thrust restraint blocks should be wrapped in plastic sheeting, minimum 6 mil thickness.
- III. Thrust restraint block to be installed as shown in Section 02513.
- IV. Tracer wire shall be installed 6 inches above the main and within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Main Connection – 2 inch HDPE to 8 inch DI / CI - End of Line

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	200214	2"IPS HDPE Pipe
2	1	200217	2" IPS AWWA - HDPE Ball Valve
3	1	800731	2" Transition Fitting
4	1	296764	8" x 2" Tap Plug
5		295279	8" Ductile Iron Pipe
6	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

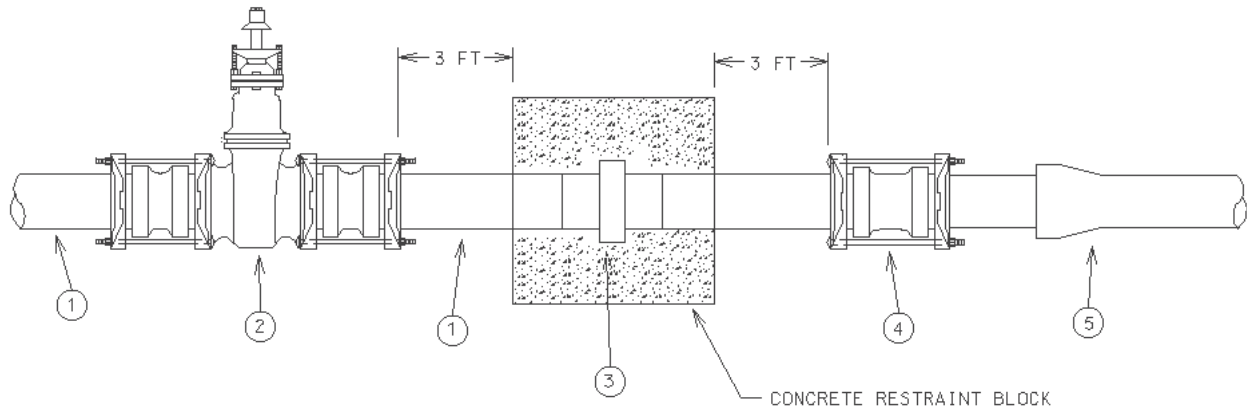


Figure 8-02515-h : Main Connection – 8 inch HDPE to 8 inch DI - End of Line

Notes:

- I. Valve jacket to be installed as shown in section 3.7.
- II. All pipe and fittings in contact with concrete thrust restraint blocks should be wrapped in plastic sheeting, minimum 6 mil thickness.
- III. Thrust restraint block to be installed as shown in Section 02513.
- IV. Tracer wire shall be installed 6 inches above the main and within the valve box, bring up tracer wire in 1/2 inch IPS PE pipe inside the valve box; tracer wire shall looped and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Material List for Main Connection – 8 inch HDPE to 8 inch DI - End of Line

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	200216	8” DIPS HDPE Pipe
2	1	200708	8” Aquagrip Valve
3	1	200222	8” Thrust Restraint Fitting
4	1	200698	8” Aquagrip Coupling
5		295279	8” Ductile Iron Pipe
6	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

END OF SECTION

[HOME](#)



SECTION 02516
WATER LINES – DISINFECTION AND TESTING

PART 1. GENERAL

- 1.1 The work to be performed shall consist of the installation of water lines according to the specifications and the Standard drawings herein.
- 1.2 Design drawings must be prepared and sealed by a Professional Engineer licensed by the State of Tennessee. Profile Drawings may be required as directed by the OWNER.
- 1.3 The CONTRACTOR shall be responsible for safely storing materials needed for the work until they have been incorporated into the completed project.

PART 2. PRODUCTS

- 2.1 The OWNER will inspect all materials at the site for conformance to the specifications. At the OWNER's discretion, the CONTRACTOR may be required to supply certified mill tests, samples, or other suitable forms of verification that the material meets the required specifications.

PART 3. EXECUTION

3.1 DISINFECTION AND SAMPLING (Reference *AWWA C651* for further details.)

- A. The basic disinfection procedure consists of the following steps:
 1. Inspecting all materials to be used to ensure the integrity of the materials.
 2. Preventing contaminating materials from entering the water main or components during storage, construction, or repair.
 3. Removing, by flushing or other means, those materials that may have entered the water main.
 4. Disinfecting any residual contamination that may remain, and flushing the disinfected water from the main.
 5. Protecting the existing distribution system from backflow due to hydrostatic pressure test and disinfection procedures.
 6. Documenting that an adequate level of disinfectant contacted each pipe to provide disinfection.
 7. Determining the bacteriological quality by laboratory test after disinfection.
 8. Final connecting of the approved new water main to the active distribution system.

- B. If dirt or other foreign material that has gotten into a pipe will not, in the opinion of the OWNER, be removed by flushing, the interior of the pipe shall be cleaned and swabbed with a disinfecting solution of 5 percent hypochlorite.
- C. Unless otherwise stated, disinfection shall be performed using chlorine or a chlorine-based chemical compound. The OWNER may allow use of alternate disinfection substances and/or methods on a case-by-case basis.
- D. Table I gives chlorine amount needed for each 100 feet of line for pipes of various diameters. A 1 percent chlorine solution may be prepared either with 1 pound of calcium hypochlorite for each 8.5 gallons of water or with sodium hypochlorite.



TABLE I
Disinfectant Amounts Needed to Produce 10 - 300 mg/l Chlorine Residuals in 100 Feet of Water Main of Various Sizes

Pipe Size, Inches	100% Chlorine, lbs				1% Chlorine Solution, Gallons				68% (HTH) Calcium Hypochlorite, lbs				
	PPM	10	50	100	300	10	50	100	300	10	50	100	300
4		0.005	0.027	0.055	0.164	0.07	0.33	0.65	1.96	0.008	0.04	0.08	0.24
6		0.012	0.061	0.123	0.368	0.15	0.74	1.47	4.42	0.018	0.09	0.18	0.54
8		0.022	0.109	0.218	0.655	0.26	1.31	2.62	7.85	0.032	0.16	0.32	0.96
10		0.034	0.171	0.341	1.023	0.41	2.05	4.09	12.27	0.050	0.25	0.50	1.51
12		0.0	0.2	0.5	1.5	0.59	2.95	5.89	17.67	0.07	0.36	0.72	2.17
14		0.1	0.3	0.7	2.0	0.80	4.01	8.02	24.05	0.10	0.49	0.98	2.95
16		0.1	0.4	0.9	2.6	1.05	5.24	10.47	31.42	0.13	0.64	1.28	3.85
18		0.1	0.6	1.1	3.3	1.33	6.63	13.25	39.76	0.16	0.81	1.63	4.88
20		0.1	0.7	1.4	4.1	1.64	8.18	16.36	49.09	0.20	1.00	2.01	6.02
22		0.2	0.8	1.7	5.0	1.98	9.90	19.80	59.40	0.24	1.21	2.43	7.28
24		0.2	1.0	2.0	5.9	2.36	11.78	23.56	70.69	0.29	1.44	2.89	8.67
26		0.2	1.2	2.3	6.9	2.77	13.83	27.65	82.96	0.34	1.70	3.39	10.17
28		0.3	1.3	2.7	8.0	3.21	16.04	32.07	96.21	0.39	1.97	3.93	11.80
30		0.3	1.5	3.1	9.2	3.68	18.41	36.82	110.45	0.45	2.26	4.52	13.55
32		0.3	1.7	3.5	10.5	4.19	20.94	41.89	125.66	0.51	2.57	5.14	15.41
34		0.4	2.0	3.9	11.8	4.73	23.64	47.29	141.86	0.58	2.90	5.80	17.40
36		0.4	2.2	4.4	13.3	5.30	26.51	53.01	159.04	0.65	3.25	6.50	19.51
38		0.5	2.5	4.9	14.8	5.91	29.53	59.07	177.21	0.72	3.62	7.24	21.73
40		0.5	2.7	5.5	16.4	6.55	32.73	65.45	196.35	0.80	4.01	8.03	24.08
42		0.6	3.0	6.0	18.1	7.22	36.08	72.16	216.48	0.89	4.43	8.85	26.55
44		0.7	3.3	6.6	19.8	7.92	39.60	79.19	237.58	0.97	4.86	9.71	29.14
46		0.7	3.6	7.2	21.7	8.66	43.28	86.56	259.67	1.06	5.31	10.62	31.85
48		0.8	3.9	7.9	23.6	9.42	47.12	94.25	282.74	1.16	5.78	11.56	34.68
50		0.9	4.3	8.5	25.6	10.23	51.13	102.27	306.80	1.25	6.27	12.54	37.63
52		0.9	4.6	9.2	27.7	11.06	55.31	110.61	331.83	1.36	6.78	13.57	40.70
53		1.0	4.8	9.6	28.7	11.49	57.45	114.91	344.72	1.41	7.05	14.09	42.28
54		1.0	5.0	9.9	29.8	11.93	59.64	119.28	357.85	1.46	7.31	14.63	43.89

E. While chlorine is being applied, the CONTRACTOR shall manipulate valves under the direction of the OWNER so that the treatment dosage will not flow back line that is supplying the water. The OWNER shall perform and document sufficient chlorine residual checks in the adjacent system to assure no highly chlorinated water is



introduced back into the water system. The CONTRACTOR , under the direction of the OWNER, shall continue the application of chlorine until the entire line being treated is filled with the chlorine solution. Contact time (CT) shall be equivalent to retaining an initial residual of 25 mg/l for 24 hours in the main. The OWNER shall document the date and time that the chlorine is added to the line and the initial chlorine concentration. Then the CONTRACTOR shall operate all valves and hydrants in the line being treated so that appurtenances can also be disinfected. After 24 hours, the treated water shall have a detectable free chlorine concentration throughout the line. The OWNER shall document the end chlorine concentration and the date and time it was recorded. Alternate methods using higher disinfectant residuals and shorter retention times may be used, with OWNER’s consent, to reduce detention time as described in AWWA Standard C651.

- F. After the applicable retention period, the CONTRACTOR shall flush the heavily hyperchlorinated water from the line until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, but not less than 0.20 mg/l. The CONTRACTOR shall perform such flushing only at sites where there is adequate drainage and as approved by the OWNER. The OWNER shall document the start and end date, time, and chlorine concentration of the final flush.
- G. The CONTRACTOR at the discretion of the OWNER shall use dechlorination and/or other treatment techniques if the treated water flushed from the line presents a hazard to the environment.
- H. The velocity of the water used to flush a line shall be at least 2.5 fps. The flow rates required to produce this velocity in various sizes of pipe are shown in Table II.

TABLE II
REQUIRED OPENINGS TO FLUSH PIPELINES
(40 PSI RESIDUAL PRESSURE)

Pipe Size (Inches)	Flow Required To Produce 2.5 fps Velocity (gpm)	Orifice Size (Inches)	Hydrant Outlet (Number)	Hydrant Nozzles Size (Inches)
4	100	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
14	1,200	3-1/4	2	2-1/2
16	1,565	3-5/8	2	2-1/2
18	1,980	4-3/16	2	2-1/2
20	2,440	-----	2	2-1/2



24	3,470	-----	2	2-1/2
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- I. The CONTRACTOR shall be responsible for maintaining sanitary conditions during handling, installation, and testing of mains, valves, blowoffs and other components as per *Section 4.3* of the current *AWWA Standard C651*. Reactive measures, such as flushing, shall not replace cleaning, swabbing, covering, and other preventive actions to insure components are installed with cleaned, disinfectant-wetted surfaces.
- J. Upon completion of bacteriological testing, hydrostatic testing should be performed to ensure integrity of the new pipeline system.

3.2 BACTERIOLOGICAL TESTING FOR NEW MAINS

- A. Once a new water line has undergone final flushing but before it is placed into service, the OWNER shall collect samples for bacteriological testing from both ends of the main line and the ends of any branch lines connected to the main line. In the case of extremely long lines, additional samples will be collected at intervals of approximately 2500 feet or as determined by the OWNER. Additional sampling may be required if the OWNER determines sanitary conditions have not been maintained.
- B. Samples will be collected in sterile bottles containing sodium thiosulfate as specified by *Standard Methods for the Examination of Water and Wastewater*. A hose shall not be used to collect samples; as a last resort, fire hydrants may be used as sampling points. A corporation cock may be installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.
- C. Two sets of samples taken 24 hours apart or one set of samples taken 48 hours or longer after flushing will be collected by the OWNER and tested for bacteriological quality by a state-certified laboratory. Each set of samples will consist of at least two samples representing water from both ends of the main line. If the initial disinfection fails to produce satisfactory samples, the CONTRACTOR at no cost to the OWNER will repeat disinfection and flushing until the two consecutive sample sets taken 24 hours apart produce satisfactory results.
- D. When the samples tested are found to be satisfactory, the water line should be hydrostatically tested.

3.3 HYDROSTATIC PRESSURE TEST - Ductile Iron

- A. All testing shall be scheduled with the OWNER.
- B. Mains and services shall be pressure tested as a complete system or as directed by the OWNER.



- C. All newly installed and backfilled pipe or any valved section thereof shall be subjected to a hydrostatic pressure test, conducted in the presence of the OWNER. If testing against a previously existing valve and the valve leaks, the CONTRACTOR shall be responsible for the valve. However, the OWNER shall not be liable for costs or lost time incurred by the CONTRACTOR when attempting to test a line against a faulty valve.
- D. Water used to conduct the hydrostatic testing shall be of the same quality required for KUB tap water.
- E. Each valved section of pipe shall be slowly filled with water, and a test pressure equal to the 1.5 times the normal working pressure (but not less than 200 psi) shall be applied for a minimum of 2 hours. Test pressure shall be based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge. A pump shall be connected to the pipe in a manner satisfactory to the OWNER. The CONTRACTOR shall furnish the labor and equipment, including the pump pipe, connections, gauges, and all necessary apparatus.
- F. The hydrostatic pressure test shall be conducted by measuring, through a calibrated meter, the amount of water, which enters the test section under 200 psi or normal working pressures (whichever is greater) for a period of at least 2 hours. No installation will be accepted until the hydrostatic testing allowance is less than the number of gallons per hour as determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

L = allowable leakage gallons/hour
 S = length of pipeline tested, in feet
 D = nominal diameter at the pipe, inches
 P = average test pressure during the leakage test, psig

- G. The following table has been developed for the commonly used sizes of ductile iron pipe with the nominal laying length of 20 feet, under a test pressure of 200 psi. The hydrostatic testing allowance formula above may be used when conditions differ from those stated parameters.

<u>Pipe Diameter</u> (Inches)	<u>Allowable Leakage per 1000 feet</u> (Gallons/Hr)
8	0.66
12	0.99
16	1.32



20	1.66
24	1.99
30	2.48
36	2.98

H. Cracked or defective pipes, fittings, valves, or hydrants discovered in consequence of this hydrostatic pressure test shall be replaced with sound material in the manner specified at no cost to the OWNER. The test shall be repeated until the results are satisfactory to the OWNER. A recording chart shall be used to document the results of the test if requested by the OWNER.

3.4 HYDROSTATIC PRESSURE TEST - HDPE

- A. All testing shall be scheduled with the OWNER.
- B. Mains and services shall be pressure tested as a complete system or as directed by the OWNER.
- C. Water lines installed using HDPE pipe shall pass a hydrostatic pressure test pressure equal to the 1.5 times the normal working pressure (but not less than 200 psi) for a period of 2 hours minimum and 4 hours maximum.
- D. The total test time including initial pressurization, initial expansion and time at test pressure shall not exceed eight hours. If the pressure test is not completed within 8 hours, the test section shall be depressurized, and allowed to relax for at least 8 hours before reapplying the test pressure.
- E. Hydrostatic pressure test shall be conducted following manufacturer and accepted industry recommendations.
- F. The OWNER shall be notified at least 24 hours prior to beginning any testing and shall be present during the test procedure. Test results shall be recorded in the as built drawings for the project including date, name of CONTRACTOR, name and signature of CONTRACTOR's employee responsible for testing, test pressure, and test duration. A recording chart shall be used to document the results of the test if requested by the OWNER.
- G. Monitored make-up water test shall consist of an initial expansion and test phase. During the initial expansion phase, the test section is pressurized to the test pressure and sufficient make-up water is added each hour for three hours to return to the test pressure.

Make-up Water Allowance (gallons per 100 feet of pipe)

Nominal Pipe Size	1 Hour Test	2 Hour Test	3 Hour Test
2"	0.07	0.11	0.19
6"	0.3	0.6	0.9
8"	0.5	1.0	1.5
12"	1.1	2.3	3.4

After the initial expansion phase, about four hours after pressurization, the test phase begins. The test phase may be two or three hours after which a measured amount of make-up water is added to return to the test pressure. The amount of make-up water added shall not exceed the allowable make-up water allowance.

3.5 DISINFECTION PROCEDURE AFTER CUTTING INTO EXISTING LINES

- A. The disinfection procedure for tie-ins on existing components is slightly different from that for new mains. Tie-ins made under pressure and where the components remain full will, in general, not require internal disinfection and sampling. Flushing and sampling is necessary when a tie-in requires the components to be dewatered and depressurized, as it presents the possibility of contamination being introduced into the system. The OWNER shall provide guidance as needed to the CONTRACTOR to determine proper action in these situations.

The general procedure for handling tie-ins is listed in the following steps:

1. Inspecting all materials to be used to ensure the integrity of the materials.
 2. Preventing contaminating materials from entering the water main or components during storage and construction (trench treatment).
 3. Disinfecting, swabbing, and cleaning replacement components prior to installation
 4. Removing, by flushing or other means, those materials that may have entered the water main or other components.
 5. Sampling to determine bacteriological quality by laboratory test after disinfection.
 6. Returning the replacement components back into service after bacteriological samples are taken. It is permissible to return tie-in sections to service as soon as samples are taken and before results are obtained.
 7. If necessary, removing the repaired components from service and repeating flushing and sampling until bacteriological samples are negative as directed by OWNER.
- B. When an existing line is opened, whether by accident or design, the excavated area is subject to contamination from many sources, particularly under wet or muddy

conditions. The CONTRACTOR shall, as directed by the OWNER, apply liquid hypochlorite to disinfect the exposed trench area around the tie-in. Dry granular or tablet hypochlorite shall be used for pools of standing water due to the more controlled release of disinfectant. Application amount shall be sufficient to cause a faint chlorine odor and be reapplied as necessary to maintain sanitary conditions. These steps shall be repeated as necessary to minimize the possibility of contamination of the main, fittings, or other components.

- C. The sampling procedure for a tie-in section, which has been dewatered and/or lost pressure is as follows:
1. The OWNER shall take a single bacteriological sample from a point, which represents the water in the tie-in area. If the direction of flow is unknown, two samples, one from each side of the tie-in area shall be taken. The main and other components can then be returned to service as soon as samples are taken. It is not necessary to wait until sample results are available before putting the main back into service.
 2. If the sample is positive for coliform, repeat sampling by the OWNER shall include one sample from each side of the original sample point, as well as the point itself (total of three samples). The process shall be repeated until sampling results are negative. Additional flushing/disinfection may be required prior to taking the repeat samples.
 3. Actions following positive sample results may vary according to regulatory requirements. The CONTRACTOR shall act at the direction of the OWNER until satisfactory sampling results are obtained.

END OF SECTION

SECTION 02518 WATER SERVICE ASSEMBLIES

PART 1. GENERAL

The work to be performed herein shall consist of the installation of service assemblies, which include a corporation cock, service pipe, copper horn, meter, meter box, valve, and tapping saddle as required and according to the Standard Drawings herein. Contractor shall provide all materials except for the meter, which will be supplied by the OWNER.

PART 2. PRODUCTS

- 2.1 All products and materials proposed for use in the execution of the work shall require approval by OWNER before being incorporated into the work. All products and materials shall meet or exceed the specified characteristics provided herein. Approved products may be reviewed at www.kub.org/standards, Section 02080, Materials Specifications or at KUB/Procurement 4505 Middlebrook Pike.
- 2.2 Do not substitute materials, equipment, or methods unless such substitution has been specifically approved for this work by OWNER. Where the phrase "or equal" or "or approved equal" occurs in the plans or specifications, do not assume that materials, equipment, or methods will be approved as equal unless the item has been specifically approved for this work by OWNER. The decision of OWNER shall be final.
- 2.3 **CORPORATION COCK:** The corporation cock shall be made of solid bronze suitable for a compression flange on the service pipe and for tapping into the water main and shall be furnished with AWWA tapered thread inlets and compression connections for Type-K copper service pipe outlets or female pipe thread for HDPE service pipe outlet.
- 2.4 **SERVICE PIPE:** Service pipe larger than 2 inch in diameter shall be ductile iron as specified in the Materials Specifications or shall be HDPE 3408 with blue stripes or blueshell manufactured in accordance with AWWA C906 and NSF 61. Service pipe 2 inch in diameter and smaller shall be Type-K copper meeting ASTM B88 or shall be HDPE 3408 with blue stripes or blueshell manufactured in accordance with AWWA C901 and NSF 61. Pipes larger than 2 inch shall be Ductile Iron Pipe Size (DIPS) in compliance with AWWA C906 and ASTM F 714. Pipes 2 inch and less shall be Iron Pipe Size (IPS) in compliance with AWWA C901 and ASTM D3035. HDPE pipe 2 inch and larger shall be SDR 11 and pipe smaller than 2 inches shall be SDR 9.
- 2.5 **COPPER HORNS:** Copper Horns shall be equipped with one male swivel and one female swivel and shall conform to the Material Specifications and Standard Drawings.
- 2.6 **WATER METERS:** All 5/8-inch through 2-inch meters shall be magnetic drive, sealed register, disc, or piston type meters meeting or exceeding the latest revision of AWWA C700. All meters shall conform to the Materials Specifications and Standard Drawings.

- 2.7 **METER BOXES:** Meter boxes for 5/8-inch meter sets shall be polyethylene outside of roadways and cast iron in roadways or paved areas. Meter boxes for 2-inch meter assemblies shall be polymer concrete meter well with lid, and meter boxes for larger than 2-inch meter assemblies shall be block. All meter boxes shall conform to the Standard Drawings and the Materials Specifications.
- 2.8 **TAPPING SADDLES:** Tapping saddles shall be used for tapping all PVC pipe, asbestos pipe, ductile or cast iron pipe for taps larger than 1-inch, and on all air valves regardless of tap size. Tapping saddles shall be threaded to accept the corporation cock specified above. Two wraps of 3 mil Teflon tape shall be utilized. No taps larger than 1-inch shall be made in any size pipe without Owner approval. 3/4" taps on new Water lines, not under pressure, may be direct tapped and a corporation threaded into the line.
- 2.9 **BALL VALVE:** 5/8" straight ball service valve shall be designed to operate as inlet valve in a meter installation and be furnished with a 3/4" compression type inlet designed for copper tubing and 3/4" I.P. female outlet. A new ball valve must be installed on all water main installations or replacements and/or service reconnections.
- 2.10 **GATE VALVE:** Gate Valve shall be used on sizes larger than 3/4".

PART 3. EXECUTION

- 3.1 **General**
- A. Service assemblies shall be as shown on the Standard Drawings herein.
 - B. Taps shall not be made on dry lines without approval from the Owner.
 - C. The service line shall have a minimum of 24 inches of cover.
 - D. After the line is installed and yoke set, flush the service line through the yoke, and record chlorine residual prior to meter installation. If the chlorine residual is below 0.2 ppm or above 2.5 ppm, the OWNER shall be contacted before placing the meter in service.
 - E. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter in the meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
 - F. The service line shall not be under tension from corporation stop to meter cock.
 - G. Set the yoke parallel to the proposed grade.

- H. Backflow preventers shall be required in accordance with the backflow prevention specifications in Section 02519, Backflow/Cross Connection.
- I. 1" HDPE service may be used in place of 3/4" or 1" copper service.
- J. 2" HDPE service may be used in place of 1 1/2" or 2" copper service.
- K. Blue coated # 12 copper clad tracer wire shall be installed with all services. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall be placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.
- L. The RPR / Owner will inspect all service taps and service lines before back filling can begin, unless prior authorization is given by the RPR / Owner.
- M. The Contractor shall furnish temporary services as required and approved by the Owner to provide continuous service to customers where relaying operations are being conducted
- N. All services shall be relayed from the main to the meter, or as directed by the Owner
- O. All services to be abandoned on an active main shall be discontinued at the main, as approved by the Owner. The disposal of the meter box and service assembly shall be at the discretion of the Owner.
- P. All services encountered during construction that are not constructed of ductile iron, HDPE or copper shall be replaced. No splices shall be allowed between the main and the meter without the approval of the Owner.
- Q. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.

3.2 3/4" Copper and 1" HDPE Service lines with 5/8" Meters

3.2.1 Standard Installation Notes – 3/4" Copper and 1" HDPE Service lines with 5/8" Meters

- A. All fittings must be threaded. No soldered connections allowed. All HDPE to HDPE connections shall be butt fusion or electrofusion. No socket fusion connections will be allowed for service lines.
- B. No fittings or connections are allowed within 18" of the customer side of meter box. Materials inside meter well must be copper pipe and brass fittings.
- C. Tapping saddle must be used with corporation stop.
- D. Copper connections must be compression type.
- E. Corporation stop must be installed at 45 degrees from vertical.
- F. Non-metallic mains must have tapping saddle with corporation stop.
- G. Meter lid must be set to grade.
- H. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
- I. HDPE Service saddle should be rotated approximately 30 to 45 degrees from vertical so that the service line crosses over the top of the main.
- J. Contractor will be required to connect to customer's existing service line in accordance with plumbing codes.
- K. The critical stress area for HDPE service lines is the first several feet beyond the service tee. This portion of pipe shall be protected using a support sleeve (even if pipe is looped). This support sleeve should be included with service tee for HDPE mains.
- L. If the support sleeve is not included, a piece of plastic pipe 12 to 18 inches long with a wall thickness equivalent to an SDR 17 may be used. For 3/4" and one inch services on HDPE mains, the sleeve should be no larger than 2". For 3/4" and one inch services on cast iron, asbestos cement, PVC, or ductile iron mains, the sleeve should be 4". The sleeve shall completely cover the area where the service pipe inserts into the service tee.
- M. IF APPROVED BY OWNER'S RESIDENT PROJECT REPRESENTATIVE, individual service lines may be looped in the trench when installation of a support sleeve is impractical. Approval shall be for each site prior to installation of looped connection. If a service connection is made by looping, then details of the connection shall be noted on the service card drawing.

3.2.2 Standard Details - Services with 5/8" meter

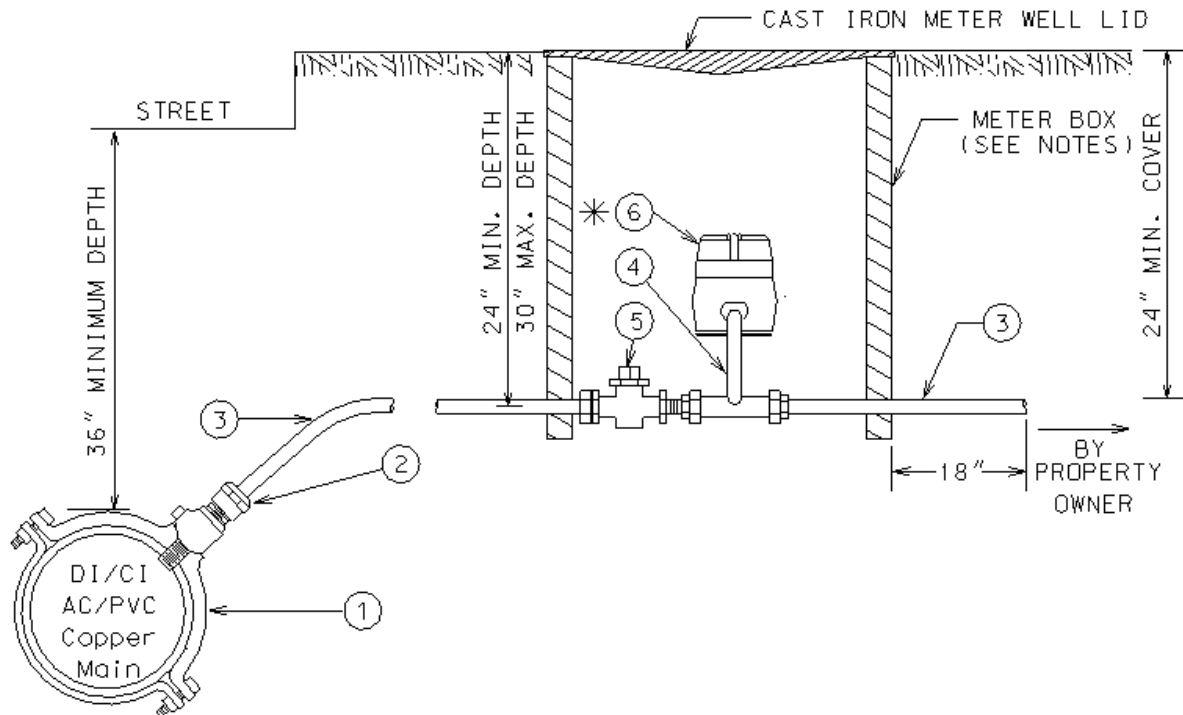


Figure 1-02518-a : 3/4" Copper Service - 5/8" Meter – Existing Main

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 3/4" Copper Water Service on Copper Meter Yoke with 5/8" Meter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	--	299644	3/4" Service Saddle – 12" DI / CI / AC Main
	--	-----	3/4" Service Saddle – 12" PVC Main
	1	291864	3/4" Service Saddle – 8" DI / CI / AC Main
	--	299420	3/4" Service Saddle – 8" PVC Main
	--	207241	3/4" Service Saddle – 6" DI / CI / AC Main
	--	219840	3/4" Service Saddle – 6" PVC Main
	--	205294	3/4" Service Saddle – 2" PVC Main
	--	205518	3/4" Service Saddle – 2" Copper Main
2	1	-----	3/4" Corporation Stop
3		294751	3/4" Copper Pipe
4	1	204362	Copper Yoke
5	1	210732	5/8" Ball Valve
*6	1	-----	5/8" Water Meter
7	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

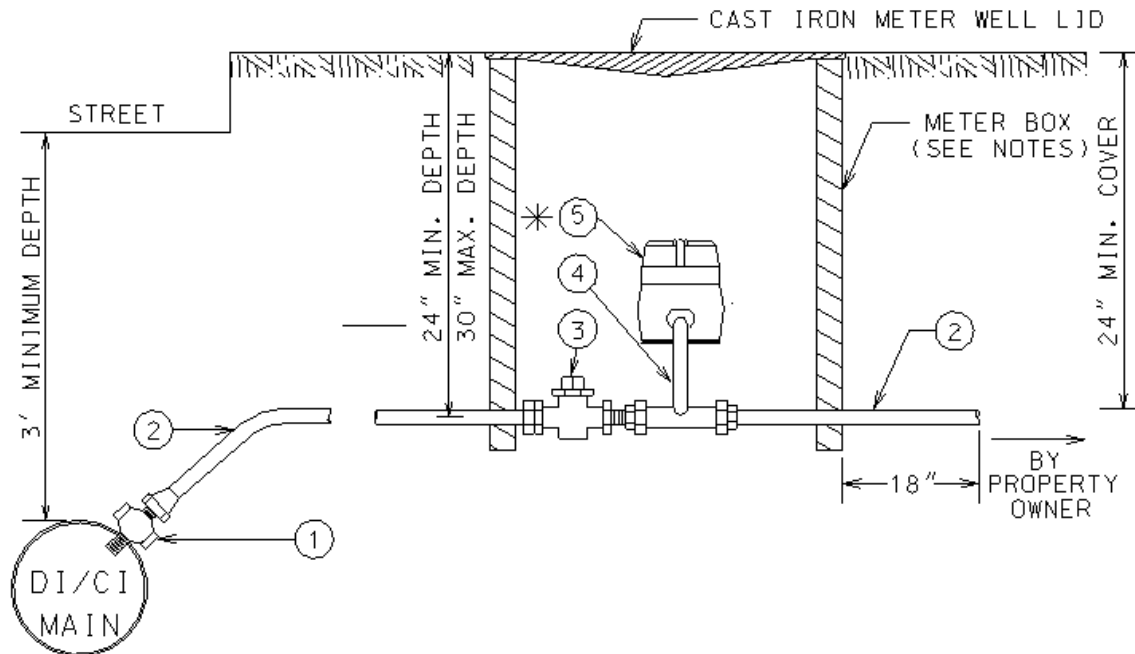


Figure 2-02518-b Typical 3/4" Copper Service - 5/8" Meter – New or Out of Service Main

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill

- slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
 - IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
 - V. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 3/4" Copper Water Service on Copper Meter Yoke with 5/8" Meter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	202762	3/4" Corporation Stop
2	--	294751	3/4" Copper Pipe
3	1	210732	5/8" Ball Valve
4	1	204362	Copper Yoke
*5	1	-----	5/8" Water Meter
6	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

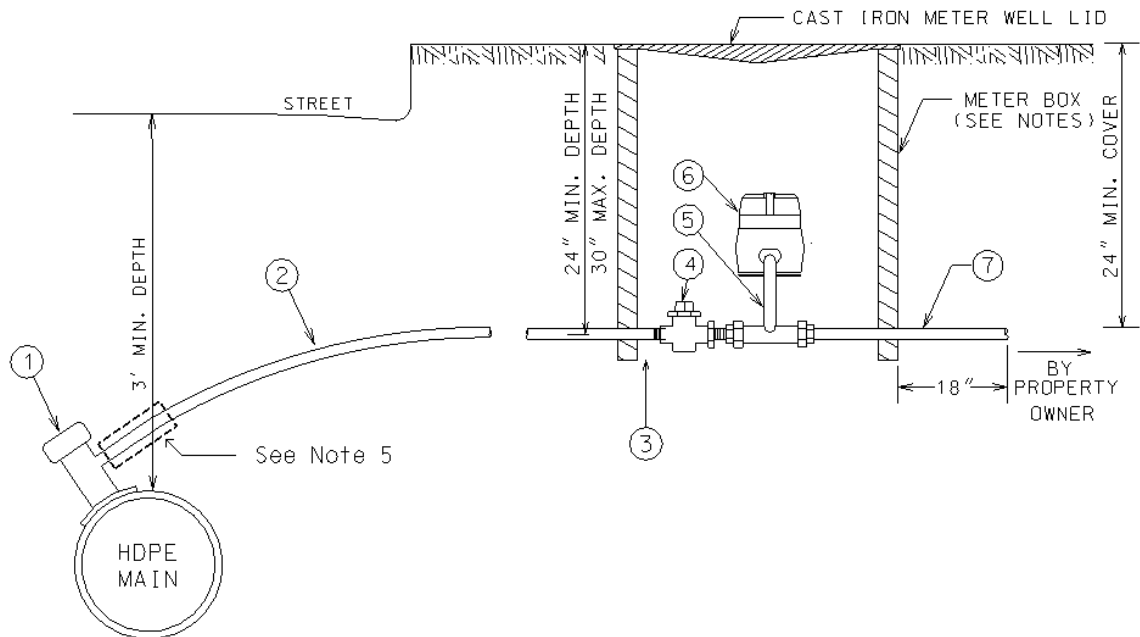


Figure 3-02518-c : 1" HDPE Water Service on HDPE Mains with 5/8" Meter

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade

and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.

- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Service line shall be encased with a protective sleeve (next larger size HDPE pipe 12 to 18 inches in length) provided with the saddle at the connection of the service line to the service saddle.
- VI. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall be placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 1" HDPE Water Service on HDPE Mains with 5/8" Meter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	--	-----	12" DIPS x 1" IPS HDPE
	1	200218	8" DIPS x 1" IPS HDPE Service Saddle
	--	200219	2" IPS x 1" IPS HDPE Service Saddle
2	--	200213	1" IPS Bluestriped HDPE
3	1	800744	1" HDPE Transition
4	1	200355	3/4" Ball Valve (3/4" FPT x 1" FPT)
5	1	204362	3/4" Copper Yoke
*6	1	-----	5/8" Water Meter
7	--	294751	3/4" Copper Pipe
8	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

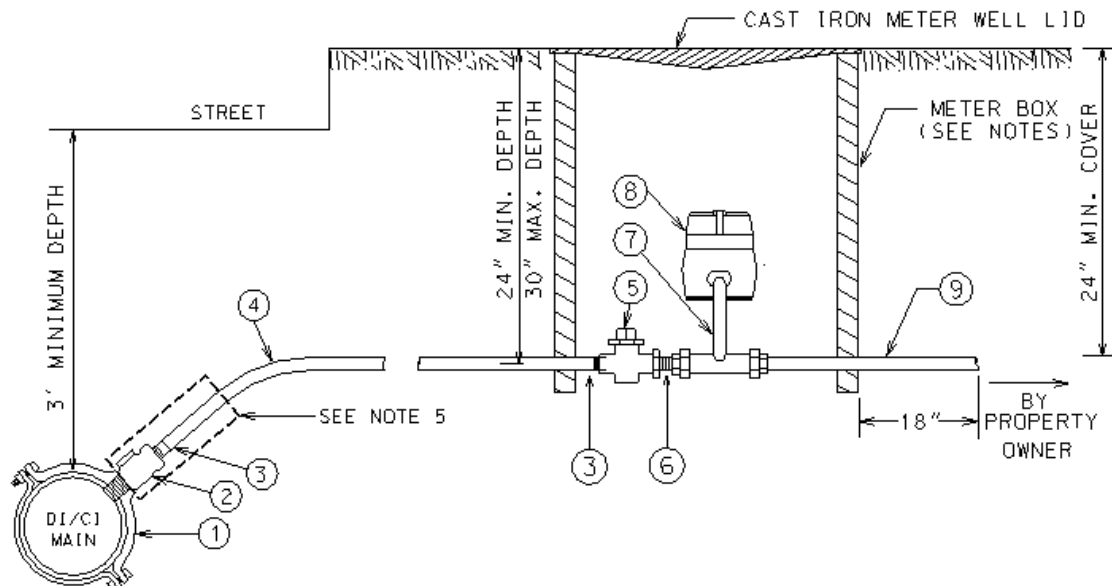


Figure 4-02518-d : 1" HDPE Water Service on 12", 8" or 6" DI/CI/AC/ PVC or 2" PVC/Copper Main with 5/8" Meter

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Service line shall be encased with a protective sleeve (next larger size HDPE pipe 12 to 18 inches in length) provided with the saddle at the connection of the service line to the service saddle.
- VI. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall be placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.



Materials List for 1" HDPE Water Service on 8" DI/CI Main with 5/8" Meter

Item	Quantity	KUB Item #	Description
1	--	205344	1" Service Saddle – 12" DI / CI / AC Main
	--	-----	1" Service Saddle – 12" PVC Main
	1	200218	1" Service Saddle – 8" DI / CI / AC Main
	--	206961	1" Service Saddle – 8" PVC Main
	--	207266	1" Service Saddle – 6" DI / CI / AC Main
	--	-----	1" Service Saddle – 6" PVC Main
	--	205252	1" Service Saddle – 2" PVC Main
	--	-----	1" Service Saddle – 2" Copper Main
2	1	200354	1" Corp Stop
3	2	800744	1" HDPE Transition
4	--	200213	1" IPS Bluestriped HDPE
5	1	N/A	¾" Ball Valve
6	1	203356	¾"x2" Brass Nipple
7	1	204362	Copper Yoke
* 8	1	-----	5/8" Water Meter
9	--	294751	¾" Copper Pipe
10	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

3.3 1" Copper & HDPE Service Lines with 1" meter

3.3.1 Standard Installation Notes – 1" Copper & HDPE Service Lines with 1" meter

- A. Items marked by an * on standard drawings and in material lists shall be furnished by OWNER when installed by others.
- B. All fittings shall be threaded. No soldered connections allowed. All HDPE to HDPE connections shall be butt fusion or electrofusion.
- C. No fittings or connections are allowed within 18" of either side of meter box.
- D. Materials inside meter box must be copper pipe and brass fittings.
- E. Tapping saddle must be used with corporation stop.
- F. Copper connections must be compression type.
- G. Corporation stop must be installed at 45°.
- H. Non-metallic mains must have tapping saddle with corporation stop.
- I. Meter lid must be set to grade.
- J. Polyethylene meter well must be used in grass areas. Brick must be used in paved areas, potential traffic areas, or when required by Owner.
- K. HDPE service saddle should be rotated approximately 30 to 45 degrees from vertical so that the service line crosses over the top of the main.
- L. Service pipe may be HDPE, PVC or copper on customer side of meter.
- M. HDPE or copper pipe required under streets, sidewalks, or any concrete or paved areas.
- N. Meter well pit shall be gravel (57 clean stone).

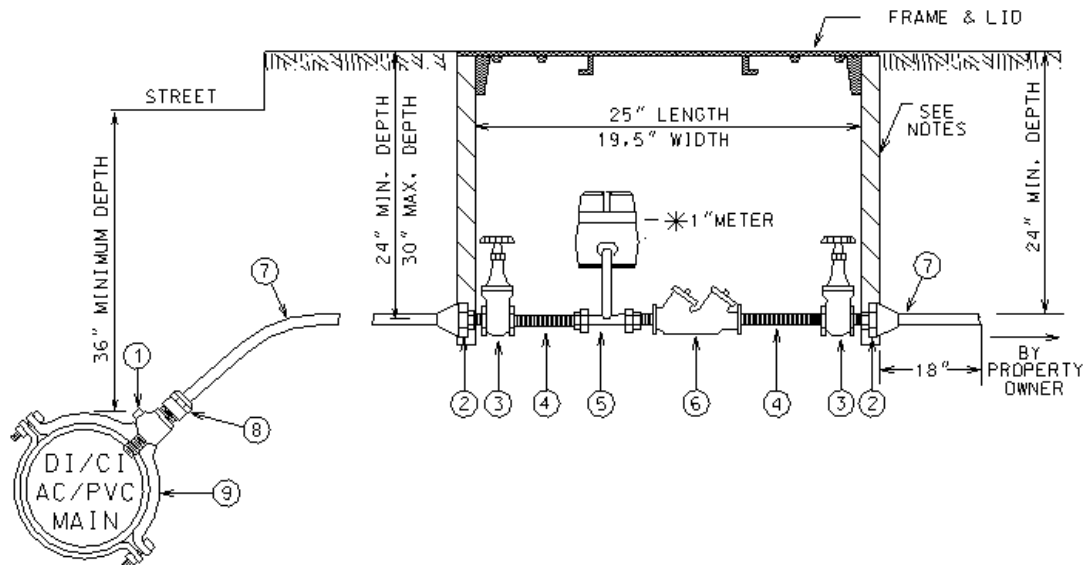


Figure 5-02518-e : 1" Copper Water Service with 1" Meter

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 1" Copper Water Service with 1" Meter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	202770	1" Corporation Stop
2	2	203976	1" Copper to Steel Adapter – Compression x MPT
3	2	207167	1" Brass Gate Valve
4	2	203273	1" x 6" Full Threaded Brass Nipple
5	1	202937	1" Copper Meter Yoke
6	1	220004	1" Dual Check Valve
7		290650	1" Copper Pipe
8	1	203984	1" Copper to Steel Adapter – Compression x FPT

9	--	205344	1" Service Saddle – 12" DI / CI / AC Main
	--	-----	1" Service Saddle – 12" PVC Main
	1	206961	1" Service Saddle – 8" DI / CI / AC Main
	--	-----	1" Service Saddle – 8" PVC Main
	--	207266	1" Service Saddle – 6" DI / CI / AC Main
	--	-----	1" Service Saddle – 6" PVC Main
	--	205252	1" Service Saddle – 2" PVC Main
	--	-----	1" Service Saddle – 2" Copper Main
10	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

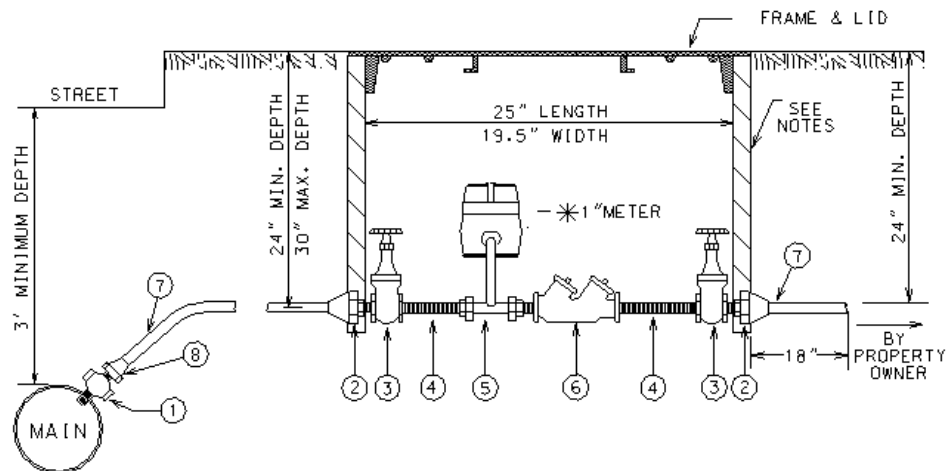


Figure 6-02518-f : 1" Copper Water Service with 1" Meter

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 1" Copper Water Service with 1" Meter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	202770	1" Corporation Stop
2	2	203976	1" Copper to Steel Adapter – Compression x MPT
3	2	207167	1" Brass Gate Valve
4	2	203273	1" x 6" Full Threaded Brass Nipple
5	1	202937	1" Copper Meter Yoke
6	1	220004	1" Dual Check Valve
7	--	290650	1" Copper Pipe
8	1	203984	1" Copper to Steel Adapter – Compression x FPT
9	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

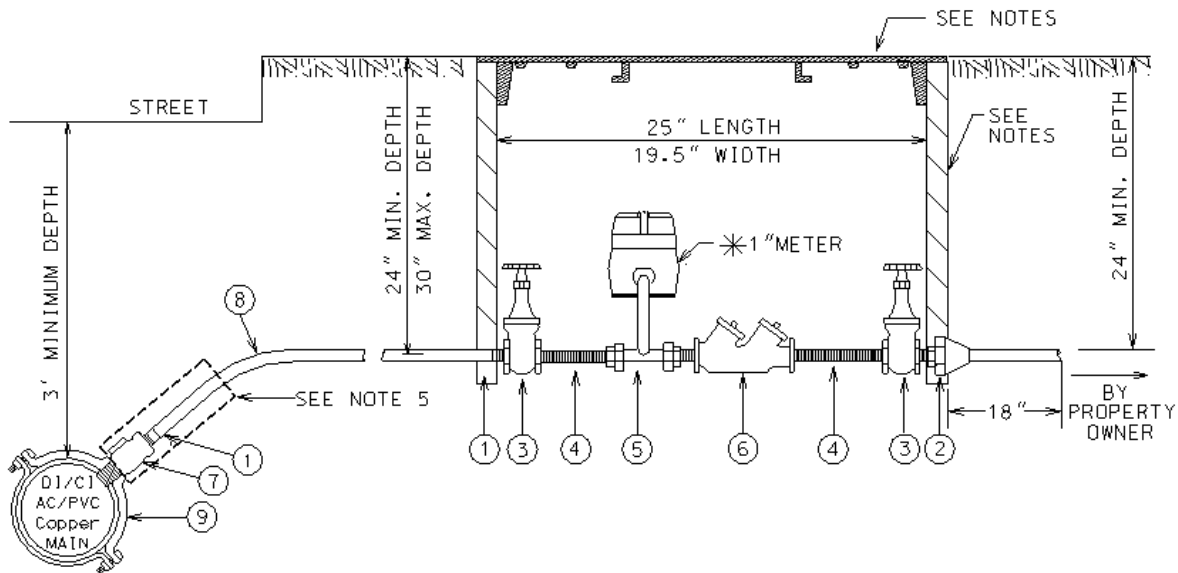


Figure 7-02518-g : 1" HDPE Water Service with 1" Meter

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.



- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Service line shall be encased with a protective sleeve (next larger size HDPE pipe 12 to 18 inches in length) provided with the saddle at the connection of the service line to the service saddle.
- VI. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall be placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 1" HDPE Water Service with 1" Meter

Item	Quantity	KUB Item #	Description
1	2	800744	1" HDPE Transition
2	2	203976	1" Copper to Steel Adapter – Compression x MPT
3	2	207167	1" Brass Gate Valve
4	2	203273	1" x 6" Full Threaded Brass Nipple
5	1	202937	1" Copper Meter Yoke
6	1	220004	1" Dual Check Valve
7	1	200354	1" Corp Stop
8	1	200213	1" IPS Bluestriped HDPE
9	--	205344	1" Service Saddle – 12" DI / CI / AC Main
	--	--	1" Service Saddle – 12" PVC Main
	1	206961	1" Service Saddle – 8" DI / CI / AC Main
	--	-----	1" Service Saddle – 8" PVC Main
	--	207266	1" Service Saddle – 6" DI / CI / AC Main
	--	207266	1" Service Saddle – 6" PVC Main
	--	205252	1" Service Saddle – 2" PVC Main
	--	-----	1" Service Saddle – 2" Copper Main
10	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

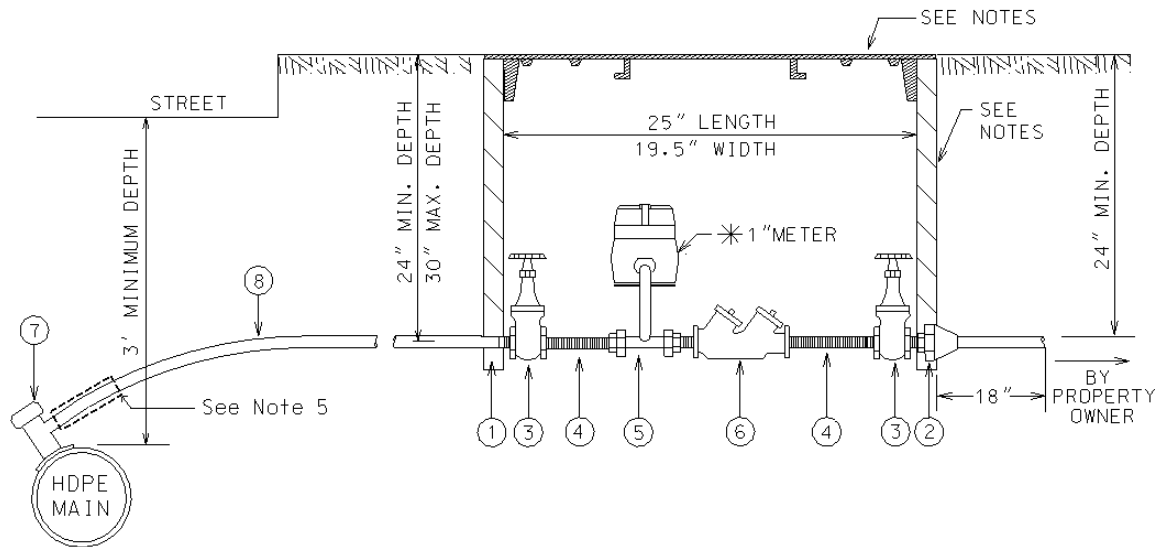


Figure 8-02518-h : 1" HDPE Water Service on HDPE Mains with 1" Meter

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Service line shall be encased with a protective sleeve (next larger size HDPE pipe 12 to 18 inches in length) provided with the saddle at the connection of the service line to the service saddle.
- VI. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall be placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 1" HDPE Water Service on HDPE Mains with 1" Meter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	1	800744	1" HDPE Transition
2	2	203976	1" Copper to Steel Adapter – Compression x MPT
3	2	207167	1" Brass Gate Valve
4	2	203273	1" x 6" Full Threaded Brass Nipple
5	1	202937	1" Copper Meter Yoke
6	1	220004	1" Dual Check Valve

7	--	-----	12" DIPS x 1" IPS HDPE
	1	200218	8" DIPS x 1" IPS HDPE Service Saddle
	--	200219	2" IPS x 1" IPS HDPE Service Saddle
8	--	200213	1" IPS Bluestriped HDPE
9	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

3.4 2" Copper & HDPE Service Lines with 1½" and 2" meters

3.4.1 Standard Installation Notes – 2" Copper & HDPE Service Lines with 1½" and 2" meters

- A. Items marked by an * on standard drawings and in material lists shall be furnished by OWNER when installed by others.
- B. All fittings shall be threaded. No soldered connections allowed. All HDPE to HDPE connections shall be butt fusion or electrofusion.
- C. No fittings or connections are allowed within 18" of either side of meter box.
- D. Materials inside meter box must be copper pipe and brass fittings.
- E. Tapping saddle must be used with corporation stop.
- F. Copper connections must be compression type.
- G. Corporation stop must be installed at 45°.
- H. Non-metallic mains must have tapping saddle with corporation stop.
- I. Meter lid must be set to grade.
- J. Corrugated meter well must be used in grass areas. Brick must be used in paved areas, potential traffic areas, or when required by Owner.
- K. HDPE service saddle should be rotated approximately 30 to 45 degrees from vertical so that the service line crosses over the top of the main.
- L. Service pipe may be HDPE, PVC or copper on customer side of meter.
- M. HDPE or copper pipe required under streets, sidewalks, or any concrete or paved areas.
- N. Meter well pit shall be gravel (57 clean stone).

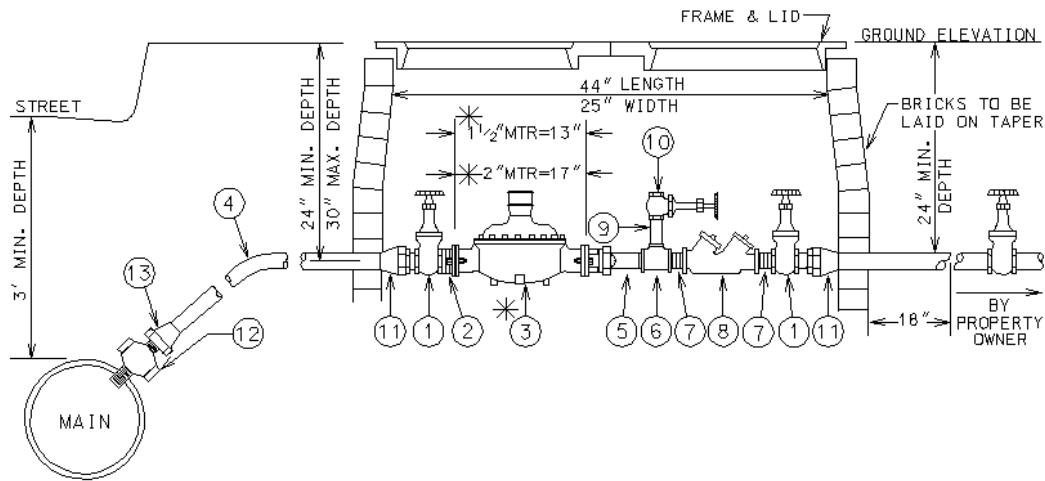


Figure 9-02518-i : Typical Installation of 1 ½" and 2" Water Services With Lok-Pak Coupling

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 1 ½" Water Service on Copper Meter Yoke

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	3	207506	1½" Gate Valve
2	1	207084	Loc-Pac Coupling - Meter Flange (male) incl.
*3	1	-----	1½" Meter
4	--	290676	1½" Copper Pipe
5	1	203232	1½" X 6 Nipple
6	1	203661	1½" X 1 1/2 X 3/4 Tee
7	1	203265	1½" X 2 all thread nipple
8	1	220012	Dual Check Valve
9	1	203331	¾" X 4 Nipple
10	1	207183	¾" Gate Valve
11	2	203760	Copper Fitting (Male)
12	1	202788	Corporation Stop
13	1	203752	1½" Female Fitting
14	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

Materials List for 2" Water Service on Copper Meter Yoke

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	3	205625	2" Gate Valve
2	1	207100	Loc-Pac Coupling - Meter Flange (male) incl.
*3	1	-----	2" Meter
4	--	290668	2" Copper Pipe
5	1	203190	2 X 6 Nipple
6	1	203885	2 X 2 X 1 Tee
7	1	203216	2 X 2 all thread nipple
8	1	220020	2" Dual Check Valve
9	1	203281	1 X 4 Nipple
10	1	207167	1" Gate Valve
11	2	203539	Copper Fitting (Male)
12	1	202796	2" Corporation Stop
13	--	203547	2" Female Fitting
14	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

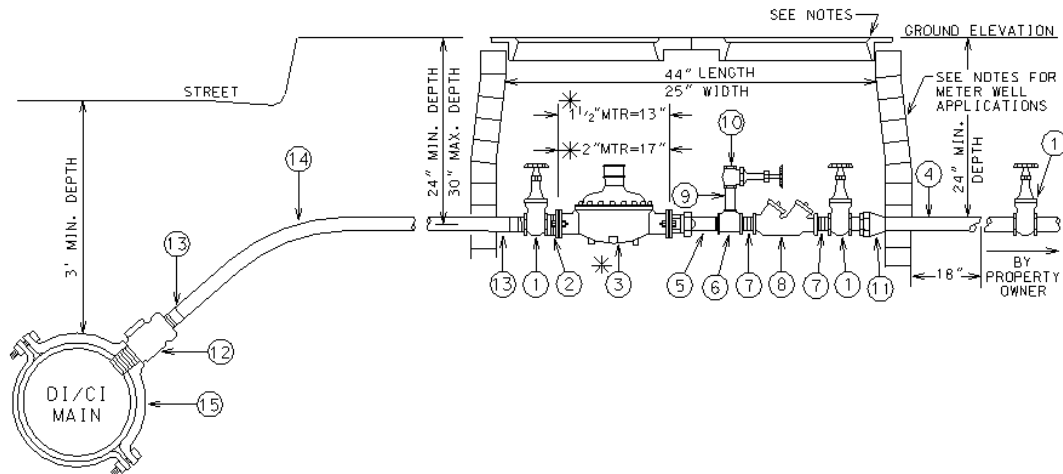


Figure 10-02518-j : 2" HDPE Service with 1 1/2" and 2" Water Meter With Lok-Pak Coupling

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.



- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 2" HDPE Service with 1 1/2" Water Meter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	3	207506	1 1/2" Gate Valve
2	1	207084	Loc-Pac Coupling - Meter Flange (male) incl.
*3	1	-----	Meter
4	--	290676	Copper Pipe
5	1	203232	1 1/2 X 6 Nipple
6	1	203661	1 1/2 X 1 1/2 X 3/4 Tee
7	1	203265	1 1/2 X 2 all thread nipple
8	1	220012	Dual Check Valve
9	1	203331	3/4 X 4 Nipple
10	1	207183	3/4 Gate Valve
11	2	203760	Copper Fitting (Male)
12	1	202788	Corporation Stop
13	2	800731	2" HDPE Transition
14	--	200214	2" IPS Bluestriped HDPE
15	1	294165	2" Service Saddle-24" DI/CI/AC
		205351	2" Service Saddle-12" DI/CI/AC Main
		210922	2" Service Saddle-8" DI/CI/AC Main
		207043	2" Service Saddle-6" DI/CI/AC Main
16	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

Materials List for 2" HDPE Service with 2" Water Meter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	3	205625	2" Gate Valve
2	1	207100	Loc-Pac Coupling - Meter Flange (male) incl.
*3	1	-----	Meter
4	--	290668	Copper Pipe
5	1	203190	2 X 6 Nipple
6	1	203885	2 X 2 X 1 Tee
7	1	203216	2 X 2 all thread nipple
8	1	220020	Dual Check Valve
9	1	203281	1 X 4 Nipple
10	1	207167	1 Gate Valve
11	2	203539	Copper Fitting (Male)
12	1	202796	Corporation Stop
13	2	800731	2" HDPE Transition
14	--	200214	2" IPS Bluestriped HDPE

15	1	294165	2" Service Saddle-24" DI/CI/AC
		205351	2" Service Saddle-12" DI/CI/AC Main
		210922	2" Service Saddle-8" DI/CI/AC Main
		207043	2" Service Saddle-6" DI/CI/AC Main
16	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

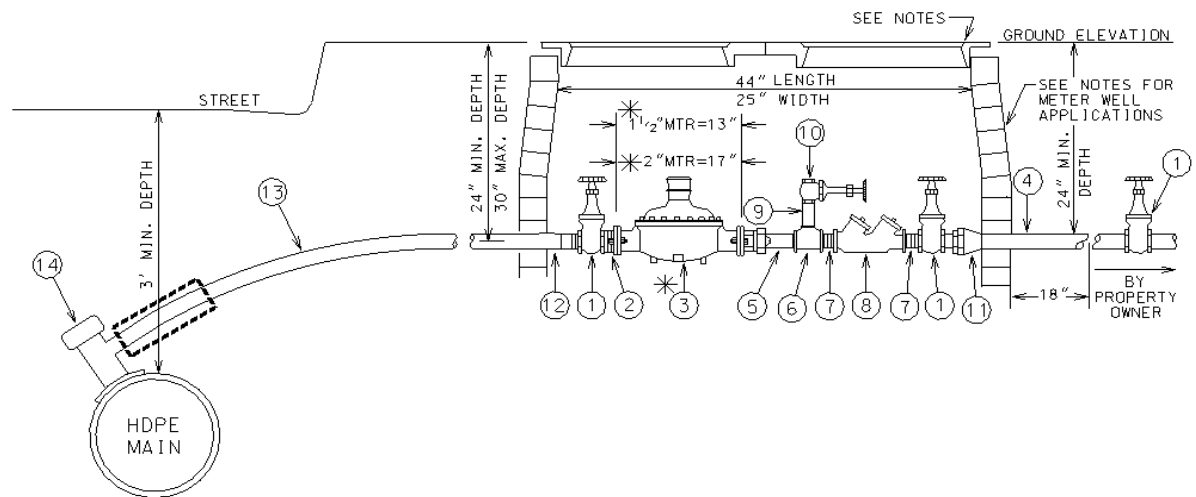


Figure 11-02518-k (2" HDPE Service with 1 1/2" and 2" Water Meter With Lok-Pak Coupling)

Notes:

- I. Compact trench from main to meter including tie-ins.
- II. In general, install the meter box as near to the property line as possible in the street right-of-way. Set the meter box approximately 1 inch above the existing or proposed grade and so that surface drainage will not enter meter well. Fill from the existing or proposed grade to the top of the meter box at a slope of 1 inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the Owner.
- III. Polyethylene meter well must be used in grass areas. D&R type (cast iron) meter well must be used in paved areas, potential traffic areas, or when required by Owner.
- IV. Meter boxes and meter horns not meeting current standards shall be replaced at the discretion of the OWNER.
- V. Service line shall be encased with a protective sleeve (next larger size HDPE pipe 12 to 18 inches in length) provided with the saddle at the connection of the service line to the service saddle.
- VI. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

Materials List for 2" HDPE Service with 1 1/2" Water Meter

Item	Quantity	KUB Item #	Description
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**KNOXVILLE UTILITIES BOARD
STANDARDS AND SPECIFICATIONS**

1	3	207506	1 1/2" Gate Valve
2	1	207084	Loc-Pac Coupling - Meter Flange (male) incl.
*3	1	-----	Meter
4	--	290676	Copper Pipe
5	1	203232	1 1/2 X 6 Nipple
6	1	203661	1 1/2 X 1 1/2 X 3/4 Tee
7	1	203265	1 1/2 X 2 all thread nipple
8	1	220012	Dual Check Valve
9	1	203331	3/4 X 4 Nipple
10	1	207183	3/4 Gate Valve
11	2	203760	Copper Fitting (Male)
12	1	800731	2" Transition Fitting
13	--	200214	2" IPS Bluestriped HDPE
14	1	200221	8" DIPSx2" IPS HDPE Service Saddle
		200210	6" DIPSx2" IPS HDPE Service Saddle
15	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

Materials List for 2" HDPE Service with 2" Water Meter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	3	205625	2" Gate Valve
2	1	207100	Loc-Pac Coupling - Meter Flange (male) incl.
*3	1	-----	Meter
4	--	290668	Copper Pipe
5	1	203190	2 X 6 Nipple
6	1	203885	2 X 2 X 1 Tee
7	1	203216	2 X 2 all thread nipple
8	1	220020	Dual Check Valve
9	1	203281	1 X 4 Nipple
10	1	207167	1 Gate Valve
11	2	203539	Copper Fitting (Male)
12	1	800731	2" Transition Fitting
13	--	200214	2" IPS Bluestriped HDPE
14	1	200221	8" DIPSx2" IPS HDPE Service Saddle
		200210	6" DIPSx2" IPS HDPE Service Saddle
15	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

3.5 3", 4", 6" Services

3.5.1 Standard Installation Notes – 2" Copper & HDPE Service Lines with 1½" and 2" meters

- A Items marked by an * on standard drawings and in material lists shall be furnished by OWNER when installed by others.
- B All fittings shall be threaded. No soldered connections allowed. All HDPE to HDPE connections shall be butt fusion or electrofusion.
- C No fittings or connections are allowed within 18" of either side of meter box.
- D Materials inside meter box must be copper pipe and brass fittings.
- E Tapping saddle must be used with corporation stop.
- F Copper connections must be compression type.
- G Corporation stop must be installed at 45°.
- H Non-metallic mains must have tapping saddle with corporation stop.
- I Meter lid must be set to grade.
- J Meter vaults and lids shall be traffic bearing material when used in potential traffic areas as required by the owner (i.e. brick, block, concrete, or steel)
- K HDPE service saddle should be rotated approximately 30 to 45 degrees from vertical so that the service line crosses over the top of the main.
- L Service pipe may be HDPE, copper on customer side of meter.
- M HDPE or copper pipe required under streets, sidewalks, or any concrete or paved areas.
- N Meter well pit shall be gravel (57 clean stone).

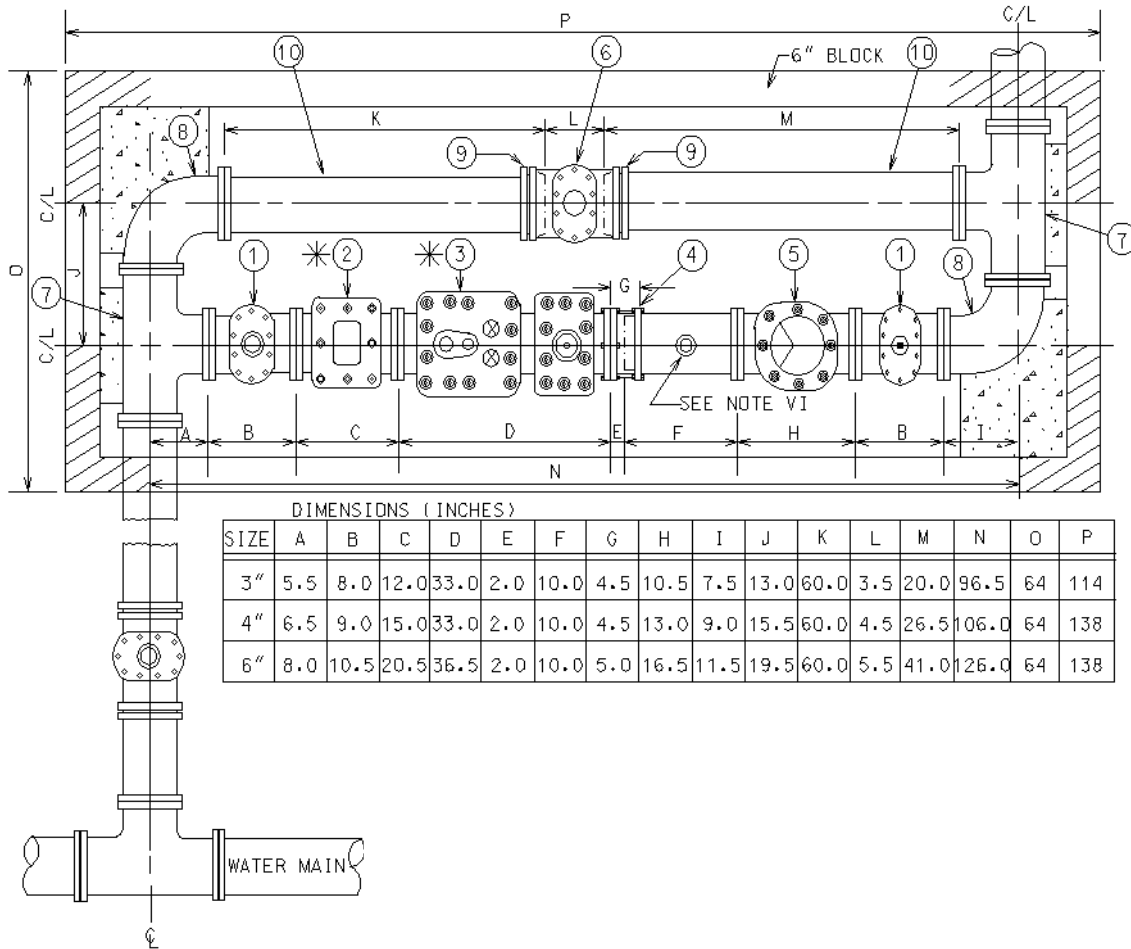


Figure 12-02518-1 : Typical Installation of 3", 4" and 6" Service With Flanged Coupling Adapter

Notes:

- I. Items marked by an * furnished by KUB when installed by others. Also included: Frame and Lid, Precast concrete top slab.
- II. Use all thread rods as directed by KUB inspector.
- III. All other material to be as directed by latest revision of standard specifications.
- IV. All fittings are flanged except where noted.
- V. Cover must be 3' minimum and 4' maximum.
- VI. 2" tap for turbine meter.
- VII. All pipe is ductile iron.
- VIII. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.



Typical installation of 3" Service with Flanged Coupling Adapter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	2	290890	Gate Valve Flanged
*2	1	-----	Strainer
*3	1	-----	Meter
4	1	204206	Coupling/Adapter
5	1	290031	Check Valve
6	1	290478	MJ Gate Valve
7	2	290023	Flange Tee
8	2	290080	Flange 90°
9	4	219691	Uniflange
10	--	295014	Ductile Iron Pipe
11	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

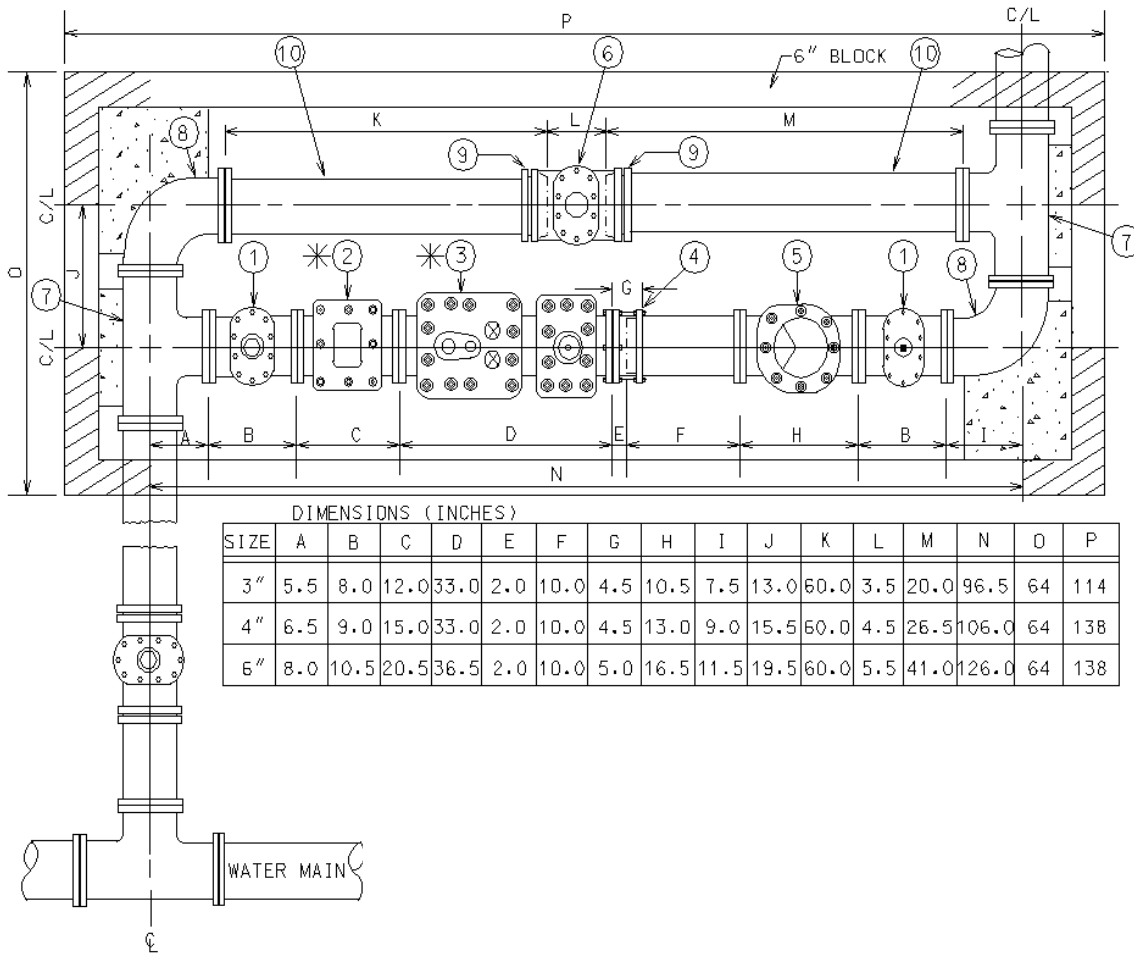
Typical installation of 4" Service with Flanged Coupling Adapter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	2	290056	Gate Valve Flanged
*2	1	-----	Strainer
*3	1	-----	Meter
4	1	204313	Coupling/Adapter
5	1	290049	Check Valve
6	1	294231	MJ Gate Valve
7	2	290015	Flange Tee
8	2	290098	Flange 90°
9	4	219709	Uniflange
10	--	295006	Ductile Iron Pipe
11	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)

Typical installation of 6" Service with Flanged Coupling Adapter

<u>Item</u>	<u>Quantity</u>	<u>KUB Item #</u>	<u>Description</u>
1	2	290759	Gate Valve Flanged
*2	1		Strainer
*3	1		Meter
4	1	204321	Coupling/Adapter
5	1	293050	Check Valve
6	1	290551	MJ Gate Valve
7	2	290767	Flange Tee
8	2	290510	Flange 90°
9	4	219725	Uniflange
10		290742	Ductile Iron Pipe

11	1-Lot	383448	#12 Solid Cu. Insulated Tracer Wire (not shown)
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DIMENSIONS (INCHES)

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
3"	5.5	8.0	12.0	33.0	2.0	10.0	4.5	10.5	7.5	13.0	60.0	3.5	20.0	96.5	64	114
4"	6.5	9.0	15.0	33.0	2.0	10.0	4.5	13.0	9.0	15.5	60.0	4.5	26.5	106.0	64	138
6"	8.0	10.5	20.5	36.5	2.0	10.0	5.0	16.5	11.5	19.5	60.0	5.5	41.0	126.0	64	138

Figure 13-02518-m : Typical Installation of 3", 4" and 6" Service With Compound Meter

Notes:

- I. Items marked by an * furnished by KUB when installed by others. Also included: Frame and Lid, Precast concrete top slab.
- II. Use all thread rods as directed by KUB inspector.
- III. All other material to be as directed by latest revision of standard specifications.
- IV. All fittings are flanged except where noted.
- V. Cover must be 3' minimum and 4' maximum.
- VI. All pipe is ductile iron.
- VII. Tracer wire shall be installed 6 inches above the service line; the tracer wire shall placed in the meter well and extend a minimum of 3 feet above the street or ground level or as approved by the OWNER.

END OF SECTION

[HOME](#)

SECTION 02519
BACKFLOW/CROSS CONNECTION

I. GENERAL REQUIREMENTS

- A. In accordance with the Tennessee Code Annotated, and Knoxville Utilities Board (KUB) Rules and Regulations, no person shall cause a cross-connection or inter-connection to be made, or allow one to exist for any purpose whatsoever unless the construction and operation of the same have been approved by the OWNER (KUB).
- B. Protective devices are required to:
 - 1. Protect the OWNER's water system from contamination.
 - 2. Eliminate or control existing or potential cross connections between potable and non-potable water systems.
 - 3. Protect the occupants or users of the water supply within the customers' premises in certain situations from in-house contamination.
- C. Protective devices will be required when the nature of use of the water supplied to a premise by the OWNER is such that it is deemed:
 - 1. Impractical to provide an effective air gap separation.
 - 2. That the property owner and/or occupant cannot or will not demonstrate to the OWNER that the water use and protective features of the plumbing are such that they pose no threat to the safety or potability of the water supply.
 - 3. That the nature and mode of operations within a facility are such that frequent plumbing changes are made.
 - 4. There is likelihood that protective measures may be subverted, altered, or disconnected (portable or temporary meters).
 - 5. A type of facility requiring protection as listed by the Tennessee Department of Environment and Conservation (TDEC) and/or the Environmental Protection Agency (EPA).
 - 6. To come into contact with chemicals or remain stagnant within the water line. Use of secondary meters to supply fire suppression systems, irrigation systems, pools, fountains, and hot tubs.
- D. Dual devices installed in parallel are required where continuous, uninterrupted service is required and there is no auxiliary service line. Refusal to install two parallel devices shall constitute agreement by the property owner or occupant that the water service may be interrupted as necessary to test the device.



- E. Area Plumbing Inspectors' Offices may require a plumbing permit and inspection for the installation of backflow prevention devices (BFD). The City or County office should be contacted to determine their requirements prior to installing a BFD. If a permit and inspection is not required by the City or County, then the property owner or occupant must call the OWNER at (865) 594-8333 to schedule an inspection after the device is installed.

II. DEFINITIONS

- A. **Cross-Connection:** Any physical connection whereby the public water supply is connected with any other water supply system, whether public or private, either inside or outside of any public building or buildings, in such a manner that a flow of water into the public water supply is possible either through the manipulation of valves, ineffective check or back pressure valves, or because of any other arrangement.
- B. **Inter-Connection:** Any system of piping or other arrangement whereby the public water supply is connected directly with a sewer, drain, conduit, pool, storage reservoir or other device which does or may contain sewage or other waste, or liquid which would be capable of importing contamination to the public water supply.
- C. **OWNER:** Knoxville Utilities Board (KUB), the owner of the public water supply.

III. ACRONYMS

BFD – backflow device

DC – Double Check Valve Assembly

DWS – Division of Water Supply

EPA – Environmental Protection Agency

gpm – gallons per minute

KUB – Knoxville Utilities Board

psi – pounds per square inch

RPZ – Reduced Pressure Zone

TDEC – Tennessee Department of Environment and Conservation

IV. MATERIALS - RPZ

- A. A reduced pressure zone (RPZ) BFD is required for protection of the water distribution system. Only RPZ's listed in the "Approved Backflow Prevention

Assemblies” listing available through TDEC Division of Water Supply (DWS) shall be installed on the OWNER’s water system. (The only exception is on non-chemical fire suppression systems, where a DC may be used instead of an RPZ. See Section VI. Materials – DC for non-chemical fire suppression systems.)

- B. BFD should be of sufficient size to deliver the same gallons per minute (gpm) capacity as the water meter supplying the premises when it is installed in the main line.
- C. The RPZ device must contain two spring loaded, resilient seat check valves and be equipped with a relief valve mechanism between the two check valves that ensures the pressure in the zone is always at least 2 psi lower than the inlet pressure.
- D. Devices ¾" through 2" shall have bronze bodies and 2-1/2" through 10" shall have fusion epoxy coated bodies rated at a minimum 175 pounds working pressure and water temperature 32 to 140 degrees Fahrenheit. Contact KUB for questions regarding operating pressure before installation. Some locations may require a minimum of 250 pounds working pressure.
- E. The RPZ device must be installed with either a bronze or inside and out coated fusion epoxy strainer, complete with a blow down.
- F. The device must be installed between two tight-closing resilient seated, inside and outside coated fusion epoxy gate valves, or full port ball valves.
- G. Test cocks must be of bronze, stainless steel, or polymer construction. They must also be resilient seated, have full port characteristic, and be located as follows:
 - 1. On the upstream side of the #1 shut off valve.
 - 2. Between the #1 shut off valve and the #1 check valve.
 - 3. Between the check valves.
 - 4. Between the #2 check valve and the #2 shut off valve.

Note: See Figures 1-02519-a through 3-02519-c for test cock locations.

V. INSTALLATION - RPZ

- A. RPZ’s shall be installed in a location such that:
 - 1. The master valve (if installed) is located after the backflow.
 - 2. The device is located before the first use of water.
 - 3. The device is not installed in a way that allows it to be bypassed.
 - 4. The device can be easily accessed for testing on an annual basis and repaired as needed.

5. The device is installed with at least 12" between the ground, floor, or mulch and the bottom of the BFD.
 6. The device is installed at least 6" away from walls for BFDs size 2" and under and at least 12" away from walls for BFDs over 2".
 7. The device is not installed below ground or inside a pit.
 8. The device is not exposed to grit, sticky, corrosive, or abrasive substances.
 9. The device is protected from mechanical abuse, freezing, and flooding.
 10. The device is adequately supported to prevent the unit from sagging. Special supports are needed for units in the 4" to 10" size range.
- B. The water line shall be thoroughly flushed to expel all debris prior to installation of the BFD. Debris lodging under check valves is one of the most common reasons of device failure.
- C. RPZ devices shall be installed in accordance with installation drawings of these specifications (See Figure 1-02519-a, Figure 2-02519-b, and Figure 3-02519-c) and according to manufacturers' instructions. Any variations in these drawings must have prior approval of the OWNER.

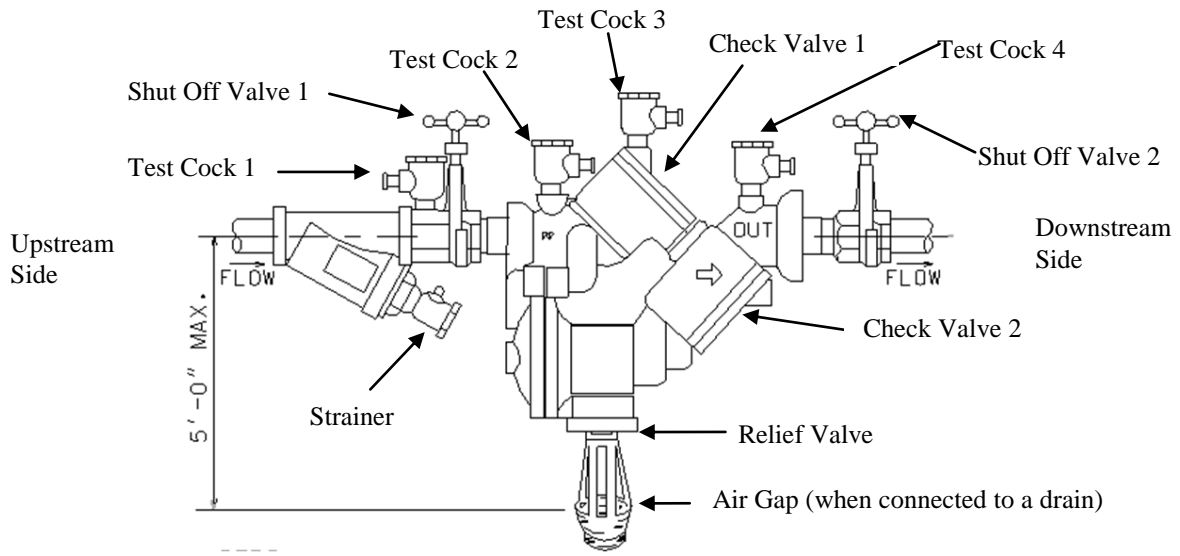


Figure 1-02519-a (RPZ, Size ¾" to 2" BFD)

Notes: The device must be installed:

- With a strainer (only on commercial properties),
- Above ground level,
- With suitable air gap between relief valve discharge port and ground level or flood level (12" minimum, 5' maximum),
- With a minimum of 6" clearance from all walls, and
- With adequate support to prevent the unit from sagging.

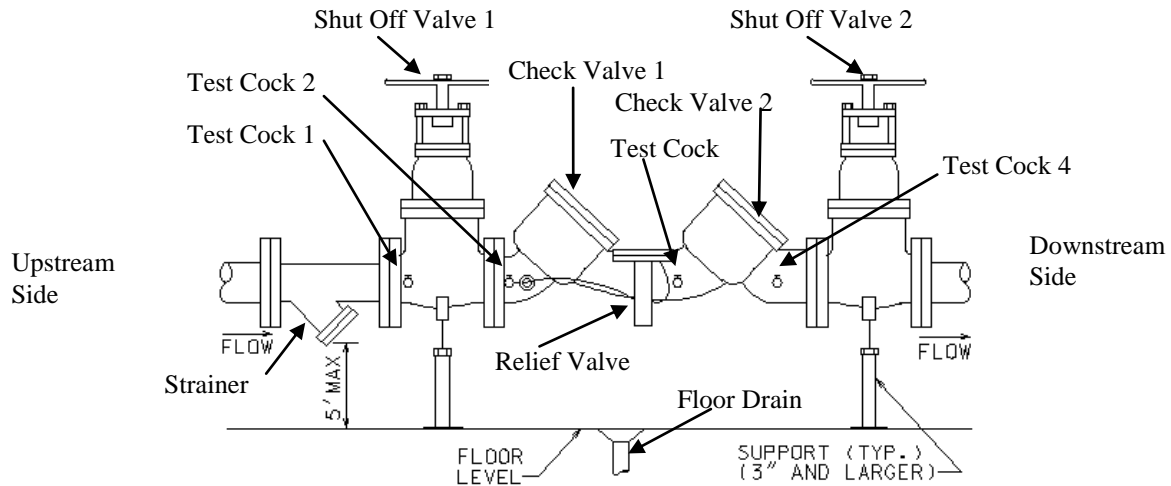


Figure 2-02519-b (RPZ, Indoor Installation, Size 2 ½" - 10" BFD)

Notes: The device must be installed:

- With a strainer (only on commercial properties),
- Above ground level,
- With suitable air gap between relief valve discharge port and ground level or flood level (12" minimum, 5' maximum),
- With a minimum of 12" clearance from all walls, and
- With adequate support to prevent the unit from sagging.

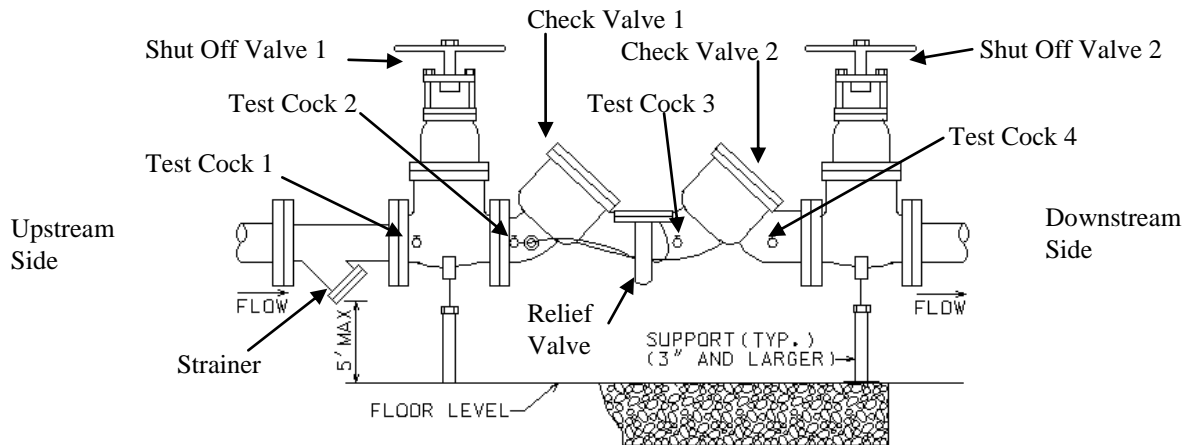


Figure 3-02519-c (RPZ, Outdoor Installation, Size 2 1/2" - 10" BFD)

Notes: The device must be installed:

- With a strainer (only on commercial properties),
- Above ground level,
- With suitable air gap between relief valve discharge port and ground level or flood level (12" minimum, 5' maximum),
- With a minimum of 12" clearance from all walls, and
- With adequate support to prevent sagging.

D. Cross Connection Protection Requirement

The TDEC DWS determines the types of facilities requiring cross connection protection. A current list of these facilities may be obtained by contacting the OWNER. This list is also available at www.KUB.org under the Cross Connection webpage.

E. Existing Facilities:

After a complete premise inspection by the OWNER, a formal written notice advising of RPZ BFD requirements will be issued to the property owner or occupant of an establishment or premise.

VI. MATERIALS - DC

- A. Double check (DC) BFDs are required for protection of the water distribution system on non-chemical fire lines only. A DC does not provide the same degree of protection as the RPZ. Only DC's listed in the "Approved Backflow Prevention Assemblies" listing maintained by TDEC DWS shall be installed on the OWNER's water system.
- B. The DC device must have two internally loaded, independently acting, resilient seat valves in series. The unit includes tightly closing shutoff valves located on

each end of the assembly and suitable connections for testing the water-tightness of each check valve.

- C. The DC will function under pressure for extended periods and, when functioning properly, will protect against backpressure and back-siphonage conditions. Unlike the RPZ, protection against backflow is not provided when both check valves leak.
- D. Devices ¾" through 2" shall have bronze bodies and 2-1/2" through 10" shall have fusion epoxy coated bodies rated at a minimum 175 pounds working pressure and water temperature 32 to 140 degrees Fahrenheit. Contact KUB for questions regarding operating pressure before installation. Some locations may require a minimum of 250 pounds working pressure.
- E. Test cocks must be of bronze, stainless steel, or polymer construction. They must also be resilient seated, have full port characteristic, and be located as follows:
 - 1. On the upstream side of the #1 shut off valve.
 - 2. Between the #1 shut off valve and the #1 check valve.
 - 3. Between the check valves.
 - 4. Between the #2 check valve and the #2 shut off valve.

Note: See Figures 4-02519-d through 5-02519-e for test cock locations

VII. INSTALLATION - DC

- A. DC's shall be installed in a location such that:
 - 1. The device is located before the first use of water.
 - 2. The device is not installed in a way that allows it to be bypassed.
 - 3. The device can be easily accessed for testing on an annual basis and repaired as needed.
 - 4. The device is installed with at least 12" between the floor and the bottom of the BFD.
 - 5. The device is installed at least 6" away from walls for BFDs size 2" and under and at least 12" away from walls for BFDs over 2".
 - 6. The device is not installed below ground or inside a pit.
 - 7. The device is not exposed to grit, sticky, corrosive, or abrasive substances.
 - 8. The device is protected from mechanical abuse, freezing, and flooding.
 - 9. The device is adequately supported to prevent the unit from sagging. Special supports are needed for units in the 4" to 10" size range.

- B. The water line shall be thoroughly flushed to expel all debris prior to installation of DC.
- C. DC devices shall be installed in accordance with the installation drawing of these specifications (See Figures 4-02519-d and 5-02519-e) and according to manufacturers' instructions. Any variations in this drawing must have prior approval of the OWNER.

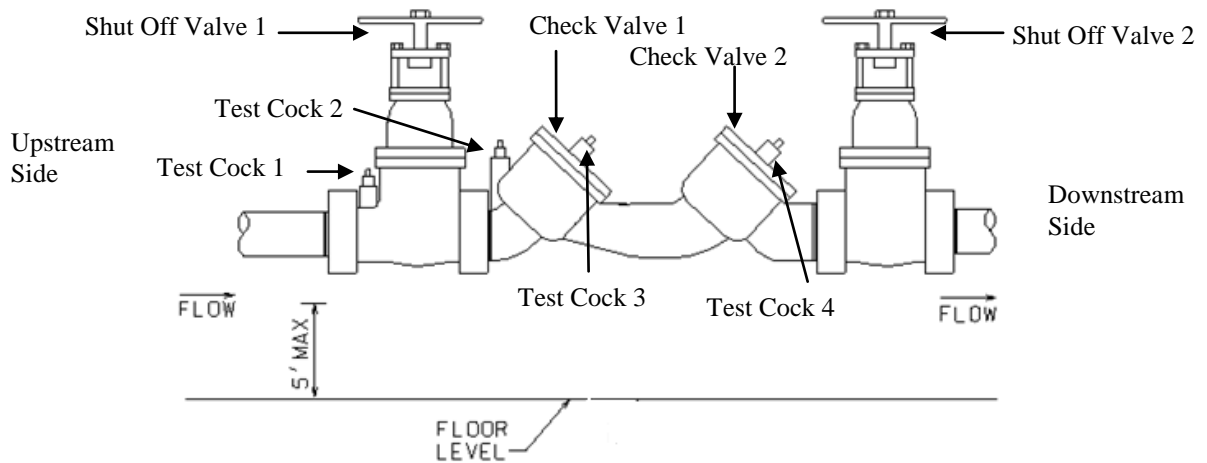


Figure 4- 02519-d (DC, Size 3/4" to 2" BFD)

Notes: The device must be installed:

- Above floor level,
- Within a minimum of 12" and a maximum of 5' from the floor,
- Within a minimum of 6" clearance from all walls, and
- With adequate support to prevent sagging.

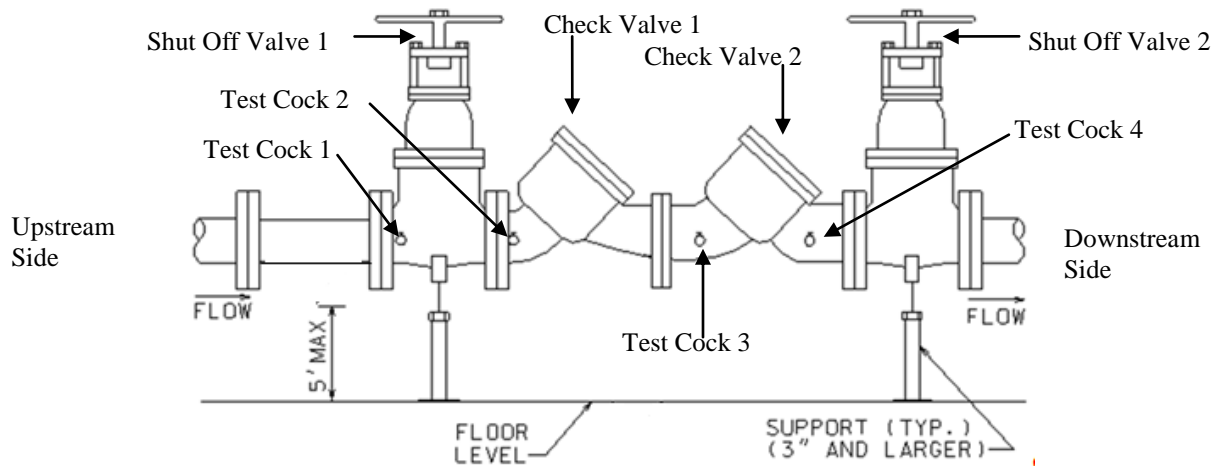


Figure 5- 02519-e (DC, Size 2 1/2" to 10" BFD)

Notes: The device must be installed:

- Above floor level,
- Within a minimum of 12" and a maximum of 5' from the floor,
- Within a minimum of 12" clearance from all walls, and
- With adequate support to prevent sagging.

VIII. INSPECTION - RPZ and DC

A. The OWNER shall examine:

1. Properties subject to frequent changes in on-site plumbing, where new cross-connections may be installed and existing protection may be bypassed, removed or otherwise made ineffective shall be subject to an annual inspection.
2. New Construction – all new commercial construction plans and specifications shall be made available to the OWNER for review.
3. Existing Facilities – existing facilities' cross connection protection shall be subject to inspection to determine the degree of hazard. Should installation of BFD or plumbing changes be required, the OWNER will notify the occupant of the requirements and a follow-up inspection will be made to assure proper protective devices have been installed.

IX. TESTING - RPZ and DC

A. Unless otherwise specified, it shall be the duty of the property owner/occupant to ensure annual (or more frequent, if necessary) testing of backflow devices.

- B. BFDs shall be successfully tested:
 - 1. Immediately upon completion of installation.
 - 2. At least every 12 months, recommended more often for high-hazard installations.
 - 3. When unit has been disassembled for cleaning and/or repairs.
 - 4. When there is any indication the BFD is not functioning properly.
- C. The OWNER shall keep an updated file on all BFDs that have been added to the system and records of annual tests of those devices.

X. COST - RPZ and DC

All costs associated with the subject program are to be borne by the customer or appropriate party. This includes the initial purchase of the BFD and its proper installation, testing, and maintenance.

XI. GENERAL

The procedures outlined herein are based on the principle of containment of the potential or actual hazard within the customer's premises. Should a customer refuse the right of entry of the OWNER or their designated representative, the OWNER must assume maximum hazard and therefore require the highest degree of protection on such a customer's service line.

XII. REFERENCE DOCUMENTS

- A. EPA Cross Connection Control Manual
- B. TDEC DWS Cross Connection Control Manual
- C. ANSI/AWWA Standards C-510-89 and C-511-89
- D. ASSE Standard 1013
- E. Foundation for Cross Connection Control and Hydraulic Research, 7th Edition. University of Southern California Standards. 1985.

END OF SECTION

SECTION 02530
MANHOLES

PART 1. GENERAL

1.01 SCOPE

- A. Manholes shall be precast concrete. The top section of the manholes shall be either flat top or eccentric cones as shown on Drawings.
- B. Cast iron frames shall be set at the required elevation and properly bonded to the flat top, eccentric cone, or grade rings with two rings of butyl mastic sealant and anchor bolts.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

- a. Cast-in-Place Manholes: Details of construction.
- b. Precast Manholes: Details of construction.
- c. Precast Base, Cones, and Top Slab Sections: Details of construction.
- d. Manholes Over Existing Piping: Plans and schedule for diverting flow.

B. Informational Submittals:

- 1. Certificate from manufacturer of castings indicating they meet applicable requirements of these Specifications.
- 2. Proposed curing method for cast-in-place concrete structures.
- 3. Precast Manhole Sections: Manufacturer's results of tests performed on representative sections to be furnished.
- 4. Certified load test data for precast manhole steps.
- 5. Plan for diversion of flow during installation of manhole over existing piping
- 6. Certificate from cementitious lining manufacturer that applicator has the experience and expertise for the application of the product.
- 7. Certificate of conformance for cementitious lining material.

1.03 QUALITY ASSURANCE

- A. Mortar mix for cementitious lining shall have at least 5-years of successful performance in similar applications, and shall be supplied by an ISO 9002 certified manufacturer. Manufacturer's ISO 9002 certificate shall be submitted to the OWNER.
- B. Mortar mix installer shall have a minimum of 5 years of experience installing the product provided, and shall be certified by the manufacturer.



1.04 DELIVERY, STORAGE, AND HANDLING

A. Cementitious Lining Mortar Mix:

1. Store with adequate provisions for the prevention of absorption of moisture.
2. Store in manner that will permit easy access for inspection and identification of each shipment.

PART 2. PRODUCTS

2.01 GENERAL DRAWINGS:

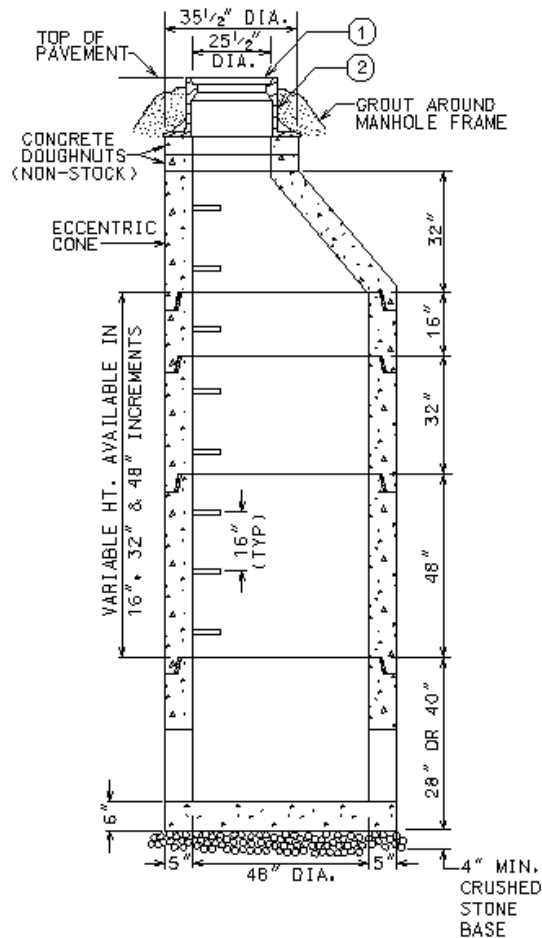


Figure 1-02530-a
Precast Concrete Manhole

Notes:

- I. Precast sections and section WWF reinforcing to meet specification ASTM C478 (Latest Revision).
- II. Joints shall be single step 288-4G and use press seal gasket.
- III. Do not install manhole steps in plastic lined manholes.
- IV. Manhole steps shall be copolymer polypropylene plastic with 1/2-inch grade 60 steel reinforcement.
- V. Place manhole steps in line vertically over the outlet pipe.
- VI. Pipe openings shall be cast with an A-LOK X-CELL gasket for pipe connections.
- VII. Shape inverts to flow of incoming and outgoing pipes.
- VIII. Provide plastic lined manholes as noted on Drawings.
- IX. Flat tops shall be used on lined manholes. Flat tops shall be lined.

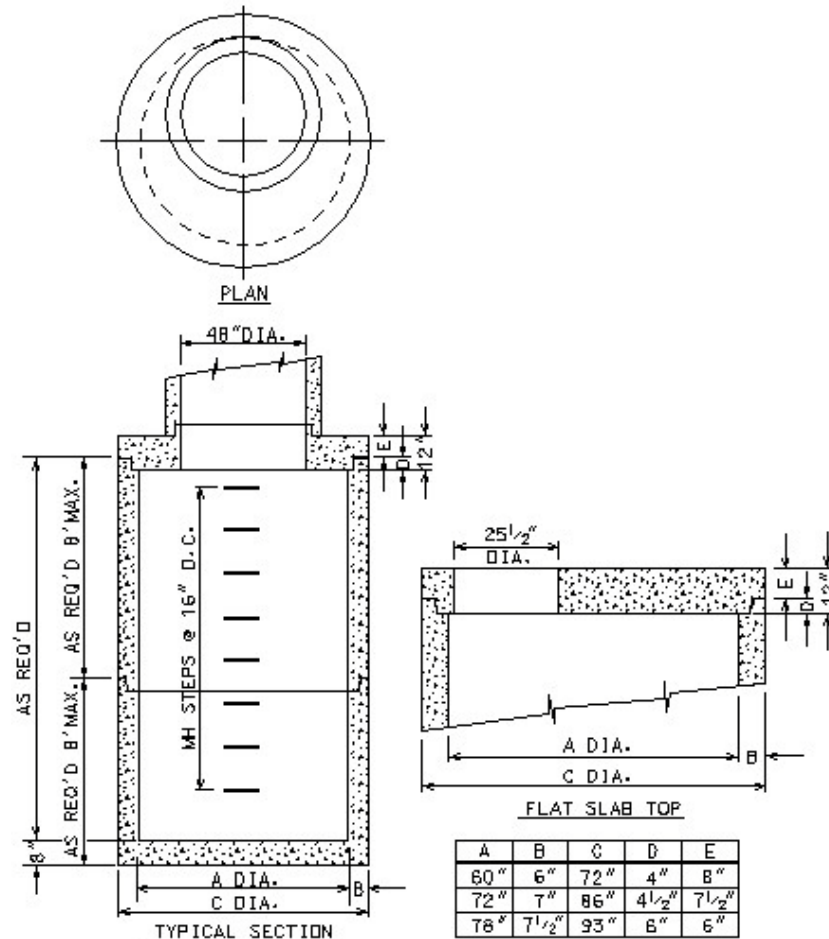


Figure 2-02530-b
5-foot, 6-foot, and 6-1/2-foot Precast Concrete Manhole

- I. Precast sections and section WWF reinforcing to meet spec. ASTM C478 (latest revision).
- II. Provide base and riser sections with two lifting holes at 180 degrees apart. Minimum 2-inch diameter.
- III. Joints shall be single step 288-4G and use press seal gasket.
- IV. Do not install manhole steps in plastic lined manholes.
- V. Manhole steps shall be copolymer polypropylene plastic with 1/2-inch grade 60 steel reinforcement.
- VI. Manhole steps must be placed in line vertically over outlet pipe.
- VII. Pipe openings shall be cast with an A-LOK X-CELL gasket for pipe connections.
- VIII. Shape inverts to flow of incoming and outgoing pipes.
- IX. Provide plastic lined manholes as noted on Drawings.
- X. Flat tops shall be used on lined manholes. Flat tops shall be lined.

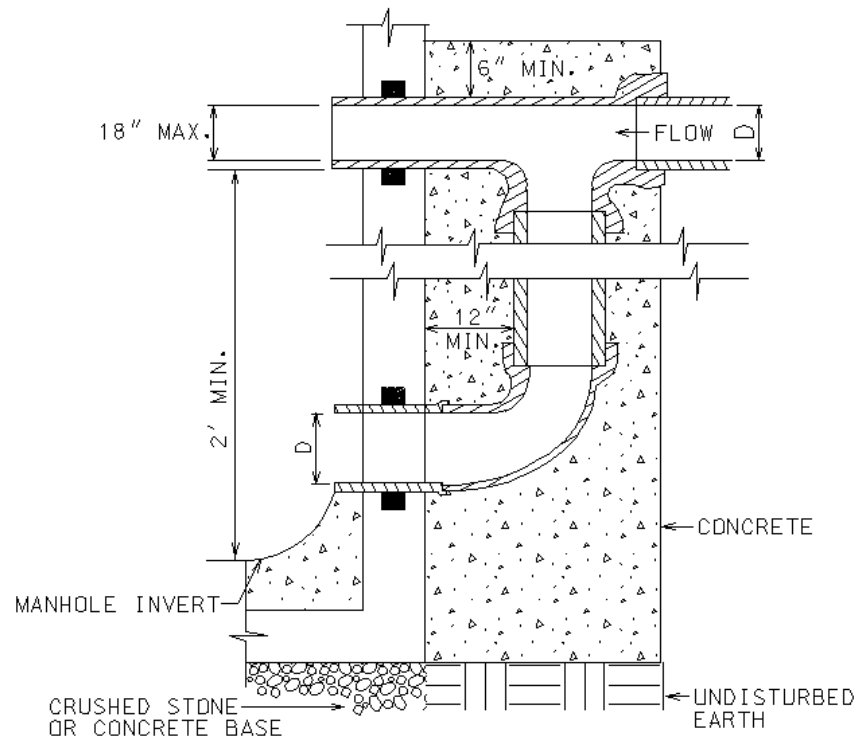


Figure 3-02530-d
Standard Drop Manhole Detail

Notes:

- I. Drop pipe to be minimum SDR 26, PVC
- II. Drop pipe to match incoming sewer pipe diameter.
- III. Joints shall be compression type bell and spigot
- IV. Provide bell joint at incoming sewer connection
- V. Encase drop assembly at precast facility or in the field, as directed by OWNER
- VI. Provide A-lok gaskets in manhole.

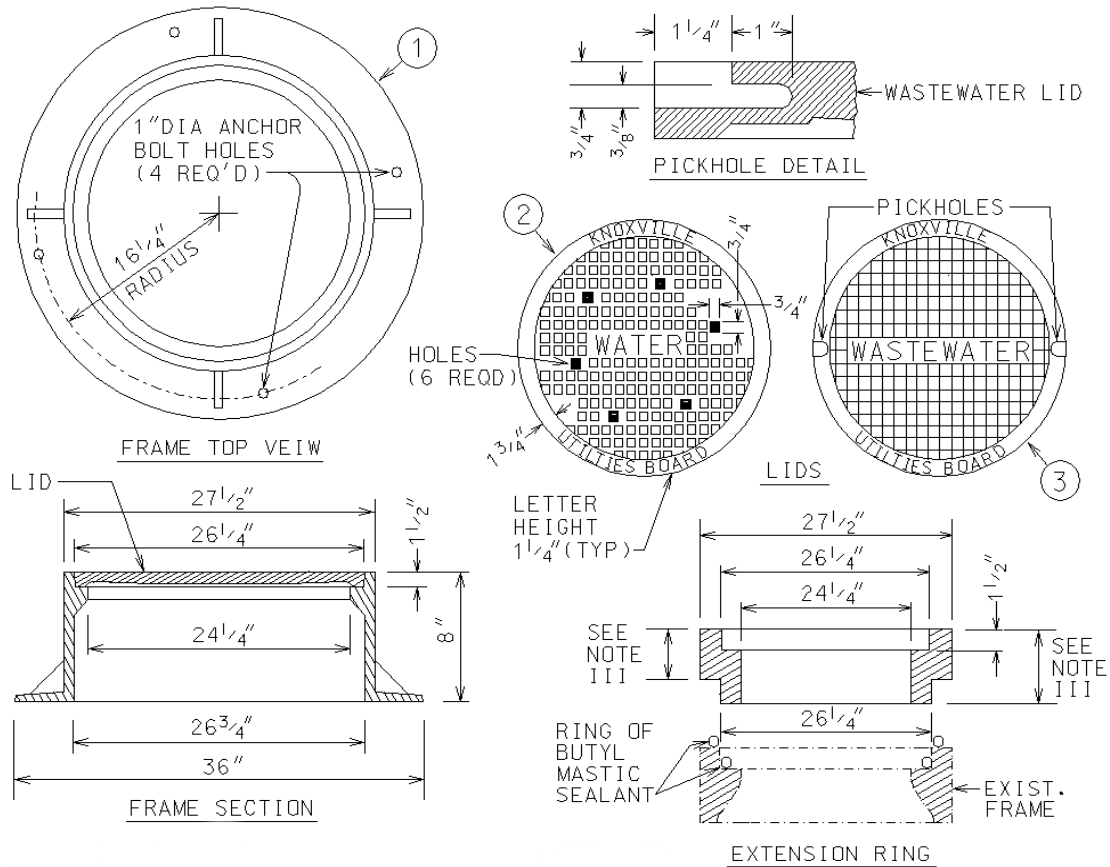


Figure 4-02530-e
Standard Water and Wastewater Traffic Bearing Manhole Frame and Cover and Extension Ring

Notes:

- I. Weights: Lid=165 lbs. Frame=205 lbs.
- II. Bearing surfaces must be machined.
- III. Dimensions H and E are dependent upon thickness of paving.
- IV. Bolts and nuts shall be made of a non-corrosive material.

2.02 WATERTIGHT MANHOLE FRAMES AND COVERS

- A. Frames and covers shall be manufactured from ductile iron in accordance with ISO 1083 or unfinished cast gray iron ASTM A48, Class 35B.
- B. Covers:
 - 1. Hinged with a 90-degree blocking system to prevent accidental closure.
 - 2. One-man operable utilizing standard tools and capable of withstanding a proof load of 16,000 pounds.
- C. Frames:
 - 1. Circular with a seating gasket. Gasket material shall be nitrile rubber
 - 2. Depth shall not exceed 5 inches.
- D. Flange shall incorporate bedding slots and boltholes.
- E. Bolts, nuts, and washers shall be stainless steel.
- F. Manufacturers and Products:
 - 1. Saint-Gobain; Pamrex.
 - 2. Neenah; LIFTMATE R-1650-LM.

2.03 PRECAST CONCRETE GRADE RINGS

- A. Grade rings shall be 4 inches or 6 inches in height and in conformance with the Standard Drawings contained within this section and all other applicable sections.

2.04 MORTAR

- A. Mortar shall be composed of one part Portland cement and two parts sand (volumetric measure) thoroughly mixed in a tight box, with water added gradually and mixed continually until mortar has attained the proper consistency for use in brick masonry; prepared only in such quantities as needed for immediate use; mortar mixed for more than 30 minutes, retempered, or previously set will not be allowed.

2.05 CAST IRON CASTINGS

- A. Castings shall be cast iron conforming to the Standard Drawings and the requirements of Class 30 ASTM A48; made accurately to the required dimensions; sound, smooth, clean, and free from blisters and other defects; not plugged or otherwise treated to remedy defects; machined so that covers rest securely in the frames with no rocking, and such that they are in contact with frame flanges for the entire perimeter of the contact surfaces.

2.06 BUTYL MASTIC SEALANT

- A. The sealant shall be used when joining the casting frame to the precast manhole and for all manhole adjustments to provide a watertight structure. The sealing compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes, or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded rope form of suitable cross section and in such sizes as to seal the joint space. Use two complete ropes at each joint. The sealing compound shall be protected by a suitable removable two-piece wrapper, which shall be designed so that half may be removed longitudinally without disturbing the other half in order to facilitate application of the sealing compound. The sealant shall also meet the requirements of the following table:

Composition	Test Method	Minimum	Maximum
Bitumen (Petroleum Plastic Content)	ASTM D4	50	70
Ash Inert Mineral Matter	AASHTO T11	30	50
Volatile Matter	ASTM D6	---	2.0
Property	Test Method	Minimum	Maximum
Specific Gravity at 77 degrees F	ASTM D71	1.2	1.3
Ductility at 77 degrees F(cm)	ASTM D113	5.0	---
Softening Point	ASTM D36	320 degrees F	---
Penetration 77 degrees F (150 gms) 5 sec.	ASTM D217	50	120

2.07 PRECAST MANHOLES

- A. All components shall meet the requirements of the Standard Drawings, ASTM C478, and ASTM C76 Class III. The mix design shall be:

Type I Portland Cement Content	615 Pounds per Cubic Yard
Fly Ash Content	85 Pounds per Cubic Yard
Coarse Aggregate Content	1,600 Pounds per Cubic Yard
Fine Aggregate Content	1,250 Pounds per Cubic Yard
Maximum Water/Cement Ration	0.40
Superplasticizer shall be added to create a workable slump.	

- B. The circumferential reinforcement for the manhole sections shall consist of welded wire fabric per ASTM C478.
- C. Manholes shall be constructed with the minimum number of sections possible that the precaster can provide, to minimize the number of joints in the manhole. Minimum manhole section shall be 16 inches deep.
- D. Lifting holes through the manhole structure shall not be permitted.
- E. Each joint shall be a tongue and groove with two layers of butyl mastic sealant.
- F. Pipe Connections:
1. Pipe connections to precast concrete manholes shall be with A-LOK cast-in-place gaskets for new and replacement manholes. Grout shall not be allowed to encase A-LOK gaskets. Pipe connections for cured-in-place or for existing pipe shall be KOR-N-SEAL flexible connectors. Proper torque shall be applied to KOR-N-SEAL flexible connectors with a torque wrench per manufacturer's specifications.
 2. Channels and benches in shall be factory grouted only. There shall be no field grouting of channels or benches.
 3. Where possible a minimum line drop of 0.1 foot shall be provided across new manholes.
 4. Where the difference in invert elevation of two intersecting sewers in a manhole is 2 feet or more, a drop connection cast integrally into the barrel wall shall be provided.
 5. Where invert elevations are not shown on the Drawings, pipes of differing sizes enter and exit manholes, all pipe crowns shall be matched to the same elevation.
- G. All precast reinforced concrete manhole sections specified herein shall be inspected by the RESIDENT PROJECT REPRESENTATIVE. All materials that fail to conform to these Specifications shall be rejected. After delivery to the Site, any materials that have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the Site by the CONTRACTOR at no cost to the OWNER.

2.08 FIBERGLASS MANHOLES

A. Manholes shall be one piece units manufactured from commercial grade resins and Grade E glass reinforcement. The inner surface shall be resin rich, free of crazing and delamination. Maximum blister shall be 1/2 inch in diameter, and the maximum wrinkle depth shall be 1/8 inch. Maximum surface pits shall be 3/4 inch in diameter and 1/16 inch deep. Voids which cannot be broken with finger pressure can be a maximum of 1/2 inch in diameter and 1/16-inch deep.

B. Manholes shall meet the following ASTM requirements:

1. 16,000 foot-pound dynamic load rating, ASTM 3753, 8.5, Note 1.
2. ASTM 3753, 8.5, Note 1 for Pipe Stiffness:

Manhole Length	PSI
3'-6'	0.72
7'-12'	1.26
13'-20'	2.01
21'-25'	3.02
26'-35'	5.24

3. Structural Capacities:

- a. Tensile Strength (psi): 18,000 hoop; 5,000 axial.
- b. Tensile Modulus (psi): 600,000 hoop; 700,000 axial.
- c. Flexural Strength (psi): 26,000 hoop; 4,500 axial.
- d. Flexural Modulus (psi): 1,400,000 hoop; 700,000 axial.
- e. Compression Strength (psi): 18,000 hoop; 10,000 axial.

2.09 CONFLICT MANHOLE

A. Conflict manholes shall be reinforced concrete structures formed and cast onsite. Concrete and reinforcing shall conform to Section 02770, Concrete Pavement, Curb, and Gutters. All other features shall conform to this section of the Specification.

2.10 MANHOLE STEPS

A. Manhole steps shall be constructed of a 1/2-inch minimum diameter Grade 60 steel reinforced rod encapsulated in polypropylene plastic. The steps shall be installed in a vertical row on 16-inch centers over the invert of the downstream pipe.

B. Manhole steps shall be removed, and shall not be reinstalled in rehabilitated manholes.

2.11 MANHOLE LINING

- A. New manholes located in a corrosive environment, as determined by OWNER, shall be lined with noncorrosive material as specified. Existing manholes in a corrosive environment shall be replaced with new lined precast concrete manholes.

- B. Lining for manholes shall be HDPE (studded) liner as manufactured by AGRU, or PVC Duraplate 100 Liner System as manufactured by ALOK.
 - 1. HDPE Liner:
 - a. Sheets shall be studded and have a minimum design thickness of 2 mm (0.079 inch).
 - b. Provide minimum of 39 anchoring studs per square foot of liner.
 - 2) Minimum Stud Height: Minimum 9 mm (0.39 inch) with a minimum length of 14 mm (0.55 inch).
 - 2) Capable of resisting continuous hydraulic backpressure, to a minimum of 40 feet of hydraulic head, exerted between interior wall of concrete structure and anchoring stud side of protective liner.
 - 2. PVC Liner, Channel Joints, H-joints and Corner Joints:
 - a. Manufactured from polyvinyl chloride resin.
 - b. White in color to assist in providing a light reflective environment.
 - c. All sheet compounds shall result in a semi-rigid material for thermoforming to the contour of the structure and shall maintain a minimum wall thickness of 1.7mm (0.065 inch).
 - 3. Lined manholes shall have a flat top that is lined with same type of protective liner as manhole.
 - 4. Provide a rubber gasket between structures for a watertight seal. Gasket shall be DURA-Plate-Lok-Sealant MT-320 measuring 0.5 inch by 1.5 inches to be placed on the return. When the two sections are coupled, the butyl-lok will displace over the return on the bell and tongue ends of the liner.

- C. Linings shall be installed by certified lining manhole precaster, while constructing the manhole, in strict conformance with the manufacturer's requirements.

2.12 PNEUMATIC SPRAYED CEMENTITIOUS LINING

- A. Pneumatic sprayed cementitious lining shall be used for manhole rehabilitation only.

- B. Cementitious Lining Material:
 - 1. Prepackaged mortar mix, including cement, aggregates, and any required additives.
 - 2. Add proper amount of potable water so as to produce concrete suitable for spray application.
 - 3. Do not add portland cement, other aggregates, or any admixtures.

- C. Mortar Mix Design Properties:
 - 1. Compressive Strength: ASTM C109, greater than 8,000 psi in 28 days.

2. Flexural Strength: ASTM C293, greater than 1,200 psi 28 days.
 3. Tensile Strength: ASTM C496, greater than 800 psi in 28 days.
 4. Shrinkage at 28 Days: ASTM C596, greater than 0.1 percent cured at 90 percent relative humidity.
 5. Freeze/Thaw: ASTM C666, no visible damage after 100 cycles.
- D. Water used in mixing shall be fresh, clean, potable water, free from injurious amounts of oil, acid, alkali, vegetable, sewage or organic matter.
- E. Manufacturers:
1. Strong Seal.
 2. SewperCoat.
 3. Permacast.
 4. Quadex.

2.13 CHIMNEY LINER AND SEALS

- A. Manufacturers and Products:
1. Cretex Specialty Products; Internal Manhole Chimney Seal.
 2. NPC, Inc.; FlexRib Chimney Seal.
 3. Sealing Systems, Inc.; Flex-Seal.

2.14 MANHOLE LID PLUGS

- A. Plug shall consist of a gasketed bolt as manufactured by Cretex, Style 3.

2.15 MANHOLE EXTERNAL JOINT SEALS

- A. External joint seals shall be utilized for manholes that are in low lying areas, as determined by the OWNER, to prevent infiltration by providing a water-tight seal.
- B. External joint seal shall be made of EPDM rubber with a minimum thickness of 65 mils. Each unit shall have a 2-inch wide mastic strip on the top and bottom edge of the rubber wrap. The mastic shall be nonhardening butyl rubber sealant, with a minimum thickness of 250 mils.
- C. Manufacturer and Product: Sealing Systems, Inc.; Infi-Shield Seal Wrap.

PART 3. EXECUTION

3.01 LOCATE MANHOLES

- A. Locate existing manholes not visible at the surface using metal detectors or other means of detection.

3.02 MANHOLE FOUNDATIONS

- A. Dewater sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to and during placement of the foundation. Obtain an adequate foundation for all manhole structures by removing and replacing unsuitable material with well-graded granular material, by tightening with coarse rock, or by such other means as provided for foundation preparation of the connected sewers or as directed by the OWNER.
- B. Wherever water is encountered at the construction site, CONTRACTOR shall place all cast-in-place bases or monolithic structures on a one-piece waterproof membrane with a minimum thickness of 40 mils to prevent any movement of water into the fresh concrete.
- C. Thoroughly wet and completely fill all precast manhole joints with non-shrinking grout to a smooth finish, both inside and outside of the manhole

3.03 MANHOLES INSTALLED ON EXISTING LINES

- A. For all lines 12 inches in diameter or less, a section of pipe shall be removed and a complete precast manhole installed. The existing pipes shall be joined by a flexible coupling (Section 02532, Sanitary Sewers) to pipe extensions from the manhole. Minimum 4-foot pipe extension shall be required from manhole to connect to existing pipe. By-pass pumping shall be conducted in accordance with Section 02540, Sewer Flow Control, and other requirements of the OWNER or regulatory agency having jurisdiction. The most stringent requirements shall apply.
- B. Monolithic (poured-in-place) manholes must be approved in advance by the OWNER.

3.04 MANHOLE SPACING

- A. The maximum center-to-center distance between manholes shall be 400 feet for pipe diameters of 21 inches and smaller, and shall be 500 feet for larger pipes.

3.05 MANHOLE DIAMETERS

- A. In general, the internal diameter of manholes shall be 4 feet for lines less than 18 inches in size. Lines from 18 inches to 24 inches shall have 5-foot diameter manholes, and lines larger than 24 inches shall have 6-foot diameter manholes.
- B. Manhole diameter sizing, however, is contingent upon limitations of manufacturer due to pipe sizes and pipe deflections at manhole. CONTRACTOR shall verify proper manhole diameter is provided based on proposed manhole pipe configuration and pipe sizes indicated. Manhole sizing shall be approved by the OWNER.

3.06 MANHOLE ADJUSTMENTS

- A. Manholes shall be raised or lowered to the final grades in a watertight manner. Two rings of butyl mastic sealant shall be used for all grade rings. Where manholes are raised 12 inches or more, the existing cone shall be removed and precast sections installed. No more than one concrete grade rings shall be installed above the manhole cone. All testing must be repeated following any manhole adjustments.

3.07 DROP MANHOLES

- A. Where the difference in invert elevation of two intersecting sewers in a manhole is 2 feet or more, an outside drop connection shall be constructed. Drop connection shall be constructed and encased at the precast facility as part of the base section or fabricated in the field, as directed by the OWNER.

3.08 CONFLICT MANHOLES

- A. Where two or more sewers intersect and conflict with each other construct a conflict manhole conforming to the Drawings.

3.09 FRAMES AND COVERS

- A. Cast iron frames and covers shall be set at the required elevation and properly bonded to the masonry with two rings of butyl mastic sealant and anchor bolts.
- B. OWNER standard watertight frame and cover shall be used in flood prone areas, and areas where water ponds or could pond, including traffic areas.
 - 1. Where shown on the Drawings, vents shall be installed in long runs of sewers, potentially with watertight frames and covers. Vents shall be designed and constructed to preclude water entering the sewer system during storm events through the vents.
- C. OWNER standard frame and cover shall be used in all other areas. Cover shall be provided with an inset gasket.
- D. Manhole rim elevations shall be set at grade in traffic areas and finished landscaped areas (finished grade is at the top of mulch in finished landscape areas), shall be set at

3 inches above grade in nonfinished landscaped areas, and to be set at 2 feet or more above finish grade in nontraffic and nonlandscaped areas.

- E. Wherever manholes are constructed in paved areas, the top surface of the frame and cover shall conform to the exact slope, crown, and grade of the existing adjacent pavement.

3.10 MANHOLE ABANDONMENT PROCEDURES

- A. Cut pipes on the outside of manhole, and plug with brick and mortar.
- B. Brick and mortar pipe openings inside manhole, including drop connections and laterals.
- C. Remove the manhole frame, cover, and grade rings. Disposal to be off Site. Remove precast cones and risers if they are exposed.
- D. Fill abandoned manholes with backfill material as specified in Section 02321, Excavation, Bedding, and Backfill for Utilities. Fill with flowable fill where shown on Drawings.
- E. Lines to be abandoned that enter an existing manhole shall be cut on the outside of the manhole and the inlets shall be plugged with brick and mortar to ensure a watertight structure.

3.11 MANHOLE REHABILITATION

- A. General:
 - 1. Use pneumatic sprayed cementitious lining to repair the interior of all existing rehabilitated manholes (concrete or brick). Membrane linings shall not to be used to repair existing manholes.
 - 2. Remove manhole steps prior to cementitious lining installation and do not replace manhole steps after lining installation.
- B. Brick Cones: In existing concrete manholes with brick cones, if replacement of the brick cone is required, replace the brick cone with circular cast-in-place concrete flat slabs.
- C. Cementitious Lining Installation:
 - 1. Install pneumatic sprayed cementitious lining in strict conformance with manufacturer's requirements.
 - 2. Preparation for Application: Ensure the following:
 - a. Sub-surfaces are clean and free of loose material.
 - b. Sub-surfaces have been prepared to a minimum degree of roughness designated as required by manufacturer.

- c. Equipment to be used will operate within manufacturer's specifications.
 - d. Surface dryness is in accordance with manufacturer's requirements.
 - e. Inflow (seeping or weeping) into the manhole has been eliminated.
 - 3. Mixing:
 - a. Thoroughly mix by mechanical means
 - b. Each batch of material shall be entirely discharged before recharging with fresh material.
 - c. Mixing equipment shall be cleaned at regular intervals to remove all adherent materials.
 - d. The addition of water to the mix shall be in strict accordance with the manufacturer's recommendations.
 - e. Re-mixing or tempering shall not be permitted. Rebound materials shall not be reused.
 - 4. Application:
 - a. Pneumatic sprayed cementitious lining shall not be applied to a frozen surface or to a surface that may freeze within 24 hours of application. Frozen conditions shall be defined as ambient temperatures of 32 degrees F or below.
 - b. Construction joints within a manhole shall not be allowed.
 - c. Minimum Thickness: 1-inch cover over all surfaces.
 - 5. Cure cementitious lining material in strict conformance with manufacturer's requirements. Curing compounds may be permitted to assist curing, but shall be approved by manufacturer and OWNER prior to application.
- D. Sampling and Testing:
- 1. A recognized independent testing laboratory shall test mortar materials used on the project. Specific materials recommended by the OWNER shall be tested, if required.
 - 2. The cost of sampling and testing of the mortar mix shall be born by the CONTRACTOR. Other testing required showing conformance with these specifications shall be the responsibility of the CONTRACTOR.
 - 3. Certified test reports and certificates, when so requested, shall be submitted to the RESIDENT PROJECT REPRESENTATIVE.

3.12 CHIMNEY LINER

- A. The chimney liner shall be measured and installed in accordance to manufacturer's recommendation. Chimney seals are to be installed as shown on the Drawings or as directed by the OWNER.

3.13 MANHOLE VACUUM TESTING

- A. The CONTRACTOR shall provide all labor and equipment for vacuum testing.
- B. All manholes are to be vacuum tested following backfill and compaction. The ring and lid casting assembly shall be installed prior to testing. The testing equipment shall consist of a gasoline-powered vacuum pump with sufficient vacuum hose length and a test head of proper size to fit the inside opening of the manhole. The test head shall be equipped with an inflatable rubber bladder to affect the seal to the manhole, an air pressure gauge, and a safety valve for filling the bladder, a 30-inch Hg liquid-filled vacuum gauge, a double air exhaust manifold with quarter turn ball valves, three bolt-on feet, and a bridge assembly with height adjustment rod.
- C. CONTRACTOR shall plug all pipe openings, taking care to securely brace the plugs and the pipe. The plugs shall be placed a minimum of 6 feet beyond the manhole wall.
- D. With the vacuum tester in place, inflate the compression to affect a seal between the vacuum base and the structure. Connect the vacuum pump to the outlet port with the valve open and evacuate the manhole to 10 inches Hg (0.3 bar) for 48-inch diameter manholes and 5 inches Hg (0.15 bar) for 60-inch and greater diameter manholes.
- E. Close vacuum inlet/outlet ball valve, disconnect the vacuum pump, and monitor the vacuum for the specified time period. If the vacuum does not drop in excess of 1-inch Hg over the specified time period, the manhole if considered acceptable passes the test. If the manhole fails the test, identify the leaking areas by removing the head assembly, coating the interior surfaces of the manhole with a soap and water solution, and repeating the vacuum test for approximately thirty seconds. Once the leaks have been identified, complete all necessary repairs by sealing the leaks of the manhole to the satisfaction of the OWNER, and repeat test procedures until satisfactory results are obtained.

Vacuum Test Timetable			
Depth (Feet)	Manhole Diameter (Inches)		
	48"	60"	72"
4'	10 sec.	13 sec.	16 sec.
8'	20 sec.	26 sec.	32 sec.
12'	30 sec.	39 sec.	48 sec.
16'	40 sec.	52 sec.	64 sec.
20'	50 sec.	65 sec.	80 sec.
24'	60 sec.	78 sec.	96 sec.
*	5.0 sec.	6.5 sec.	8.0 sec.

*Add extra testing time "T", for each additional 2-foot depth. (The values listed above have been extrapolated for ASTM designation C924-85.)

- F. The OWNER and RESIDENT PROJECT REPRESENTATIVE reserves the right to reject any and all manholes that do not pass vacuum testing requirements, and replacement shall be at the CONTRACTOR's expense. A significant number of leaks on a single manhole or significant number of manholes leaking shall be considered as a basis for rejection and replacement of manholes.

END OF SECTION



SECTION 02532
SANITARY SEWERS (GRAVITY)

PART 1. GENERAL

1.01 SCOPE

- A. The Work to be performed herein shall consist of the installation of wastewater gravity lines and lateral connections according to the Specifications and the Standard Drawings herein.

1.02 DEFINITIONS

- A. CCFMP: Centrifugally Cast Fiberglass Mortar Pipe.
- B. CCTV: Closed Circuit Television.
- C. SDR: Standard Dimension Ratio.
- D. HDPE: High Density Polyethylene
- E. Pipe Stiffness Classification: Referred to as SN.
- F. Pressure Class: Referred to as PN.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Information on gasket polymer properties.
 - 2. Tee fabrication details.
 - 3. Application methods, application requirements, and chemical resistance data for coating and lining products.
 - 4. CCFMP:
 - a. Detailed pipe fabrication drawings showing pipe details, special fittings and bends, dimensions, coatings, standards for design, and other pertinent information.
 - b. Layout drawing showing location of each pipe section and, if special sections are provided, each special length.
 - c. Pipe pressure class and pipe stiffness.
 - d. Details for connections to noncentrifugally cast fiberglass mortar pipe material or other nonfiberglass pipe material.



- e. Product Data:
 - 1) Manufacturer's data for couplings, fittings, saddles, gaskets, and other pipe accessories. Indicate maximum rated working pressure and test pressure for each item. Indicate storage requirements, installation, and repair instructions.
 - 2) Lining and coating data for protection of metallic fittings.

B. Informational Submittals:

- 1. Certificates:
 - a. Manufacturer's Certificate of Compliance for each type of pipe that products furnished meet requirements of this section.
 - b. Certification of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
 - c. Certified statement from manufacturer of gaskets, setting forth that basic polymer used in gaskets and test results of physical properties of compound are in accordance with ASTM F477 for PVC pipe and AWWA C111 for ductile iron pipe.
- 2. Manufacturer's Written In-Plant Quality Control Program: Quality control procedures and materials testing to be used throughout manufacturing process. Submit prior to manufacture of any pipe for this Project.
- 3. Manufacturer's written recommendations for pipe handling and installation.
- 4. CCFMP:
 - a. Provide historical data indicating that polyester resin systems have proven history of performance for use with pipe similar in construction and composition to proposed product.
 - b. Report from CONTRACTOR identifying vertical cross-section deflections after completion of backfilling and removal of dewatering systems.
- 5. Pipe deflection test results.
- 6. Field Leakage Testing Plan: Submit at least 15 days in advance of the testing and include at least the following:
 - a. Testing dates.
 - b. Piping systems and sections to be tested.
 - c. Test type.
 - d. Method of isolation.
 - e. Method of conveying water from source to system being tested.
 - f. Calculation of maximum allowable leakage for piping section(s) to be tested.
 - g. Method for disposal of test water, if applicable.
- 7. CCTV Inspection Equipment: Submit minimum 15 days prior to performing inspections:
 - a. Name and qualifications of inspection firm.
 - b. Brand name and model number of video equipment to be used.
- 8. Leakage test results.



1.04 QUALIFICATIONS

- A. CCTV Inspection Firm: Actively performed such services for minimum of 2 years.

PART 2. PRODUCTS

2.01 PIPE

- A. All materials will be visually inspected by the OWNER at the Site for conformance to the Specifications. At the OWNER's discretion the CONTRACTOR may be required to supply certified mill tests, samples, or other suitable form of verification that the material meets the required specifications.
 - 1. Polyvinyl chloride (PVC) pipes and fittings shall meet or exceed the requirements of ASTM D3034, SDR 26 for pipe from 4 inches to 15 inches in diameter. For sizes from 18 inches to 24 inches in diameter, the pipe shall meet or exceed the requirements of ASTM F679, wall thickness T-1.
 - 2. Ductile Iron Pipe:
 - a. Made of good quality ductile iron in conformance with the latest revision of AWWA C151/A21.51.
 - b. Push-on joint with a minimum pressure class of 150 psi for pipe sizes 24 inches and larger.
 - c. Ceramic epoxy lined and coated outside with an asphaltic coating.
 - d. Ceramic Epoxy Lining:
 - 1) 40-mils dry film thickness lining, consisting of amine cured novolac epoxy containing at least 20 percent by volume quartz pigment manufactured under the name of Protecto 401.
 - 2) Line interior of bell and exterior of spigot in joint sealing areas with 6 mils to 10 mils of specified lining.
 - 3) Surface Preparation: SP10 near-white abrasive blast.
 - 4) Pinhole Detection: 2,500 volts minimum over 100 percent of lined surfaces.
 - 3. HDPE:
 - a. Pipe and fittings shall be a minimum of SDR 17 meeting the requirements of AWWA C906, with DIP outside pipe diameters, External green stripe, light interior color, and heat fusion welded joints.
 - b. Provide butt welded or electro-fusion pipe fittings.
 - 4. CCFMP:
 - a. Manufactured according to the following standards:
 - 1) ASTM D3262, Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
 - 2) ASTM D4161, Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

- 3) ASTM D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- b. Service Conditions and Design Requirements:
 - 1) External Loads: To be determined for individual application, including depth of cover and embedment condition. Embedment shall be per Section 02321, Excavation, Bedding, and Backfill for Utilities.
 - 2) Pipe Stiffness: SN shall be a minimum of 46 and shall be determined based on project site conditions.
- c. Resin: Manufacturer shall use only polyester resin system with proven history of performance for pipe manufacturer. Historical data shall have been acquired from composite material of similar construction and composition as proposed product.
- d. Glass Reinforcement: Reinforcing glass fibers used to manufacture components shall be of highest quality commercial Grade E glass filaments with binder and sizing compatible with impregnating resins.
- e. Silica Sand: Minimum 98 percent silica with maximum moisture content of 0.2 percent.
- f. Additives: Curing agents, pigments, dyes, fillers, thixotropic agents, when used, shall not detrimentally affect performance of product.
- g. Lengths: Pipe shall be supplied in nominal lengths of 20 feet. Actual laying length shall be nominal plus 1 inch, minus 4 inches. At least 90 percent of pipe supplied for each class of pipe shall be furnished in nominal length sections.
- h. Pipe Ends: Square to pipe axis with maximum tolerance of 1/8 inch.
- i. Joints:
 - 1) Pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing couplings that utilize elastomeric sealing gaskets made of EPDM rubber compound as sole means to maintain joint water tightness.
 - a) Joints shall meet requirements of ASTM D4161.
 - b) Rated for working, test, and surge pressures, even under deflected conditions.
 - c) Tie-ins, when needed, may utilize gasket-sealed mechanical couplings.
 - 2) Gaskets: Suitable for service conditions and loads indicated.
 - 3) Joint Lubricant: Suitable for service conditions and as recommended by manufacturer.
- j. Fittings: Change in direction or any deflection angles shall be accomplished with manholes as indicated on Drawings or fittings with manhole risers for pipe larger than 48 inches.
- k. Manufacturers:
 - 1) Hobas Pipe USA, Inc.
 - 2) Amitech USA; Flowtite.



2.02 COUPLINGS

A. Flexible Couplings:

1. Designed to join sewer pipes of the same or different material or sizes. Flexible couplings shall fit over the end of plain end or spigot pipe to form a positive seal against infiltration and exfiltration in nonpressure applications. Flexible couplings shall flex with normal earth movement to maintain integrity of seal. Use of flexible couplings shall be at the OWNER's discretion.
2. Manufactured from elastomeric polyvinyl chloride (PVC) which is unaffected by soil conditions and resistant to chemical, ultraviolet rays, and normal sewer gases. The PVC material shall contain bactericide and fungicide to inhibit growth of bacteria and fungus. The PVC material shall be 55 minimum to 65 maximum Shore A durometer hardness. Couplings shall conform to the applicable parts of ASTM C443, ASTM C425, ASTM C564, and ASTM D1869.
3. Flexible coupling shall be supplied with two corrosion resistant Series 300 stainless steel clamps, which when tightened to 60 inch-pounds torque, seal the joint.
4. Approved and listed by all of the following code agencies: SBCCI (Southern Building Code Congress International, Inc.), BOCA (Building Officials & Code Administrators International, Inc.), IAPMO (International Association of Plumbing and Mechanical Officials), and CSA (Canadian Standards Association).

B. HDPE Couplings: Electro-fusion couplings meeting the same requirements as HDPE pipe.

2.03 CCFMP SOURCE QUALITY CONTROL

A. Factory Testing: Manufacturer shall perform the following in plant tests, according to ASTM D3262 and shall supply submittals of test results prior to delivery of pipe to Site. Factory testing shall be performed on pipe sections to be furnished for this Project and shall include:

1. Production test.
2. Long term hydrostatic qualification test.
3. Joint tightness qualification test.
4. Beam strength and longitudinal tensile strength qualification test.

2.04 DOUBLE SWEEP CLEANOUT

A. Double sweep cleanout shall be SDR 35 as manufactured by Plastic Trends, Inc.



2.05 CLEANOUT BOX

- A. Cleanout box in paved areas shall be metal with screwed down cap Model Z1402 as manufactured by ZURN Industries.
- B. Cleanout box in unpaved areas shall be high-density polyethylene of one piece molded construction, Model MSBCF1015-12 with polymer concrete cover, Model 1015, gray, marked "SEWER" with lift eye as manufactured by Carson Industries, LLC. Cleanout cap inside the cleanout box in unpaved areas shall be PVC.

PART 3. EXECUTION

3.01 GENERAL DESIGN REQUIREMENTS

- A. Plan and profile drawings have been prepared and sealed by a Professional Engineer licensed by the State of Tennessee.
- B. Sewers shall be designed with a 10-foot horizontal separation from any existing or proposed water main. If this is not practical, the sewer may be placed closer than 10 feet to a water main, provided it is laid in a separate trench and the elevation of the top of the sewer is at least 18 inches below the bottom of the water main, or as directed by the OWNER.
- C. Where a sewer crosses under a water main, the top of the sewer shall be at least 18 inches below the bottom of the water main. If the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation, or the water main shall be reconstructed with ductile iron pipe for a distance of 10 feet on each side of the sewer with a full pipe section of the water main centered over the sewer, or as directed by the OWNER.



D. Minimum slope for sanitary sewers shall be as follows:

Pipe Size	Min. % Slope
6"	0.62%
8"	0.40%
10"	0.28%
12"	0.22%
15"	0.15%
18"	0.12%
21"	0.10%
24"	0.08%

- E. Minimum slope for other diameters shall be such that a minimum velocity of 2 feet per second is maintained while the pipe is flowing full.
- F. Where the slope of a sewer line is in excess of 20 percent, the line shall be constructed of push-on or mechanical joint ductile iron pipe, Protecto 401 lined, with concrete anchors at each joint or as specified by the OWNER (See Figure 1-02532-a).
- G. Minimum cover in roadways and other traffic-bearing areas is 48 inches for PVC, HDPE, and CCFMP pipe and 30 inches for ductile iron pipe. In nontraffic-bearing areas, the minimum cover is 30 inches.
- H. Pipe depths greater than 17 feet shall generally require ductile iron pipe and shall be approved by the OWNER. Specific design of other pipe types to meet depth requirements will be considered by the OWNER.
- I. Ductile iron pipe or HDPE shall be used beneath waterways which have a continuous flow of water. Provide concrete encasement when joints on the ductile iron pipe are located beneath waterways, or as directed by OWNER .
- J. The maximum spacing for manholes shall be 400 feet for pipe diameters of 21 inches and smaller and 500 feet for larger pipes.
- K. Where the difference in the invert elevations of two sewers intersecting in a manhole is 2 feet or more, a drop manhole shall be provided in accordance with Section 02530, Manholes.

- L. When ductile iron pipe must be used on a portion of a new sewer line segment due to minimum or maximum cover, water line proximity, or waterway crossing, ductile iron pipe shall be installed from manhole to manhole. No flexible couplings will be permitted on new construction to convert to PVC between manholes.

- M. Sanitary Sewers in Proximity with Storm Sewers:
 1. New Parallel Sewer Construction: Minimum horizontal separation shall be greater than or equal to 3 feet outside to outside.
 2. New Sewer Crossings: Minimum vertical separation shall be greater than or equal to 24 inches.
 3. When horizontal separations are less than 3 feet, the minimum sanitary sewer pipe material specification shall be C900 or C905 (SDR18) PVC Pipe, or Class 150 Ductile Iron Pipe with Protecto 401.
 4. When vertical separations are less than 2 feet, the sewer pipe shall be Class 150 Ductile Iron Pipe with Protecto 401, and the lower pipe shall be exposed down to the springline and encased in concrete.

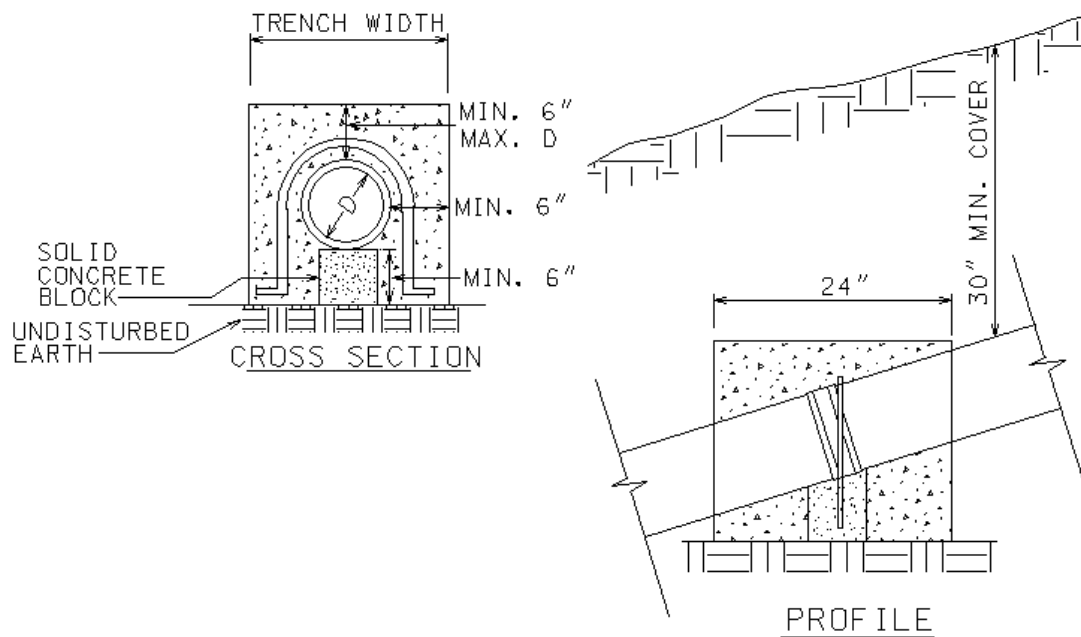


Figure 1-02532-a (Concrete Anchor Detail)

Notes:

- I. For pipe diameters greater than 24 inches. Dimensions will increase as directed by OWNER.
- II. Concrete anchors are to be used.
- III. Pipe joint must be completely encased in concrete.



3.02 PVC AND DUCTILE IRON PIPE INSTALLATION

- A. All pipe shall be installed in the presence of the OWNER. Do not begin the backfilling of trenches until the pipe in place has been visually inspected by the OWNER. Pipe installation shall begin at the lowest elevation, unless otherwise approved by the OWNER.
- B. Before placing sewer pipe in position in the trench, carefully prepare the bottom and sides of the trench, and install any necessary bracing and sheeting as provided in Section 02321, Excavation, Bedding, and Backfill for Utilities.
- C. Lasers shall be used to install sewer lines and the type and procedures shall be approved by the OWNER. Reference points for both line and grade shall be set at each manhole. Where grades are 0.6 percent or less, check the elevation of the beam each 100 feet with an offset point or engineer's level.
- D. Do not allow water to run or stand in the trench while pipe laying is in progress or before the trench has been backfilled. Do not at any time open up more trenches than the available pumping facilities are able to dewater.
- E. Trench bottoms that are found to be unsuitable for foundations after pipe laying operations have started shall be corrected by bringing them to exact line and grade with minimum 3/4-inch material approved by the OWNER.
- F. Carefully inspect each piece of pipe and special fitting before it is placed, and lay no defective pipe in the trench. Pipelaying shall proceed upgrade, starting at the lower end of the grade and with the bells upgrade. When pipe laying is not in progress, keep the ends of the pipe tightly closed with an approved temporary plug.
- G. Excavation for bell holes shall be large enough to allow ample room for the pipe joints to be properly made. Excavate out bell holes no more than 2 joints ahead of the pipe laying. Carefully grade the bottom of the trench between bell holes so that each pipe barrel rests on a solid foundation as specified in Section 02321, Excavation, Bedding, and Backfill for Utilities. Install each pipe with a close concentric joint to avoid sudden offsets or inequalities in the flow line.
- H. As the Work progresses thoroughly clean the interior of the pipe in place. After each line of pipe has been laid, carefully inspect it, and remove and, in accordance with all laws and regulations, dispose of all earth, trash, rags, and other foreign matter from its interior.

- I. Install tee branches in sewer lines to serve properly each lot adjoining the sewer and at such other locations as may be designated by the OWNER. If tee branches are not to be used immediately, close them with approved plugs that are held in place to prevent infiltration and withstand all test requirements.
- J. For all tees that are plugged and laid in rock, cut or blast a minimum of 6 linear feet of ditch line in the direction and to the approximate grade of the future lateral as directed by the OWNER, but do not excavate the material. Furnish the OWNER with a record of the exact location of each tee installed.
- K. If the Work consists of constructing a new sewer to replace an existing one, existing laterals shall be replaced to the property line. Laterals which have been disconnected, cut or abandoned shall be plugged and sealed with a backing block securing the plug.
- L. New service laterals with cleanouts will be required for each active service. Cleanouts should be located on the property line or easement in most cases. However, where a long lateral crosses another private property, the cleanout should be located at the road right-of-way.

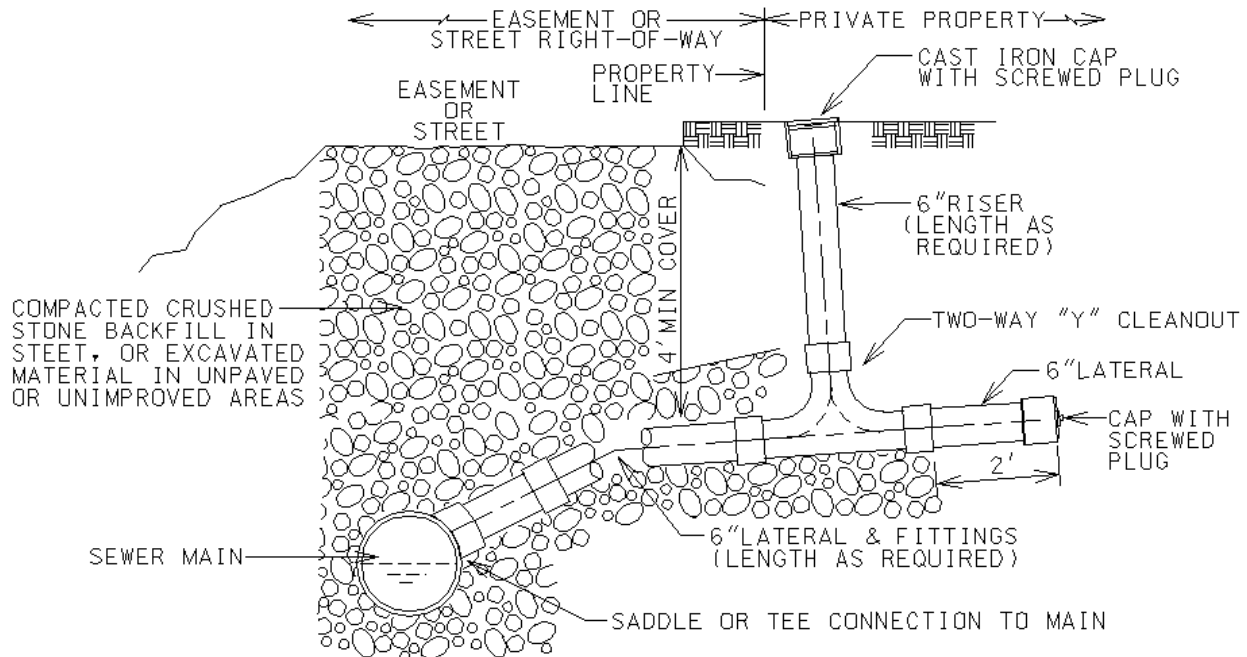


Figure 2-02532-b (Typical Installation of Service Lateral)

Notes:

- I. OWNER (KUB) or an approved contractor will install lateral from main to a point 2 feet on customer side of cleanout.
 - II. Property owner (customer) is responsible for installation from 6-inch plug to customer residence and maintenance of lateral all the way from residence to sewer main.
 - III. Customer installed portion of lateral must be minimum 4-inch diameter and have minimum slope of 1 percent.
 - IV. Additional cleanouts may be required on private property portion of lateral.
 - V. Customer must contact city plumbing inspector for permits, inspection, and standard plumbing code requirements within city and OWNER for inspection in county.
 - VI. All lateral pipe to be bedded with 6-inch minimum bedding material above and below pipe.
- M. For new service laterals to be installed on existing sewer lines larger than 6 inches in diameter, a sewer saddle as specified in Part 2 above may be used in lieu of a tee section. The saddle shall be installed on a clean-cut, properly sized hole on the existing sewer, such that a watertight connection results. The cut in the existing pipe shall be made with a hole saw which retains the coupon. Sewer saddles shall not be used on vitrified clay pipe, or any other pipe deemed unsuitable for this method by the OWNER.



- N. For new service laterals to be installed on existing sewer lines 6 inches in diameter, or as required by the OWNER, the existing line shall be cut and a watertight tee section shall be installed, while pumping the existing wastewater flow around the work zone. The tee section shall consist of a new tee of the same diameter as the existing pipe, with short sections of pipe on either end. The tee section shall be installed with waterproof flexible couplings on each end as specified in Part 2 above to connect the pipe to the new tee section.
- O. Install new service laterals to existing manholes as specified in Section 02530, Manholes. Reshape the bottom at the manhole as necessary to fit the invert of sewer pipe.
- P. Carefully protect from damage all existing sewers, water lines, gas lines, sidewalks, curbs, gutters, pavements, electrical lines, and other utilities or structures in the vicinity of the work at all times. If it is necessary to repair, remove, and/or replace any such utility or structure in order to complete the work properly, do so in compliance with the provisions set forth in other sections of these Specifications. Any such work shall be considered incidental to the construction of sewer mains.
- Q. Service or house connections to existing sewers that are damaged or removed shall be repaired or replaced by the CONTRACTOR at its own expense as an incidental part of the Work.
- R. Wastewater flow shall be maintained in the existing sewers in accordance with Section 02542, Sewer Flow Control. Whenever pipe laying progresses to the point where this flow must be interrupted, the CONTRACTOR shall plug the sewer upstream of the construction and provide by-pass pumping to the downstream manhole. All downstream pipes, manholes and appurtenances must be tested and acceptable to the OWNER to receive wastewater flow. Discharging raw wastewater to natural waterways will not be permitted. The CONTRACTOR shall notify the OWNER prior to proceeding with by-pass pumping. When working in areas where interruption of wastewater flow may occur, the CONTRACTOR shall have lines and all other equipment in readiness at the site to provide by-pass pumping. A back-up pump and hose is required. CONTRACTOR will be liable for clean ups, fines, and any other problems that may occur. All equipment will be checked by OWNER for proper working conditions.

3.03 HDPE PIPE INSTALLATION

- A. HDPE pipe shall be installed by in accordance with Section 02955, Sanitary Sewer Pipe Bursting with HDPE.

3.04 CCFMP INSTALLATION

A. General:

1. Join pipe in accordance with manufacturer's instructions, unless otherwise shown or specified.
2. Inspect pipe before installation. Clean ends thoroughly and remove foreign matter and dirt from inside.

3.05 SERVICE LATERALS

A. Service Laterals

1. Install service laterals to the property line or easement line with a minimum 6-inch PVC (SDR 26) service laterals with a minimum slope of 1 percent.
2. Provide new PVC cleanout in cleanout box, with a two way directional cleanout tee at the right-of-way line or easement line.
3. Installation to CIPP shall require removing existing pipe 1 foot each side of service lateral connection point to the sewer main to accommodate new service lateral connection.
4. Provide metal cleanout box over the vertical extension of the two-way cleanout.
5. Provide 6-inch by 4-inch concentric PVC reducer to connect 6-inch lateral to 4-inch private property lateral.

3.06 CONNECTION TO SEWER MAINS

- A. Make connections to ductile iron pipe with a minimum 6-inch ductile iron saddle with Protecto 401 ceramic epoxy coating.
- B. Make connections to HDPE with a minimum 6-inch HDPE branch or electro-fusion saddle or for 10-inches or greater installations a minimum 6-inch "Inserta-Tee" (Inserta Fittings Company).
- C. Make connections to CCFMP with a minimum 6-inch "Inserta-Tee" (Inserta Fittings Company).
- D. Connections to 8-inch CIPP mains shall be with a full saddle PVC tee solvent welded skirt to the liner with stainless steel straps, and minimum 6-inch gasketed branch connection.
- E. Connections to greater than 8-inch CIPP mains shall be with a minimum 6-inch "Inserta-Tee" (Inserta Fittings Company).
- F. Make connections to PVC pipe mains with 6-inch PVC fitting.

3.07 TESTING OF GRAVITY SEWERS

A. Visual Tests:

1. Prior to backfilling, the OWNER will make a visual inspection of the sewer. The visual tests shall include a check for proper grade and alignment, sufficient pipe bedding, pipe condition, and general cleanliness. The CONTRACTOR shall immediately repair all defects found by such inspection.
2. Sewers shall be built so as to remain true to line and grade. The inclining grade of the bottom of the sewer after completion shall be such that, after flooding, the flood water drains off so that no remaining puddle of water is deeper than 1/2 inch on pipe 36 inches internal diameter or smaller and 3/4 inch on pipe larger than 36 inches internal diameter. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or re-laid at the CONTRACTOR's expense.
3. The CONTRACTOR shall be held strictly responsible that all parts of the work bear the load of the backfill. If cracks 1/100 inch develop in the pipe within one year from the date of final acceptance of the work, the CONTRACTOR shall be required to replace, at his expense, all such cracked pipe. To this end, the CONTRACTOR is advised to purchase pipe under a guarantee from the manufacturer, ensuring proper service of sewer pipe under conditions established by the Drawings, Specifications, and local conditions at the Site of the Work.

B. Air Testing for Sewers 24 inches in Diameter and Smaller:

1. The CONTRACTOR shall be responsible for providing all labor and equipment for air testing.
2. This recommended practice defines the proper procedures for acceptance testing of installed gravity sewer pipe using low-pressure air, to provide assurance that the pipe, as installed, is free from significant leaks. Included are requirements for equipment accuracy, safety precautions, line preparation, test method, and minimum holding times. Air test results shall be recorded on the work sheet, which is included below in Paragraph Air Test Data Sheet.
3. Only lines tested after backfilling to final grade will be considered for acceptability. However, this test may also be used by the installer as a presumptive test to determine the condition of the line prior to backfilling. During sewer construction, all service laterals, stubs and fittings into the sewer test section shall be properly capped or plugged to prevent air loss that could cause an erroneous air test result. It may be necessary and is always advisable for the CONTRACTOR to restrain gasketed caps, plugs, or short pipe lengths with bracing stakes, clamps, and tie-rods or wire harnesses over the pipe bells.
4. Unless otherwise specified, the CONTRACTOR shall furnish all the necessary equipment and be responsible for conducting all low-pressure air tests. In addition, the CONTRACTOR shall be responsible for any necessary repair work on sections that do not pass the test.

5. The OWNER shall witness all low-pressure air tests and verify the accuracy and acceptability of the equipment utilized. The OWNER will inform the CONTRACTOR regarding acceptable methods of repair in the event one or more sections fail to pass the low-pressure air test.
6. Ensure that all plugs are installed and braced in such a way that blowouts are prevented. As an example of the hazard, a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psig, and a force of 2,250 pounds is exerted on a 24-inch plug by an internal pressure of 5 psig. The CONTRACTOR must realize that sudden expulsion of a poorly installed plug, or of a plug that is partially deflated before the pipe pressure is released, can be very dangerous. For this reason, it is recommended that every plug be positively braced against the manhole walls, and that no one be allowed in the manhole adjoining a line being tested so long as pressure is maintained in the line.
 - a. It is further recommended that internal pressure of more than 9 psig not be permitted except for leak location equipment where the plugs are firmly tied together.
 - b. Use either mechanical or pneumatic plugs. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the CONTRACTOR should internally restrain or brace the plugs to the manhole wall as an added safety precaution throughout the test.
7. All pressurizing equipment used for low-pressure air testing shall include a regulator or relief valve set no higher than 9 psig to avoid over-pressurizing and displacing temporary or permanent plugs. As an added safety precaution, the pressure in the test section should be continuously monitored to make certain that it does not at any time exceed 9 psig. (It may be necessary to apply higher pressure at the control panel to overcome friction in the air supply hose during pressurization.)
8. To facilitate test verification by the OWNER, all air used shall pass through a single, above ground control panel. The aboveground air control equipment shall include a shut-off valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of plus or minus 0.04 psi. Two separate hoses shall be used to: 1) connect the control panel to the sealed line for introducing low-pressure air, and 2) a separate hose connection for constant monitoring of air pressure build-up in the line. This requirement greatly diminishes any chance for over-pressurizing the line.
 - a. If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel.
9. After a manhole-to-manhole reach of pipe has been backfilled to final grade and compacted, prepared for testing, and a 24-hour waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.

- a. The CONTRACTOR is advised to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. No persons shall be allowed in the alignment of the pipe during plug testing. It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important to high groundwater situations.
 - b. When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe, and this fault may be covered by the pipe plug, and thus not revealed by the air test.
10. Low-pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig. If the groundwater table is above the sewer being tested, the air pressure shall be increased 0.43 psi for each foot that the water table is above the invert of the sewer, up to a maximum of 9.0 psig. After a constant pressure of 4.0 psig (greater than the average groundwater back pressure) is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.
- a. When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average groundwater backpressure), the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average backpressure of any groundwater over the pipe). At a reading of 3.5 psig, timing shall commence with a stopwatch.
 - b. If the time shown for the designated pipe size and length (see Paragraph Air Test Time Tables, below) elapses before the air pressure drops 0.5 psig, the section undergoing test shall have passed. The test may be discontinued once the prescribed time has elapsed even though the 0.5 psig drop has not occurred. If the pressure drops 0.5 psig before the appropriate time shown in Table I has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.
 - c. If the section fails to meet these requirements, the CONTRACTOR shall determine at its own expense the source, or sources, of leakage, and shall repair or replace all defective materials or workmanship to the satisfaction of the OWNER. The extent and type of repair which may be allowed, as well as results, shall be subject to the approval of the OWNER. The completed pipe installation shall then be retested and required to meet the requirements of this test.

C. Testing for Sewers Larger than 24 Inches in Diameter:

1. The CONTRACTOR is responsible for providing all labor and equipment for testing. Testing may be accomplished via either ultrasonic test or seepage and infiltration test.
2. Ultrasonic Test
 - a. The CONTRACTOR shall utilize an ultrasonic method to detect leaks. An ultrasonic transmitter shall be utilized to determine if a leak has occurred, which will be indicated by the sound of a running faucet.
 - b. If the pipe is buried, then the ultrasonic test shall be carried out by placing a metal rod on the pipe and placing the transmitter on the metal rod to listen for leaks. Proceed in 10 to 25 foot intervals.
3. Seepage and Infiltration Test
 - a. Where the natural groundwater is 24 inches or more above the top of a section of pipe, the CONTRACTOR shall measure the flow of water in the pipe and the rates of seepage and infiltration. Measure the flow rate by using a calibrated weir. Leave the weir in the line until the flow rate has stabilized. The CONTRACTOR is responsible for verifying the groundwater level by providing sight gauges in manholes or digging test holes at suitable locations.
 - 1) The total seepage and infiltration of groundwater as determined by the test shall in no case exceed 50 gallons per 24 hours per inch-mile of pipe. Make infiltration tests on all sewer construction before placing the lines in service and before making any connections to other sewers. If the amount of infiltration into the sewer(s) is in excess of the maximum quantity specified above, then repair the joints, relay the sewer (if necessary), or perform other remedial construction, at the CONTRACTOR's expense, in order to reduce groundwater infiltration to within the specified limits.
 - 2) In making infiltration tests, furnish the required equipment and labor and do the necessary pumping under the direction on the OWNER. Tests may be repeated until each sewer individually meets the Specifications for infiltration amounts as set above.
 - b. Where the groundwater is not 24 inches or more above the top of the pipe section being tested, the CONTRACTOR shall perform an exfiltration test. Bulkhead the pipe below the lower manhole of the section being tested with a pneumatic plug or other device. Insert a vent pipe 48 inches long in the stopper of the upper end of that section. Then fill the lower manhole with water, or add water until there is a minimum of 4 feet over the upper end; make certain that all air is forced out through the vent tube. Measure the drop in the level of the water in the manhole due to exfiltration over a specific time, and calculate the water loss due to exfiltration. The total exfiltration shall not exceed that specified above for infiltration.



D. Air Test Time Tables:

1. The following tables indicate the time that must elapse before the air pressure inside the pipe drops 0.5 psig. If the pressure inside the pipe drops 0.5 psig before the time has completely elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.

**MINIMUM SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR
SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015 FT.³ /MIN.**

1 Pipe Dia. (in.)	2 Min. Time (min.: sec.)	3 Length For Min. Time (ft.)	4 Time for Longer Length (sec.)	Specification Time for Length (L) Shown (min.:sec.)			
				100 ft.	200 ft.	300 ft.	400 ft.
4	1:53	597	.190 L	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:51
8	3:47	298	.760 L	3:47	3:47	3:48	5:04
10	4:43	239	1.187 L	4:43	4:43	5:56	7:54
12	5:40	199	1.709 L	5:40	5:42	8:33	11:24
15	7:05	159	2.671 L	7:05	8:54	13:21	17:48
18	8:30	133	3.846 L	8:30	12:49	19:14	25:38
21	9:55	114	5.235 L	9:55	17:27	26:11	34:54
24	11:20	99	6.837 L	11:24	22:48	34:11	45:35



3.08 PIPE DEFLECTION TESTING

- A. The CONTRACTOR is responsible for providing all labor and equipment for deflection testing.
- B. Test deflection of the pipe by manually pulling with twine a one-piece nine-arm go/no-go mandrel (sized in accordance with ASTM D3034) through the pipe. Within 24 hours after compaction of the backfill is complete, the line shall be tested using a 5 percent deflection mandrel. If the line is satisfactory, it shall be retested using a 7.5 percent deflection mandrel no less than 30 days following the completion of compaction.

3.09 INSPECTION

- A. Television Pipeline Inspection:
 - 1. General:
 - a. Internally inspect sewer pipelines by closed circuit television (CCTV) after completion of pipeline cleaning and testing in accordance with Section 02541, Sewer Television Inspection.
 - b. Conduct the inspection in presence of the OWNER.

3.10 CLEANUP

- A. After completing each section of the sewer line, all debris and construction materials shall be removed from the work site and disposed of in compliance with all applicable laws and regulations and with Section 02321, Excavation, Bedding, and Backfill for Utilities. Then the surface shall be graded and smoothed on both sides of the line. The entire area shall be left clean and in a condition satisfactory to the OWNER. The CONTRACTOR shall keep cleanup operations as close to active pipe laying activities as practical generally following by less than 300 feet or as approved by the OWNER.

END OF SECTION



SECTION 02533
SANITARY SEWERS-AIR TEST GUIDELINES

PART 1. GENERAL

This section outlines the testing parameters to be used when conducting an air test on pipe used for sanitary sewers. See Section 02532, Sanitary Sewers (Gravity), for the actual procedures involved in conducting the test.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

3.1 TABLES

The following tables indicates the time that must elapse before the air pressure inside the pipe drops 0.5 psig. If the pressure inside the pipe drops 0.5 psig before the time has completely elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.



**MINIMUM SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR
SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015 ft.³/min.**

1 Pipe Dia. (in.)	2 Min. Time (min.: sec.)	3 Length For Min. Time (ft.)	4 Time for Longer Length (sec.)	Specification Time for Length (L) Shown (min.:sec.)			
				100 ft.	150 ft.	200 ft.	250 ft.
4	1:53	597	.190 L	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50
8	3:47	298	.760 L	3:47	3:47	3:47	3:47
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06

1 Pipe Dia. (in.)	2 Min. Time (min.: sec.)	3 Length For Min. Time (ft.)	4 Time for Longer Length (sec.)	Specification Time for Length (L) Shown (min.:sec.)			
				300 ft.	350 ft.	400 ft.	450 ft.
4	1:53	597	.190 L	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:51	3:12
8	3:47	298	.760 L	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	26:11	30:32	34:54	39:16
24	11:20	99	6.837 L	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	43:16	50:30	57:42	64:54
30	14:10	80	10.683 L	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	76:55	89:44	102:34	115:23



3.2 AIR TEST DATA SHEET

Air test results shall be recorded on the following worksheet:

AIR TEST DATA SHEET

Owner (Name of city, district, etc.):	Test No.:
Identification of Pipe Installation (Job name, location, contract number, etc.):	

Field Test Data: (To be filled in by the inspector)										
Date:		Specified Maximum Pressure Drop:						psig		
Identification of Pipe Material Installed:										
Pipe Under Test				Specification Time	Field Test Operations Data					
Upstream MH sta #	Downstream MH sta #	Dia. D (in.)	Length L (ft.)	Refer to UNI-B-6 (min.:sec.)	Pressure Initially Raised to (psig)	Time Allowed for Pressure to Stabilize (min.)	Start Test Pressure (psig)	Stop Test Pressure (psig)	Elapsed Time (min.:sec.)	Pass or Fail (P or F)
Inspector's Name and Title:										
Signature of Inspector:										

If a section fails, the following items should be completed:	
Identify section(s) that failed:	
Leak (was) (was not) located. Method used:	
Description of leakage found:	
Description of corrective action taken:	
For test results after repair refer to Test No.:	Inspector:

END OF SECTION



SECTION 02540
SEWER CLEANING

PART 1. GENERAL

1.01 SCOPE

- A. This Section covers the cleaning of sewers to remove all debris, solids, sand, grease, grit, roots, etc. from the sewers and manholes to improve pipe flow, facilitate television inspection for sewer evaluation, for proper application of root control chemical, or as required for other specified rehabilitation.
- B. The Work covered by this section includes furnishing all labor, equipment, and materials required to clean and inspect sanitary sewer lines as specified.

1.02 SUBMITTALS

- A. Action Submittals: Catalog and manufacturer's data sheets for cleaning equipment.
- B. Informational Submittals:
 - 1. Sample of the finished picture from the picture capture system.
 - 2. Equipment manufacturer's operational manual and guidelines.
 - 3. Liquid Waste Manifest.

PART 2. PRODUCTS

2.01 EQUIPMENT

- A. Sewer television equipment shall be in compliance with Section 02541, Sewer Television Inspection.
- B. Hydraulically-Propelled Equipment: The equipment used shall be of a movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned and shall provide a flexible scraper around the outer periphery to ensure removal of grease. If sewer cleaning balls or other equipment, which cannot be collapsed, is used, special precautions to prevent flooding of the sewers and public or private property shall be taken.

C. Cleaning:

1. All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor and produce at least 2,000 psi pressure. The gun shall be capable of producing flows from a fine spray to a solid stream.
2. Sewer line cleaning equipment shall be a combination of high-velocity (hydro-cleaning) jet and vacuum system, truck-mounted for mobility and ease of operation. The hydro-cleaning equipment for sewer lines shall include a minimum 1,000-gallon water storage tank, auxiliary engines and pumps, and include a minimum of 600 feet of 1-1/4-inch I.D. high-pressure hose on a power driven hose reel. Pump nozzle combinations shall be capable of producing water flow rates up to 120 gpm, and a minimum of 60 gpm at a working pressure up to 2,000 psi. The vacuum system shall be a positive displacement blower with a minimum of 4,200 cfm at 15 inches of mercury. OWNER must approve any variations to this pumping rate, in advance.
3. A working pressure gauge shall be used on the discharge of all high-pressure water pumps.
4. CONTRACTOR shall use in addition to conventional nozzles, a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18-inch and larger.

D. Heavy Cleaning: Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be specifically heat-treated steel. To ensure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.

PART 3. EXECUTION

3.01 GENERAL

A. Prior to the start of any Work under this Project, CONTRACTOR shall make available to OWNER all equipment that is to be utilized in the execution of this contract. OWNER will hold a preconstruction conference at which the sequence of work, methods, inspection, and monitoring requirements and debris disposal shall be discussed.

- B. When sewer flow depth is greater than 25 percent, flow depth shall be decreased by plugging or bypass pumping. Plugs shall be designed to pass any desired portion of sewage flow. If bypass pumping is required, CONTRACTOR shall provide all necessary equipment, manpower, and expertise. CONTRACTOR shall be responsible for all damage to public or private property resulting from these operations.
- C. Designated sanitary sewers and manholes shall be cleaned using mechanical hydraulically propelled or high velocity sewer cleaning equipment. The cleaning process shall remove all grease, roots, sand, silt, solids, rags, debris, etc. from each sewer segment, including the manhole(s).
- D. Selection of cleaning equipment and the method for cleaning shall be based on the condition of the sanitary sewer mains at the time Work commences and will be subject to OWNER's approval.
- E. All cleaning equipment and devices shall be operated by experienced personnel.
- F. Satisfactory precautions shall be taken to protect the sanitary sewer mains and manholes from damage that might be inflicted by the improper use of the cleaning process or equipment. Any damage done to a sewer by CONTRACTOR shall be repaired by the CONTRACTOR at no additional cost to OWNER and to the satisfaction of OWNER.
- G. Cleaning shall also include the initial manhole wall washing by high-pressure water jet.
- H. CONTRACTOR, when instructed by OWNER, will be required to demonstrate the performance capabilities of the cleaning equipment proposed for use on the Project. If the results obtained by the proposed sanitary sewer cleaning equipment or attachments are not satisfactory, CONTRACTOR shall use different equipment/attachments, as required, to meet Specifications. More than one type of equipment/attachments may be required at a location.
- I. When hydraulic or high velocity cleaning equipment is used, a suitable sand trap, weir, dam, or suction shall be constructed in the downstream manhole in such a manner that all the solids and debris are trapped for removal.
- J. If water backups a lateral and enters a building or residence during cleaning, the CONTRACTOR shall notify OWNER of the occurrence. It is the CONTRACTOR's responsibility to clean any backups which occur. If prior knowledge of backups is available, the CONTRACTOR shall take measures to prevent another backup from occurring (i.e., plugging the lateral) before cleaning.



3.02 HYDRAULIC CLEANING

- A. Prior to televising, CONTRACTOR shall thoroughly clean the pipelines of debris, grease, roots, sediment, broken pipe, or other obstructions that could retard the movement of the television camera. Precautions shall be taken to protect the sewer lines being cleaned from damage by the cleaning equipment.
- B. Hydraulically propelled devices, which require a head of water to operate, shall utilize a collapsible dam. The dam shall be easily collapsible to prevent damage to the sewer, property, etc.
- C. When using hydraulically propelled devices, precautions shall be taken to ensure that the water pressure created does not cause damage or flooding to public or private property.
- D. CONTRACTOR shall not increase the hydraulic gradient of the sanitary sewers beyond the elevation that could cause overflow of sewage into area waterways or into structures.

3.03 HIGH-VELOCITY CLEANING

- A. CONTRACTOR shall operate the equipment so that the pressurized nozzle continues to move at all times.
- B. The pressure nozzle shall be turned off or water pressure be reduced anytime the hose is held or delayed in order to prevent damage to the line. In heavy debris the step cleaning method should be used.

3.04 MECHANICAL CLEANING

- A. Mechanical cleaning, in addition to normal cleaning when required by OWNER, shall be approved equipment and accessories driven by power winching devices.
- B. All equipment and devices shall be operated by experienced operators in an effort to prevent pipe damage during the cleaning process.
- C. Buckets, scrappers, scooters, porcupines, kites, heavy duty brushes, metal pigs and other debris removing equipment/accessories shall be used as appropriate and necessary in the field, in conjunction with the approved power machine(s).
- D. The use of cleaning devices such as rods, metal pigs, porcupines, root saws, snakes, scooters, sewer balls, kites and other approved equipment, in conjunction with hand



winching device, or, gas, electric rod propelled devices, shall be considered normal cleaning equipment.

3.05 WATER USAGE

- A. Any and all OWNER water used by CONTRACTOR shall be from a metered supply with an approved backflow device to protect the water supply. All metered water supply shall be paid to OWNER through the regular billing system.
- B. CONTRACTOR shall be responsible for obtaining transient water meter(s) from OWNER, which shall be installed on the trucks or at fire hydrant(s). All related charges for the set-up shall be considered incidental to the cleaning of the existing sanitary sewer mains.
- C. CONTRACTOR shall be responsible for preventing contamination of the potable water system. CONTRACTOR when drawing water from a public hydrant shall use a backflow preventer or an 18-inch air gap.
- D. No fire hydrant shall be obstructed or used when there is a fire in the area.
- E. It shall be CONTRACTOR's responsibility to obtain approval to use OWNER's fire hydrants.
- F. CONTRACTOR shall remove the water meter(s)/piping etc. from all fire hydrants at the end of each working day.

3.06 REMOVAL AND DISPOSAL OF DEBRIS

- A. All materials removed from the sewer lines during cleaning operations shall be trapped and removed from the system at the downstream manhole of the section being cleaned. All materials shall be disposed of in compliance with all applicable laws and regulations and in a manner approved by OWNER.
- B. Passing of debris from upstream manhole section to downstream manhole section will not be allowed.
- C. All debris from the manholes shall be loaded into an enclosed container that is permitted by OWNER and the Tennessee Department of Environment and Conservation (TDEC) for liquid waste hauling.
- D. All solids or semi-solids resulting from the cleaning operations shall be removed from the Site at the end of each workday, hauled to and disposed of at the Chestnut Ridge Landfill using OWNER-supplied permit.



- E. CONTRACTOR shall pay landfill-tipping fee.
- F. CONTRACTOR shall not be allowed to accumulate debris, or liquid waste, sludge, etc. on the Site except in totally enclosed containers approved by OWNER.
- G. All waste shall be hauled to the disposal Site by a transporter, which is arranged for by CONTRACTOR and holds a valid Liquid Waste Transporter Permit.
- H. CONTRACTOR shall submit and maintain a "Liquid Waste Manifest" as per OWNER and TDEC requirements. OWNER's and TDEC's copies of the completed manifest shall be sent to OWNER within 24 hours after the disposal of the waste materials.
- I. Under no circumstances shall sewage or solids removed in the cleaning process be dumped onto streets or into ditches, catch basins, storm drains, sanitary sewer manholes, cleanouts, or dumps.

END OF SECTION



SECTION 02542
SEWER FLOW CONTROL

PART 1. GENERAL

1.01 SCOPE

- A. Sewer flow control required to conduct the sewer line replacement, television inspection, sewer line testing, chemical root control application, and sewer line sealing operations effectively. Flow control will be required for inspection or other maintenance operations, for all sewer line replacements, and when sewer line flows are greater than that specified in Section 02541, Sewer Television Inspection.

1.02 PERFORMANCE REQUIREMENTS

- A. It is essential to the operation of the existing sewerage system that there is no interruption in the flow of sewage throughout the duration of the Project. To this end, CONTRACTOR shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as necessary to intercept the sewage flow before it reaches the point where it would interfere with their work, carry it past their work and return it to the existing sewer downstream of their work.
- B. Discharge of sewage into the construction trench shall not be permitted.

1.03 SUBMITTALS

- A. Informational Submittals:
 - 1. Flow Control Plan: Submit at least 48 hours prior to controlling flows. Include, as a minimum, the following:
 - a. Estimate of peak amount of flow to be controlled.
 - b. Detailed procedures for handling peak estimated flow.
 - c. Schedule.
 - d. Drawing of plug, bypass pump, and pipeline locations.
 - e. Listing of equipment.
 - 1) Bypass pump sizes, capacities, number of each size to be onsite, and power requirements including standby equipment.
 - 2) Bypass pipeline sizes and material types.
 - f. Sewer user notification plan.
 - g. Operation plan.
 - h. Emergency procedures.
 - 2. Permits to locate and operate flow control system.



PART 2. PRODUCTS

2.01 FLOW CONTROL SYSTEM

- A. General: Provide adequate capacity and size to handle existing flows plus additional flows that may occur during periods of rainstorm. Estimate peak amount of flow to be bypassed and provide bypass flow capacity of at least 125 percent of peak flow estimate.
- B. Plugs:
 - 1. Provide with taps for connection of pressure gauges and air hoses, and flow-through capability.
 - 2. Pipe Diameters 24 inches and Smaller: Use mechanical plugs with rubber gaskets or pneumatic plugs with rubber boots.
 - 3. Pipe Diameters Larger than 24 inches:
 - a. Use inflatable bag stoppers made in two or more pieces.
 - b. Manufacturer: Lansas, Cherne Industries.
- C. High-Density Polyethylene (HDPE) or Ductile Iron Discharge Piping:
 - 1. Leak free.
 - 2. Pressure rating at least 1.5 times the operating pressure.
 - 3. HDPE Pressure Piping:
 - a. In accordance with ASTM D3350.
 - b. SDR of 32.5, maximum.
 - c. Joints: Butt-fusion welded.
 - 4. Ductile Iron:
 - a. AWWA C151/A21.51, Centrifugally cast, Grade 60-42-10 iron.
 - b. Joints: Rubber gasketed push-on in accordance with AWWA C111/21.11
 - c. Fittings: In accordance with AWWA C110/A21.20.
 - 5. May reuse for subsequent flow bypass pumping system placements. OWNER, at their sole discretion, shall have right to reject sections deemed unserviceable.
- D. Flexible Discharge Pipe:
 - 1. Small diameter flexible pipe may be used for low pressure and low flow conditions, as determined by the OWNER.
 - 2. Use of this material is limited to controlling flow from 8-inch diameter collector sewer lines.
- E. Bypass Pumps:
 - 3. Fully automatic, self-priming units that do not require use of foot valves or vacuum pumps in priming system.
 - 4. Open impeller design with ability to pump minimum 3-inch diameter solids.
 - 5. Able to run dry for long periods of time to accommodate cyclical nature of flows.



6. Engine: Equipped to minimize noise. Noise levels shall not exceed 86 dBA at a distance of 50 feet from the source.
7. Standby Pump: One of each size to be available onsite.

PART 3. EXECUTION

3.01 GENERAL

- A. Notify OWNER at least 48 hours prior to implementing flow control system.
- B. Operate and maintain flow control system 24 hours per day, 7 days per week, including holidays, as required, to control flow.
- C. When depth of flow in a pipe section is above the maximum depth specified for television inspection, joint testing, or rehabilitation, reduce flow by plugging, diverting, or pumping flow around Work area.
- D. Except at pipe sags, depth of flow during television inspection and joint testing shall not exceed the requirements of Section 02541, Sewer Television Inspection.
- E. Eliminate all flow from sewer manhole-to-manhole segments during spot repair, service connection rehabilitation, manhole construction, and sewer pipe replacement or lining within that segment.
- F. If flow reaches peak estimated flow that flow control system was designed for, stop all Work that requires flow control, secure work area, and restore flow in sewer until flow recedes.
- G. After the Work is completed, return flow to replaced sewer and remove temporary equipment.

3.02 PLUGGING OR BLOCKING

- A. Flow control may consist of blocking flow with mechanical or pneumatic plugs if only a small amount of flow needs to be controlled and adequate storage is available.
- B. Use primary and secondary plugs for each flow control location.
- C. When blocking flow is no longer needed for performance and acceptance of the Work, remove plugs in a manner that permits sewage flow to slowly return to normal without surcharging or causing other major disturbances downstream.

- D. Remove temporary plugs at end of each working day and restore normal flow. If downstream work is not or cannot be completed during the workday provide, operate, and maintain bypass pumping system.
- E. Use bypass pumping if the Work cannot be scheduled at a time when flow is low or completed during low flow period.

3.03 BYPASS PUMPING

- A. The CONTRACTOR shall obtain approval and secure all permits for placement of temporary bypass pumping system and pipeline within public right-of-way.
- B. Flow bypass shall be done in such a manner that will not damage private or public property, or create a nuisance or public menace. Pumped sewage shall be in an enclosed pipe that is adequately protected from traffic, and shall be redirected into sanitary sewer system or alternatively into an enclosed tank for hauling to the wastewater treatment plant. Dumping or free flow of sewage on private or public property, gutters, streets, sidewalks, or into storm sewers is prohibited.
- C. The CONTRACTOR shall submit to the OWNER for approval a description of the bypass pumping methodology, and bypass pumping plan before CONTRACTOR commences sewage bypass pumping
- D. The CONTRACTOR shall furnish, install, and maintain power, primary and standby pumps, appurtenances, and bypass piping required to maintain existing flows and services.
- E. The CONTRACTOR shall equip pump engines with noise suppression devices to keep pump noise to a minimum and comply with applicable noise ordinances.
- F. The CONTRACTOR shall be responsible for continuity of sanitary sewer service to each facility connected to the section of sewer main during the execution of the Work, and shall also bypass the main sewer flow around the pipe to be replaced, or into adjacent sanitary sewers, if available.
- G. The pumps and the bypass lines shall be of adequate capacity and size to handle all flows without sewage backup to private property.



- H. Disconnected sewer service lateral connections shall be accommodated by bypass pumping or containment of from time of disconnection to time of reconnection. This shall be accomplished by a mechanical pump and manifold system or by storage system such as a bladder tank system. The storage system shall be capable of holding adequate sewage from each sewer service connection for period of 24 hours. Each storage system shall be emptied or pumped during each 24-hour period and properly disposed of in accordance with TDEC requirements.
- I. The CONTRACTOR shall be solely responsible for clean-up, repair, property damage costs and claims resulting from failure of the diversion system.
- J. The CONTRACTOR shall submit to the OWNER specifications for all pumping equipment to be used on the job (including all sizing calculations) and a list of all backup pumping equipment to be held in reserve on the Site.
- K. The pumps and by-pass lines shall be of adequate capacity and size to handle all flows.
- L. After Work is completed, flow shall be returned through replaced sewer and temporary equipment removed.

3.04 SERVICE LATERAL DISCONNECTION

- A. When it is necessary to shutdown a private service line while work is in progress and before the service lines are reconnected, the OWNER shall be notified by CONTRACTOR at least one week prior to the shutdown.
- B. The CONTRACTOR will notify building occupants twice regarding service lateral disconnection by placing door hangers: (1) not less than 1 week prior and (2) not more than 24 hours prior to disconnection.
- C. When a service lateral must be disconnected from the main for more than 1 work day, the lateral shall be positively drained or pumped a minimum of once every 24 hours. Monitor status of flow and storage. Pump lateral more frequently where flows exceed the storage capacity of the lateral or such temporary storage as may be provided by CONTRACTOR.
- D. Temporarily restore services in uncompleted sections during nonwork hours.
- E. Notify building occupants when work is complete and full uninterrupted service restored.



- F. No service is to remain shutdown for more than a period of 8 hours, unless CONTRACTOR provides substitute services for the residents. If the service is to be shutdown for more than 8 hours and CONTRACTOR cannot provide substitute services, then CONTRACTOR shall be required to provide temporary living quarters (i.e. hotel) for the resident at no additional cost to OWNER or the resident. Temporary living quarters shall be approved by OWNER and coordinated through OWNER's Customer Support Representative.

3.05 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Test: CONTRACTOR shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. Prior to operation, test each section of discharge piping with maximum pressure equal to 1.5 times the maximum operating pressure of system. OWNER shall be given 24 hours' notice prior to testing.
- B. Inspection: CONTRACTOR shall inspect bypass-pumping system every 2 hours to ensure that system is working correctly.
- C. Maintenance Service: CONTRACTOR shall ensure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.

3.06 CLEANING

- A. Before bypass pumping system is broken down, and moved to next section or removed at the completion of the Work, discharge sewage remaining in bypass discharge pipeline and pumping equipment to working sewer.
- B. Disturbed Areas: Upon completion of bypass pumping operation, clean disturbed areas and restore to condition, including pavement restoration, at least equal to that which existed prior to start of the Work.

3.07 LIABILITY

- A. CONTRACTOR shall be responsible for damages to private or public property that may result from his sewer flow control operations. CONTRACTOR shall be responsible for any violations of laws, regulations or permits and shall indemnify and hold OWNER harmless for any and all damages, including but not limited to, fines and penalties that arise from such violations.

END OF SECTION



**SECTION 02740
PAVEMENT REPAIR**

PART 1. GENERAL

1.01 SCOPE

- A. The Work specified by this section consists of repairing or replacing all damaged pavement, regardless of pavement type and whether public or private. Shoulders (paved or unpaved), roads, streets, drives, and walks are to be restored to equal or better than their original condition.
- B. These Specifications and the Drawings make reference to the current edition of the Standard Specifications of the Tennessee Department of Transportation (TDOT). Weather limitations, construction methods, and material specifications contained in the TDOT Specifications shall apply wherever applicable to the Work called for by this Section. The “Basis for Payment” contained in the TDOT Specifications shall not be considered applicable to this Project.

1.02 REFERENCES

- A. For construction in City of Knoxville streets, see pavement repair detail on Drawings and this Specification.
- B. For construction in Knox County streets, conform to latest version of Knox County Specifications.
- C. For construction in TDOT highways, conform to the latest version of TDOT Specifications.

1.03 SUBMITTALS

- A. Informational Submittal: Test reports for crushed stone aggregate, Bituminous materials, asphaltic concrete design mixes and portland cement concrete mixes.

PART 2. PRODUCTS

2.01 BASE COURSE

A. Grading B or B-M (TDOT specifications, Section 307).

2.02 ASPHALTIC CONCRETE BINDER

A. Grading C (TDOT Specifications, Section 307).

2.03 BITUMINOUS TACK COAT

A. Emulsified Asphalt SS-1, RS-2, or AE-3 (TDOT Specifications, Section 403).

2.04 ASPHALTIC CONCRETE SURFACE

A. Grading D (TDOT Specifications, Section 411).

2.05 MINERAL AGGREGATE BASE

A. TDOT Mineral Aggregate Base Class A Aggregate Grading D - Crusher Run (TDOT specifications, Section 903.05).

B. TDOT Mineral Aggregate Base Class A Aggregate Grading D - Pug Mix (TDOT specifications, Section 903.05).

C. TDOT Mineral Aggregate Base Size No.7 (TDOT specifications, Section 903.22).

D. TDOT Mineral Aggregate Base Size No. 57 (TDOT specifications, Section 903.22).

2.06 TEMPORARY ASPHALTIC CONCRETE SURFACE

A. Hot Mix, Grading B or B-M (TDOT Specifications, Section 307).

B. Cold Mix (TDOT Specifications, Section 410): Cold mix shall be composed of an emulsified bituminous binder, mineral filler, and aggregates.

2.07 PORTLAND CEMENT CONCRETE PAVEMENT

A. Specification KUB Standards Section 02770, Concrete for Utilities and Concrete Pavement Construction.

2.08 QUICK DRY TRAFFIC MARKING PAINT (WHITE AND YELLOW)

A. TDOT Specifications. Section 910.05.



PART 3. EXECUTION

3.01 GENERAL

- A. Prior to initiating work in roadways, notify the appropriate agency having jurisdiction over the corresponding roadway pursuant to the agency's notice requirements. Pavement repair shall be as specified herein, or to the satisfaction of the agency having primary jurisdiction over the associated pavement. The more stringent requirement shall govern.
- B. Repair damaged base on either side of a trench wherever necessary. Pavement undermined during construction operations shall be removed to straight lines back to an area of firm ground. Concrete pavement shall be cut in a manner to prevent spalling or cracking at the edges of the cut.

3.02 SUBGRADE

- A. Before any base material is installed, compact the subgrade in preparation for the installation of temporary pavement repair (to grade) in order to minimize disruption to traffic. Maintain the temporary repair until the permanent pavement is installed. At that time, excavate to the required depth, dispose of the excavated material in compliance with all applicable laws and regulations and in accordance with KUB Standards Section 02321, Excavation, Bedding, and Backfill for Utilities and compact the backfill to meet the minimum requirements for backfill herein.
- B. Backfill shall be in accordance with KUB Standards Section 02321, Excavation, Bedding, and Backfill for Utilities.

3.03 BASE COURSE

- A. Install a minimum 8-inch asphalt concrete base course in 4-inch lifts, or as specified by OWNER, compacted to a minimum of 92% maximum theoretical density. Place base course above a minimum thickness of 12 inches of No. 7 or No. 57 compacted stone.
- B. When base course is installed, cut the existing pavement straight and vertical to 12-inches beyond the excavated trench width unless otherwise directed by OWNER. Take special care to ensure good compaction of the new base course at joints. Apply and compact the surface to conform to the existing pavement so that it

will have no surface irregularity. Ensure straight vertical cuts at the joints. Reference KUB Paving Detail Sheet.

- C. Existing concrete streets that have been overlaid with asphalt pavement shall be repaired with new asphalt pavement. Install a minimum 8-inch asphalt concrete base course in 4-inch lifts, or as specified by OWNER, compacted to a minimum of 92% maximum theoretical density. Place base course above a minimum thickness of 12-inches of No.7 or No. 57 compacted stone.

3.04 ASPHALTIC CONCRETE BINDER

- A. If asphalt concrete binder is to be placed as directed by OWNER, carefully place the material to avoid segregation of the mix. Broadcasting of the material will not be permitted. Remove lumps that do not readily break down.

3.05 ASPHALTIC CONCRETE SURFACE

- A. If the surface course is to be placed on a binder course or base course as directed by OWNER, then apply specified bituminous tack coat at a rate of 0.05 to 0.10 gallon per square yard. Apply tack coat without splashing material on exposed faces of curbs, gutters, walls, walks, trees, etc. Should such splashing occur, remove the bituminous material immediately. After the tack coat has been properly cured, apply the asphaltic concrete surface to match the existing depth, a minimum 2-inch thickness, or as specified by OWNER.

3.06 PORTLAND CEMENT CONCRETE PAVEMENT

- A. City and County Streets: Install Portland cement concrete pavement to a minimum thickness of 8-inches, doweled in to existing concrete pavement per City of Knoxville Specifications Section 11 or the latest version of Knox County Specifications, whichever applies.
- B. TDOT Roadways: Install Portland cement concrete pavement to a minimum thickness of 9-inches, doweled into existing concrete pavement per the latest version of TDOT Specifications.

3.07 BRICK PAVEMENT

- A. Brick or stone pavement restoration shall be preceded by installation of an underlying 6-inch minimum concrete slab, installed per KUB Standards Section 02770, Concrete for Utilities and Concrete Pavement Construction.

- B. Brick or stone pavement shall match the existing brick or stone pavement removed.

3.08 SMOOTHNESS

- A. Finished surfaces shall conform to the lines and grades that existed prior to construction. No deviations, variations, or irregularities exceeding 1/4 inch in the direction of travel, when tested with a 12-foot straightedge will be permitted in the finished work, nor will any depressions that will not drain. Correct all such defects.

3.09 THERMALLY BONDED ASPHALT

- A. If thermally bonded asphalt is to be placed as directed by OWNER, backfill the excavation with materials in accordance with KUB Standards Section 02321, General Excavation, Bedding, and Backfill for Utilities.
- B. Existing concrete streets that have been overlaid with asphalt pavement shall be repaired with new asphalt pavement. Install a minimum 8-inch asphalt concrete base course in 4-inch lifts, or as specified by OWNER, compacted to a minimum of 92% maximum theoretical density. Place base course above a minimum thickness of 12-inches of No.7 or No.57 compacted stone.
- C. Clear loose and foreign material off the vertical edges of the pavement, and apply a tack coat to the vertical face of the existing asphalt before placing the new asphalt.
- D. At this time, the repair shall be left to settle for at least 7 days, or as directed by OWNER.
- E. After the settling period, the repair shall be completed by the thermal bonding method.
 1. Clear the repair of loose and foreign material.
 2. Lower the thermal bonding heating unit parallel with the repair. Heat the existing asphalt repair and three inches beyond the edges.
 3. Scarify the softened asphalt and remove if necessary to a minimum depth of 1-1/2 inches.
 4. Apply a rejuvenator (Reclamite or equal) to the remaining asphalt at the rate of 1/10 gallon per square yard.
 5. Place the new asphalt material by hydraulically augering it from the heated storage compartment, molding it to the existing asphalt.

6. Compact with approved compactor or roller.

3.10 SAMPLING AND TESTING

- A. Submit to OWNER test reports made by an independent testing laboratory on the crushed stone aggregate, bituminous materials, asphaltic concrete design mixes and portland cement concrete mixes. Obtain OWNER's approval of these reports before starting paving operations.
- B. OWNER will conduct tests on the completed elements of the pavement to ascertain the compacted thickness of the base and surface courses. If sections with deficient thicknesses are found, the full section for a reasonable distance on each side of the deficiency shall be refused. Remove and reinstall such sections. Patch test holes in connection with thickness tests. Repairs shall be made at no cost to OWNER.
- C. When OWNER is formally evaluating the restored pavement, the CONTRACTOR shall accompany OWNER's Representative to document and mark all surface defects for corrections.

3.11 TEMPORARY PAVEMENT REPAIR

- A. Trenches in paved areas shall be completely backfilled to pavement grade temporarily, using materials and compaction specified in KUB Standards Section 02321, General Excavation, Bedding, and Backfill for Utilities.
- B. This temporary repair shall be made the same day to allow for traffic flow, except under extenuating circumstances as determined by OWNER. The repair shall be maintained by CONTRACTOR either until the permanent pavement is restored or until the project is accepted by OWNER.
- C. Temporary Pavement Repair:
 - 1. The temporary pavement repair shall be a minimum 6-inch thickness of Class A Grade D aggregate compacted in maximum 6-inch lifts OR 2-inches of hot or cold temporary binder compacted to match the existing pavement surface. The pavement repair shall be placed within 14 calendar days of backfill (or 28 days if approved by owner). Primary collector or arterial streets as listed in the City of Knoxville's Technical Specification 34 Construction Area Traffic Control must have 2" of temporary binder (hot or cold) within 2 calendar days of backfill.
 - 2. Temporary pavement repair shall be maintained by

CONTRACTOR until permanent pavement restoration is completed.

3. The temporary pavement repair shall not remain for more than 14 days before the permanent repair is installed. The temporary pavement repair may remain up to 28 days under extenuating circumstances if approved by OWNER.

END OF SECTION



**SECTION 02770
CONCRETE FOR UTILITIES AND CONCRETE PAVEMENT
CONSTRUCTION**

PART 1 GENERAL

1.01 SCOPE

- A. The Work covered by this section consists of furnishing all plant, labor, equipment, appliances, and materials and of performing all operations in connection with the construction of concrete utility structures, concrete pavements, curbs and gutters, sidewalks, concrete steps, and driveway ramps on previously prepared subgrades in accordance with the Drawings, Specifications, or as directed by the OWNER.
- B. Concrete repair must be conducted to the satisfaction of the agency having primary jurisdiction of the facility, and the more stringent regulations shall apply.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Curb Form Material: Information on metal forms, if used, including type, condition, surface finish, and intended function.
 - 2. Concrete mix design.
- B. Informational Submittals: Concrete delivery tickets for each batch of concrete before unloading at Site.

PART 2 PRODUCTS

2.01 CONCRETE FOR UTILITY STRUCTURES

- A. Strength:
 - 1. Minimum 28-day Strength: 4,000 psi.
 - 2. Maximum Water/Cementitious Materials Ratio: 0.44.
 - 3. Fly ash shall be substituted for cement 25 percent by weight.
- B. Durability: Concrete shall be air entrained 4 percent to 7 percent.

- C. Slump Superplasticizer can be added to the mix to increase slump to 8 inches.
- D. Concrete shall be in accordance with the applicable provisions of ACI 301, Specifications for Structural Concrete for Buildings.

2.02 CONCRETE FOR CONCRETE PAVEMENT

- A. Strength:
 - 1. Minimum 28-day Strength: 4,000 psi.
 - 2. Maximum Water/Cementitious Materials Ratio: 0.44.
 - 3. Fly ash shall be substituted for cement 25 percent by weight.
- B. Durability: Concrete shall be air entrained 4 percent to 7 percent.
- C. Slump: 3 inches, plus or minus 1 inch.
- D. Concrete shall be in accordance with the applicable provisions of ACI 301, Specifications for Structural Concrete for Buildings.

2.03 REINFORCING STEEL

- A. Meet requirements of ASTM A615 with a yield strength of 60,000 psi.

PART 3 EXECUTION

3.01 WEATHER LIMITATIONS

- A. Concrete shall not be placed:
 - 1. Until the air temperature in the shade is 35 degrees F and rising and is forecast to remain 35 degrees F.
 - 2. On frozen ground.
 - 3. During periods of rain or snow.
- B. Concrete placement shall not continue when air temperature drops below 40 degrees F.
- C. Protect concrete pavement from inclement weather for 7 days after it has been placed, when rain is imminent, and when air temperature drops or is forecast to drop below 35 degrees F.

3.02 SUBGRADE AND FORMS

- A. Provide and operate a template for checking the contour of the subgrade. The template shall rest on the side forms and shall be provided with adjustable rods that project downward to the subgrade at 1-foot intervals. Adjust these rods to the required cross sections of the bottom of the slab when the template is supported at its sides.
- B. Forms shall be of metal or wood and subject to approval by the OWNER.
- C. Extruded machine curb or curb and gutter may be used. The OWNER reserves the right to approve the machine used, the contour and finish of the curb and gutter, and the design mix and the right to designate the spacing for expansion and contraction joints.
- D. Test the subgrade with respect to elevation and density prior to setting forms. Complete the subgrade to the plane of the typical sections shown on the Drawings and to the lines and grades established by the Drawings. Compact subgrades as specified in Section 02321, Excavation, Bedding, and Backfill for Utilities.
- E. After preparing the subgrade as described above, set the forms. The subgrade under the forms shall be firm and cut true to grade so that each form section will, when placed, be firmly in contact for its entire length and base width. Stake the form into position so that the top, when tested by a 10 feet straightedge, conforms to the requirements specified for the surface of the concrete and so that the longitudinal axis of the upstanding leg does not vary more than 1/4 inch. Tightly lock form sections together.
- F. Finish the subgrade to the exact section of the bottom of the pavement shown on the Drawings. Wet the subgrade down far enough in advance of the placing of the concrete to ensure that it is firm and moist. In cold weather, the subgrade shall be entirely free from frost when the concrete is deposited.
- G. Leave forms in place at least 24 hours after the concrete has been placed against them. Do not use crowbars or heavy tools against "green" concrete when removing the forms. Clean the forms well before reoiling and reuse.

3.03 PLACING

- A. Concrete shall be in place within 45 minutes from the time all ingredients are charged in the mixing drum and before the concrete has obtained its

initial set. Deposit concrete so that minimum handling will be necessary, and distribute it so that, when consolidated and finished, the slab thickness and surface grade required by the Drawings will be obtained at all points. Place concrete rapidly and continuously between expansion joints and use shovels for any necessary hand spreading. Consolidate the concrete adjacent to forms and joints with forks and spades.

- B. Do not place concrete when the ambient temperature is below 35 degrees F, or when the concrete is, without special protections, likely to be subject to freezing temperatures before final setting has occurred. The temperature of the concrete when placed shall be not less than 50 degrees F, or more than 90 degrees F. Heating of the mixing water or aggregates will not be permitted until the temperature of the concrete has decreased to 55 degrees F. Heated materials shall be free from ice, snow, and frozen lumps before entering the mixer. Methods and equipment for heating shall be subject to the OWNER'S approval. Provide suitable means for maintaining the concrete at a temperature of at least 40 degrees F for not less than 72 hours after placement. Any concrete damaged by freezing shall be removed and replaced at the expense of the CONTRACTOR.

3.04 FINISHING

- A. Immediately after placement, properly finish the concrete. The sequence of operations shall be as follows: hand finishing, longitudinal floating, straightedge finishing, and edging the joints.
- B. Provide an approved hand strike template, approved tamping template, and a longitudinal float for the hand finishing of pavement. The templates shall be at least 1 foot longer than the pavement width and at least 4 inches wide. The longitudinal float shall be 6 feet to 8 feet long. The float shall be rigid and substantially braced and provided with suitable handles to ensure smooth and effective manipulation. The bottom edges of the base of the float shall be rounded. Floats made of metal or a combination of wood and metal may be used.
- C. As soon as concrete is placed, strike off and screed to the appropriate cross section and to an elevation above grade which, when the concrete is consolidated and finished, will ensure that the surface of the pavement is at the exact elevation indicated on the drawings.
- D. Tamp the entire surface, and continue tamping until the required compaction and reduction of internal and surface voids are secured. Immediately after the final tamping of the surfaces, float the pavement longitudinally by hand. If contact with the pavement is not made at all points by the float, additional

- concrete shall be required and screened, and the float operated until a satisfactory surface is obtained.
- E. After the longitudinal floating is complete, eliminate minor irregularities and score marks remaining in the pavement surface by removing surplus material or, if necessary, by adding and working in freshly mixed concrete with long handled floats and filling in open textured areas in the pavement surfaces. Make the final finish with straightedges 8 feet in length. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than length of the pavement. Immediately fill depressions with freshly mixed concrete, strike off, consolidate, and refinish. Remove projections above the required elevation while the concrete is still plastic and workable, doing so in a time sequence that will ensure the removal of all water and laitance from the surface. Continue the straightedge testing and refloating until the entire surface is free from observable departures from the straightedge, conforms to the required grade and contour, and will, when the concrete has hardened, conform to the surface requirements specified herein.
- F. After hand finishing has been completed but before the concrete has attained initial set, carefully finish the edges of slabs along forms and at points with an edging tool of a 2-inch radius to form a smooth, rounded surface. Clean corners or edges of slabs that have crumbled and any areas that lack enough mortar for proper finishing by removing loose fragments and soupy mortar, and then fill solidly and finish with a mixture of the correct proportions and appropriate consistency. Eliminate unnecessary tool marks, and leave edges smooth and true to line. After removing the forms, fill any damaged or honeycombed areas with mortar composed of one part cement and two parts sand.
- G. Form transverse and contraction joints in the finished pavement prior to initial set, spacing them as shown on the Drawings. Contraction joints shall be 1/4 inch wide and 3/4 inch deep and shall be finished with an edging tool of 1/4-inch radius.
- H. Place transverse and premolded expansion joints 4 inches thick in such a way that the joint will be filled to within 1/2 inch of the surface of the walk. Place them to full depth and normal to the grade. Wherever concrete walks abut against transverse steps, other walks, or adjacent structures, provide expansion joints. Clean concrete from top of premolded joints and edge of concrete as specified above.

3.05 PROTECTION AND CURING

- A. Protect and cure concrete with an approved curing compound applied according to the manufacturer's directions.

3.06 SURFACE TEST

- A. Remove any portion of the pavement that shows a variation or departure greater than 1/4 inch from the testing edge of a 10-foot straightedge, and replace or correct as directed by the OWNER.

END OF SECTION



SECTION 02920 SEEDING

PART 1. GENERAL

1.01 SCOPE

- A. This Work shall be performed as shown on the Drawings or as directed by the OWNER and shall include, but not necessarily be limited to, seed bed preparation; the supplying and placing of soil additives, seed, mulch and maintenance.
- B. Unless otherwise approved in writing by the OWNER, seeding operations shall be limited to the following planting periods:
 - 1. Winter: October 15 through March 01.
 - 2. Remainder of year.
- C. Refer to other sections for items affecting seeding. Coordinate this Work with that specified by other sections for timely execution.
- D. The CONTRACTOR may submit other seeding methods such as hydroseeding to the OWNER for consideration. The OWNER shall make the final decision on the seeding method.

1.02 SUBMITTALS

- A. Action Submittals: Product labels/data sheets.
- B. Informational Submittals:
 - 1. Seed: Certification of seed analysis, germination rate, and inoculation:
 - a. Certify that each lot of seed has been tested by a testing laboratory certified in seed testing, within 6 months of date of delivery. Include with certification:
 - 1) Name and address of laboratory.
 - 2) Date of test.
 - 3) Lot number for each seed specified.
 - 4) Test Results: (i) name, (ii) percentages of purity and of germination, and (iii) weed content for each kind of seed furnished.
 - b. Mixtures: Proportions of each kind of seed.
 - 2. Seed Inoculant Certification: Bacteria prepared specifically for legume species to be inoculated.

1.03 DELIVERY, STORAGE, AND PROTECTION

A. Seed:

1. Furnish in standard containers with seed name, lot number, net weight, percentages of purity, germination, and hard seed and maximum weed seed content, clearly marked for each container of seed.
2. Keep dry during storage.

1.04 WEATHER RESTRICTIONS

- #### A. Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.05 GUARANTEE

- #### A. Secure an acceptable growth of grass in all areas designated for seeding.
- #### B. An area is considered acceptable if it is represented by a minimum of 100 seedlings per square foot of the permanent species of grass representative of the seed mixture. If an acceptable growth is not obtained on the first planting, reseeding and remulching will be required.
- #### C. If the planting is less than 50 percent successful, rework the ground, refertilize, reseed, and remulch entire area.

1.06 MAINTENANCE

- #### A. Begin maintenance immediately after each area is planted and continue for a period of 60 days after all planting under this section is completed.
- #### B. Perform maintenance operations during maintenance period to include:
1. Watering: First 2 weeks water daily, thereafter keep surface moist.
 2. Washouts: Repair by filling with topsoil, liming, fertilizing, seeding, and mulching.
 3. Mulch: Replace wherever and whenever washed or blown away.
 4. Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3-1/2 inches.
 5. Reseed unsatisfactory areas or portions thereof immediately at the end of 30 days from initial seeding if a satisfactory stand has not been produced.



PART 2. PRODUCTS

2.01 GRASS SEED

- A. Winter: Kentucky 31 Fescue (*Festuca Elatior*) and/or annual rye meeting the requirements of the State Department of Agriculture and furnished in new bags or bags that are sound and not mended; no “below standard” seed accepted.
- B. Remainder of Year: Kentucky 31 Fescue (*Festuca Elatior*) meeting the requirements of the State Department of Agriculture and furnished in new bags or bags that are sound and not mended; no “below standard” seed accepted.

2.02 FERTILIZER

- A. Commercially manufactured; Grade 10-10-10; furnished in standard containers that are clearly marked with the name, weight, and guaranteed analysis of the contents and that ensure proper protection in transportation and handling; and in compliance with all local, state, and federal fertilizer laws.

2.03 AGRICULTURAL LIMESTONE

- A. Containing a minimum of 85% calcium carbonate and magnesium carbonate combined, 85% of which passes a No. 10 mesh sieve.

2.04 MULCH

- A. Stalks of rye, oats, wheat, or other approved grain crops properly cured prior to baling, air dried, and reasonably free of noxious weeds and weed seeds or other material detrimental to plant growth.
- B. Mulch and Erosion Control Matting and Blankets for Slopes:
 - 1. Curlex blanket excelsior blanket.
 - 2. Hi-Velocity curlex blanket excelsior blanket by American Excelsior Company, P.O. Box 5067, Arlington, Texas 76011.
 - 3. Anti-Wash/Geojute jute fiber mat by Belton Industries, Inc., 8613 Roswell Road, Atlanta, Georgia 30350.
 - 4. Hold/Gro knitted fiber net with paper strips.
 - 5. Roll/lite knitted fiber net with paper strips by Gulf States Paper Corporation, P.O. Box 3199, Tuscaloosa, Alabama 35404.
- C. Erosion Control Matting and Blankets for Ditches and Drainage Channels:
 - 1. Enkamat Matting #7020 by AZKO Industrial Systems, Ridgefield Business Center, Suite 18, Asheville, North Carolina 28802.
 - 2. Miramat 1000 by Mirafi, Inc., P.O. Box 240967, Charlotte, North Carolina 28224.

2.05 TOP SOIL

- A. ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 3/4 inch or larger in any dimension and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Reuse surface soil stockpiled onsite and supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient.
 - 2. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Surface soil may be supplemented with imported or manufactured topsoil from off-site sources.

PART 3. EXECUTION

3.01 PREPARATION

- A. Scarify, disk, harrow, rake, or otherwise work each area to be seeded until the soil has been loosened and pulverized to a depth of not less than 2 inches. Perform this work only when the soil is in a tillable and workable condition.
- B. Before beginning seeding operations in any areas, complete the placing of 4 inches of topsoil and final grading, and have the area to be seeded approved by the OWNER.

3.02 APPLICATION

- A. Perform all seeding and related work as a continuous operation. Sow seed as soon as the seedbed has been prepared, and perform subsequent work in a continuous manner.
- B. Apply fertilizer and agricultural limestone uniformly over the seedbed, and lightly harrow, rake, or otherwise incorporate them into the soil for a depth of approximately 2 to 4 inches at the following rates:
 - 1. Fertilizer: 15 pounds per 1,000 square feet
 - 2. Agricultural Limestone: 40 pounds per 1,000 square feet
- C. Sow seed uniformly with a rotary seeder, wheelbarrow seeder, or hydraulic equipment or by other satisfactory means.
 - 1. Winter: The seeding rate shall be 10 pounds per 1,000 square feet for Kentucky 31 Fescue (*Festuca Elatior*) plus 4 pounds of annual rye per 1,000 square feet.
 - 2. Remainder of Year: Seeding rate shall be 10 pounds per 1,000 square feet of Kentucky 31, Fescue (*Festuca Elatior*).
- D. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.

- E. Perform no seeding during windy weather or when the ground surface is frozen, wet, or otherwise untillable.
- F. Spread the mulch material evenly over the seeded areas immediately following the seeding operation.
 - 1. Mulch Rate: Two bales (100 pound minimum) per 1,000 square feet.
 - 2. The mulch rate may be varied by the OWNER, depending on the texture and condition of the mulch material and the characteristics of the area seeded. Cover all portions of the seeded areas with a uniform layer of mulch so that approximately 25 percent of the ground is visible.

3.03 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain lawns for not less than three mowings or 60 days, whichever is longer.
- C. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading and replanting as required to establish an acceptable lawn, smooth and free of stones, weeds, and eroded or bare areas.
- D. The standard of acceptability for bare areas is no larger than 3 inches in any dimension, nor greater than 5 percent of the lawn.

3.04 INSPECTION

- A. The OWNER will inspect the seeding within 30 days and 60 days after planting and determine if it is acceptable.

3.05 PROTECTION

- A. No equipment, material storage, construction traffic, etc., will be permitted on newly seeded ground.

3.06 CLEANING

- A. Dispose of all surplus materials in compliance with all applicable laws and regulations and in accordance with Section 02321, Excavation, Bedding, and Backfill for Utilities.

END OF SECTION



**SECTION 02925
SODDING**

PART 1. GENERAL

- 1.1 This work shall include all soil preparation and the storage, transportation, placing, and maintenance of sod at all locations shown on the drawings or as directed by the OWNER.
- 1.2 Temporary storage of sod is permitted; however, take care to maintain the sod in a live, growing condition. Sod shall be rejected if it is permitted to decay or dry out to the extent that, in the judgement of the OWNER, its survival is doubtful. Dispose of rejected sod as directed by the OWNER at no expense to the OWNER.
- 1.3 Set sod between March 1 and October 15 and when the soil is in a workable condition.
- 1.4 Do not set sod out of season unless soil conditions are favorable and written permission is obtained from the OWNER.
- 1.5 Refer to other sections for items affecting sodding. Coordinate this work with that specified by other sections for timely execution. The CONTRACTOR shall be wholly responsible for the scheduling, ordering, receiving, storing, and installing of all sodding materials.

PART 2. PRODUCTS

- 2.1 **SOD:** Kentucky 31 Fescue (*Festuca Elatior*); new sod consisting of live, dense, well rooted growth; well suited for the intended purpose and soil conditions; completely free of noxious weeds and grasses (Bermuda grass, quack grass, Johnson grass, Canada thistle); and containing less than 5 plants of objectionable weeds per 100 square feet if nursery grown or 10 such plants if field grown.
- 2.2 **FERTILIZER:** commercially manufactured, Grade 10-10-10; furnished in standard containers that are clearly marked with the name, weight, and guaranteed analysis of the contents and that ensure proper protection in transportation and handling; and in compliance with all local, state, and federal fertilizer laws.
- 2.3 **AGRICULTURAL LIMESTONE:** containing a minimum of 85% calcium carbonate and magnesium carbonate combined, 85% of which passes a No. 10 mesh sieve.



PART 3. EXECUTION

- 3.1 Before beginning sodding operations in any area, complete the placing of topsoil and final grading, and have the area to be sodded approved by the OWNER.
- 3.2 Scarify each area to be sodded a minimum of 2 inches.
- 3.3 Apply fertilizer and agricultural limestone uniformly over the sod bed at the rates shown below. Immediately prior to placing sod, water the sod bed until it is saturated to a depth of 1 inch, and keep it moist until the sod is placed.
 - A. Fertilizer: 15 pounds per 1,000 square feet of 10-10-10
 - B. Agricultural Limestone: 40 pounds per 1,000 square feet
- 3.4 Place sod as soon as practical after its removal from point of origin. Keep it moist while displaced.
- 3.5 Place sod by hand so that the edges are in close contact and in a position to break joints with the long dimension perpendicular to the slope. Fit and pound the sod into place with a 10 inches x 10 inches wood tamp or other similar implement.
- 3.6 Immediately after placing the sod, thoroughly wet and roll it.
- 3.7 Two weeks after the sod is installed, top dress and thoroughly water it. Top dressing shall consist of the following:
 - A. ½ to 1 pound: 38% urea formaldehyde per 1,000 square feet
 - B. 20 pounds: 6-12-12 per 1,000 square feet
- 3.8 No equipment, material storage, construction traffic, etc., will be permitted on newly sodded areas.
- 3.9 Dispose of all surplus material in compliance with all applicable laws and regulations and in accordance with Section 02321, paragraph 3.4.
- 3.10 The OWNER will review the sod for acceptance 30 days after installation, at which time the maintenance period will begin as stated in these specifications. This acceptance by the OWNER is for the purposes of payment only.
- 3.11 **INSPECTION:** The OWNER shall inspect the sod within 30 days after installation and determine if it is acceptable.



3.12 **GUARANTEE:** Establish an acceptable growth of the specified sod on all areas indicating on the drawings or as directed by the OWNER. An area is considered acceptable if the majority of each piece of sod is alive and healthy and generally free from weeds, insects, and disease. The CONTRACTOR is responsible for watering the sod during the maintenance period.

END OF SECTION



SECTION 02930

REPLACEMENT OF TREES, PLANTS, AND GROUND COVER

PART 1. GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of Nurserymen (AAN): Z60.1, Nursery Stock.

1.02 DEFINITIONS

A. Measurement:

1. In size grading Balled and Burlapped (B & B), caliper takes precedence over height.
2. Take trunk caliper 6 inches above the ground level (up to and including 4-inch caliper size) and 12 inches above the ground level for larger trees.
3. Measure size of container-grown stock by height and width of plant.
4. Measure herbaceous perennials pot size, not top growth.

1.03 SUBMITTALS

A. Action Submittals: Product data on manufactured products specified.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Cover plants during shipment with a tarpaulin or other suitable covering to minimize drying.
- B. Balled and Burlapped Plants: Wrap each ball firmly with burlap and securely bind with twine, cord, or wire for shipment and handling. Drum-lace balls with a diameter of 30 inches or more.

PART 2 PRODUCTS

2.01 PLANT MATERIALS

- A. Replacement Shrubs and Trees: Same species, size, and quality as specified for plant being replaced, except existing trees larger than 6-inch caliper may be replaced with 6-inch caliper trees.
- B. Replacement Plants and Ground Covers: Same species, size, and quality as original existing materials.
- C. Quality and Size:
 - 1. Nursery-grown, habit of growth normal for species.
 - 2. Sound, healthy, vigorous, and free from insects, diseases, and injuries.
 - 3. Equal to or exceeding measurements of existing plants.
 - 4. Root System of Container-Grown Plants: Well developed and well distributed throughout the container, such that the roots visibly extend to the inside face of the growing container.
 - 5. Perform necessary pruning at time of planting.
 - 6. Sizes: Dimensional relationship requirements of AAN Z60.1 for kind and type of plants required.
 - 7. Balled and Burlapped Plants: Firm, intact ball of earth encompassing enough of the fibrous and feeding root system to enable full plant recovery.
 - a. Ball Size: AAN Z60.1.
 - 8. Container-Grown Plants: Self-established root systems, sufficient to hold earth together after removal from container, without being root bound.
 - a. Stock: Grown in delivery containers for at least 6 months but not over 2 years.
 - 9. Label each tree and shrub of each variety with securely attached waterproof tag bearing legible designation of botanical and common name.

2.02 ANTIDESICANT

- A. Provide transpiration retarding material to be used where any plant material is moved during the growing season.
- B. Products:
 - 1. Foliguard.
 - 2. Wiltpruf.

2.03 GUYING, STAKING, AND WRAPPING MATERIALS

- A. Ground Anchors: Screw type.

- B. Eyebolt Masonry Anchors: Galvanized steel, with 1/2-inch eye and 6 inches long provided with lead shield for setting into masonry joint or concrete, or Phillips flush shells.
- C. Wood Stake: 2 inches by 2 inches by 8 feet.
- D. Tree Ties: No. 4 chainlock tree ties as manufactured by Green Brothers, Ltd.
- E. Guy Wires: Galvanized, 12-gauge, ductile steel.
- F. Flags:
 - 1. Wood: 1/2 inch by 3 inches by 12 inches, with 3/8-inch hole centered 1-1/2 inches from each end, painted white.
 - 2. Sheet Metal: 1-1/2 inch with clipped corners, and both ends punched and painted white.
- G. Hose: Two-ply, reinforced rubber garden hose, not less than 1/2-inch diameter, new or used.
- H. Turnbuckles: Zinc-coated, with 6-1/2-inch lengthwise opening, and at each end 3/8-inch diameter threaded openings fitted with screw eyes.
- I. Wrapping Material: Heavy crepe paper.
 - 1. Burlap: Of first quality, minimum 8 ounces in weight, not less than 6 inches nor more than 10 inches in width.
- J. Deadmen: 6 inches by 6 inches by 3 feet long pressure treated timbers.

2.04 MULCH

- A. Free from noxious weed seed and foreign material harmful to plant growth.
- B. Barkdust: Medium grind, fir, pine, or hemlock; maximum 3/4-inch particle size.
- C. Stone Mulch:
 - 1. Round river rock, washed, with no fines.
 - 2. Stone Size: Minimum 1 inch; maximum 3 inches.

2.05 PEAT MOSS

- A. Sphagnum peat moss, fibrous type with neutral pH.



2.06 HERBICIDE

- A. Selective, pre-emergent, surface-applied.
- B. Manufacturers and Products:
 - 1. Eli Lilly and Co.; Surflan.
 - 2. Thompson-Hayward Chemical Co.; Casoron.

2.07 PLANTING SOIL MIX

- A. Top Soil: Amend to meet requirements of soil analysis.

2.08 FERTILIZER

- A. Commercial, complete, of neutral character; in granular, packet, or pellet form, 35 percent to 80 percent of nitrogen slow release.
 - 1. Minimum: 10 percent available nitrogen, 3 percent to 5 percent phosphoric acid, and 3 percent to 5 percent soluble potash.

PART 3 EXECUTION

3.01 TRANSPLANTING

- A. Remove existing plantings identified for transplant prior to beginning Work in area in accordance with standard nursery practices and as specified herein.
- B. Nondormant Plants: Prior to digging, spray foliage with antidesiccant, as recommended by manufacturer.
- C. Cover balls and containers of plants that cannot be planted immediately with moist soil or mulch.
- D. Water plants as often as necessary to prevent drying until planted.
- E. Do not remove container-grown stock from containers before time of planting.
- F. Bare-Root Plants:

1. Dig up with least possible injury to fibrous root system.
 2. Immediately upon removal from ground, cover roots with thick coating of mud or wrap in wet straw, moss, or other suitable packing material for protection from drying until planted.
 3. Plant or heel-in immediately upon relocation to temporary storage. Open and separate bundles of bare-root plants, and eliminate air pockets among roots as they are covered.
- G. Replant each temporarily removed tree, shrub, or other plant only after construction activities are completed and applicable grading and topsoil replacement is completed in its vicinity. Replant trees, shrubs, and other plants in their original positions unless otherwise shown or approved. Plant as specified for new plants.
- H. Maintain transplanted materials in same manner as new trees and shrubs.

3.02 LOCATION OF PLANTS

- A. Locate new planting or stake positions as shown unless obstructions are encountered, in which case notify OWNER.
- B. Locate no planting, except ground cover, closer than 18 inches to pavements, pedestrian pathways, and structures.
- C. Request OWNER inspect locations and adjust as necessary before planting begins.

3.03 PREPARATION

- A. Planting Soil: Delay mixing of amendments and fertilizer if planting will not follow preparation of planting soil within 2 days. For pit and trench type backfill, mix planting soil prior to backfilling and stockpile at Site.
- B. Plants: Place on undisturbed existing soil or well-compacted backfill.
- C. Trees and Shrubs:
 1. Pits, Beds, and Trenches: Excavate with vertical and scarified sides.
 2. B & B Trees and Shrubs: Make excavations at least twice as wide as root ball.
 3. Container-Grown Stock: Excavate as specified for B & B stock, adjust for size of container width and depth.
 4. Bare-Root Trees: Excavate pits to a width to just accommodate roots fully extended and depth to allow uppermost roots to be below original grade.
 5. Fill excavations with water and allow to percolate out prior to planting.
- D. Ground Cover Beds:
 1. Mix amendments and fertilizer with top soil prior to placing or apply on surface of top soil and mix thoroughly before planting.
 2. Scarify top soil to a depth of 4 inches to 6 inches.

3. Establish finish grading of soil. Rake areas to smooth and create uniform texture and fill depressions.
4. Moisten.

3.04 PLANTING

- A. Plant trees before planting surrounding smaller shrubs and ground covers. Adjust plants with most desirable side facing toward the prominent view (sidewalk, building, street).
- B. B & B Plants: Place in pit by lifting and carrying by its ball (do not lift by branches or trunk). Lower into pit. Set straight and in pit center with tip of rootball 1 inch to 2 inches above adjacent finish grade.
- C. Bare-Root Plants: Spread roots and set stock on cushion of planting soil mixture. Set straight in the pit center so that roots, when fully extended, will not touch walls of the planting pit and the uppermost root is just below finish grade. Cover roots of bare-root plants to the crown.
- D. Container-Grown Plants: Remove containers, slash edges of rootballs from top to bottom at least 1-inch deep. Plant as for B & B plants.
- E. Ground Covers: Dig planting holes through mulch with one of the following: hand trowel, shovel, bulb planter, or hoe. Split biodegradable pots or remove nonbiodegradable pots. Root systems of all potted plants shall be split or crumbled. Plant so roots are surrounded by soil below the mulch. Set potted plants so pot top is even with existing grade.

3.05 BACKFILLING

- A. Backfill with planting soil, except where existing soil is suitable according to top soil analysis.
- B. B & B Plants:
 1. Partially backfill pit to support plant. Remove burlap and binding from sides and tops of B & B plants, do not pull burlap from under balls.
 2. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill to eliminate air pockets even if it is raining. Finish backfilling pit sides.
 3. Never cover top of rootball with soil. Form a saucer above existing grade, completely around the outer rim of the plant pit.
- C. Bare-Root Plants:
 1. Plumb before backfilling and maintain plumb while working backfill around roots and placing layers above roots.

2. Set original soil line of plant 1 inch to 2 inches above adjacent finish landscape grades. Spread out roots without tangling or turning up to surface. Cut injured roots cleanly; do not break.
3. Carefully work backfill around roots by hand; puddle with water until backfill layers are completely saturated.

3.06 GUYING, STAKING, AND WRAPPING

- A. Support trees immediately after planting to maintain plumb position.
- B. Guying: Support deciduous trees over 4 inches in caliper and all coniferous trees with four guys equally.
- C. Staking: Support deciduous trees 4 inches in caliper or less with stakes spaced equally about each tree.

3.07 FERTILIZER

- A. Add as top dressing depending on plant size and manufacturer's recommendation.
- B. Commercial:
 1. Trees: 1/2 pound of 10:6:4 fertilizer per inch of trunk diameter.
 2. Shrubs: 1/4 pound of 10:6:4 fertilizer per foot of height or spread per plant, or 3 pounds to 5 pounds of 10:6:4 fertilizer per 100 square feet of bed area.
 3. Ground Cover: 3 pounds of 10:6:4 fertilizer per 100 square feet of bed area.

3.08 MULCHING

- A. Cover planting beds and area of saucer around each plant with 2-inch thick layer of mulch within 2 days after planting. Saturate planting area with water.

3.09 PRUNING AND REPAIR

- A. Prune only after planting and in accordance with standard horticultural practice to preserve natural character of the plant. Perform in presence of OWNER. Remove all dead wood, suckers, and broken or badly bruised branches. Use only clean, sharp tools. Do not cut lead shoot.

3.10 WEED CONTROL

- A. Maintain a weed-free condition within planting areas. Apply pre-emergent selective herbicide to mulched beds at manufacturer's recommended rate of application.



3.11 PROTECTION OF INSTALLED WORK

- A. Protect planting areas and plants against damage for duration of maintenance period.

END OF SECTION