

**STANDARD WATER SPECIFICATIONS
AND DETAILS
FOR THE
WEST KNOXVILLE UTILITY DISTRICT**



Approved By:

Wayne Hastings

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General Manager, West Knox Utility District

October 23, 2024



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APPROVED WATER SPECIFICATIONS
THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE
TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION
DIVISION OF WATER RESOURCES
AND IS HEREBY APPROVED FOR USE IN CONSTRUCTION BY THE COMMISSIONER

Cindy Wheeler
02/28/2025

THIS APPROVAL SHALL NOT BE CONSTRUED AS CREATING A
PRESUMPTION OF CORRECT OPERATION OR AS WARRANTING BY THE
COMMISSIONER THAT THE APPROVED FACILITIES WILL REACH THE
DESIGNED GOALS.

APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE

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SECTION 02240 - DEWATERING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor and equipment required to dewater all excavations.
- B. Dewatering of all excavations shall be the responsibility of the Developer/Contractor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02300 - Earthwork
- B. Section 02371 - Erosion and Sedimentation Control

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 GENERAL

- A. Dewatering equipment shall be of adequate size and quantity to assure maintaining proper conditions for installing pipe, concrete, backfill or other material or structure in the excavation.
- B. Dewatering shall include proper removal of any and all liquid, regardless of its source, from the excavation and the use of all practical means available to prevent surface runoff from entering any excavation.
- C. The site shall be kept free of surface water at all times. The Developer/Contractor shall install drainage ditches, dikes and shall perform all pumping and other work necessary to divert or remove rainfall and all other accumulations of surface water from the excavations. The diversion and removal of surface water shall be performed in a manner that will prevent flooding and/or damage to other locations within the construction area where it may be detrimental. The Developer/Contractor shall provide, install and operate sufficient trenches, sumps, pumps, hose piping, well points, deep wells, etc., necessary.

END OF SECTION

SECTION 02260 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This Section includes, but is not limited to, the following:
 - 1. Shoring and bracing necessary to protect existing buildings, streets, walkways, utilities, and other improvements and excavation against loss of ground or caving embankments.
 - 2. Maintenance of shoring and bracing.
 - 3. Removal of shoring and bracing, as required.
- B. Types of shoring and bracing systems include, but are not limited to, the following:
 - 1. Steel H-section (soldier) piles.
 - 2. Timber lagging.
 - 3. Steel sheet piles.

1.02 QUALITY ASSURANCE

- A. Engineer Qualifications: A professional engineer legally authorized to practice in jurisdiction where Project is located, and experienced in providing successful engineering services for excavation support systems.
- B. Supervision: Engage and assign supervision of excavation support system to a qualified professional engineer foundation consultant.
 - 1. Submit name of engaged consultant and qualifying technical experience.
- C. Regulations: Comply with codes and ordinances of governing authorities having jurisdiction.

1.03 EXISTING UTILITIES

- A. Protect existing active sewer, water, gas, electricity and other utility services and structures.
- B. Notify municipal agencies and service utility companies having jurisdiction. Comply with requirements of governing authorities and agencies for protection, relocation, removal, and discontinuing of services.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Provide adequate shoring and bracing materials, which will support loads imposed. Materials need not be new, but should be in serviceable condition.

- B. Structural Steel: ASTM A 36.
- C. Steel Sheet Piles: ASTM A 328.
- D. Timber:

Lagging: Any species, rough-cut, mixed hardwood, nominal 3 inches thick, unless otherwise indicated.

Sheeting, Bracing, Struts: No timber sheeting less than two inches in thickness and timber bracing, cross bracing or struts less than six inches in thickness will be acceptable.

PART 3 - EXECUTION

3.01 GENERAL

- A. Where unstable materials are encountered or as required by law or Government regulations, such as OSHA, the sides of the trench or excavation shall be supported by substantial sheeting, bracing, and shoring, or the sides sloped to the angle of repose. Adequate and proper shoring of all excavations shall be the entire responsibility of the Developer/Contractor.
- B. Foundations, adjacent to where the excavation is to be made below the depth of the foundation, shall be supported by shoring, bracing or underpinning of a temporary or a permanent nature as may be required to assure the integrity of the structure. The Developer/Contractor will be held strictly responsible for any damage to adjoining foundations or structures.
- C. All sheeting, planking, timbering, bracing and bridging shall be placed, renewed and maintained as long as necessary.
- D. Solid sheeting will be required for wet or unstable material. It shall consist of continuous vertical sheet piling of timber minimum two inches thick or of steel with suitable shores and braces. All sheeting to be left in place shall be minimum two-inch thick timber.
- E. Care shall be taken to avoid excessive backfill loads on the completed pipelines and to ensure the width requirements of the ditch at the level of the crown of the pipe do not exceed that specified in “Section 02510 - Water Distribution Piping”, “Section 02530 - Gravity Sewer Piping” and “Section 02531 - Sewage Force Mains”.
- F. Trench sheeting shall not be removed until sufficient backfill has been placed to protect the pipe.

3.01 SHORING

- A. Wherever shoring is required, locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces. Provide shoring system adequately anchored and braced to resist earth and hydrostatic pressures.
- B. Shoring systems retaining earth on which the support or stability of existing structures is dependent must be left in place at completion of work.

3.02 BRACING

- A. Locate bracing to clear permanent work. If necessary to move a brace, install new bracing prior to removal of original brace.
- B. Do not place bracing where it will be cast into or included in permanent concrete work, except as otherwise acceptable to WKUD.
- C. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
- D. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.
- E. Remove sheeting, shoring, and bracing in stages to avoid disturbance to underlying soils and damage to structures, pavements, facilities, and utilities.
- F. Repair or replace adjacent work damaged or displaced through installation or removal of shoring and bracing work.

END OF SECTION

SECTION 02300 - EARTHWORK

PART 1 - GENERAL

1.01 SCOPE OF WORK

Provide all materials, labor, equipment and services necessary to do all clearing and grubbing, excavation, backfilling, providing of additional fill material and topsoil, control of surface drainage and ground water, finished site grading and erosion control required to construct the work as shown.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. State and local code requirements shall control the disposal of trees and shrubs.
- B. All burning shall be controlled by applicable local regulations.

1.03 JOB CONDITIONS

- A. Weather: Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained on account of rain, snow, ice, drought or other adverse weather conditions.
- B. Existing Utilities: Prior to commencement of work, the Developer/Contractor shall locate existing underground utilities in areas of the work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
- C. Use of Explosives: The Developer/Contractor (or any of his Subcontractors) shall not bring explosives onto site or use in work without prior written permission from WKUD. All activities involving explosives shall be in compliance with the rules and regulations of all governing authorities. Developer/Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.
- D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- E. Dust Control: Use all means necessary to control dust on or near the project site where such dust is caused by the Developer/Contractor's operations or directly results from conditions left by the Developer/Contractor.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Definitions:
 - 1. Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, SP, GC, SC, ML, and CL.

2. Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups MH, CH, OL, OH and PT. The Developer/Contractor shall notify the WKUD if these soil materials are encountered.
3. Sub base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand.
4. Drainage Fill: Washed, evenly graded mixture of crushed stone, or uncrushed gravel, with 100 percent passing a 1 to 2-inch sieve and not more than 5 percent passing a No. 4 sieve.
5. Backfill and Fill Materials: Satisfactory soil materials free of debris waste, frozen materials, vegetable, and other deleterious matter.

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

- A. Work shall consist of cutting and removing designated trees, stumps, brush, logs, removal of fences, or other loose and projecting material. Unless otherwise specified, it shall also include the grubbing of stumps, roots, and other natural obstructions, which, in the opinion of WKUD, must be removed to execute properly the construction work and operate properly the facility upon the completion of construction.
- B. Trees, bushes, and all-natural vegetation shall only be removed with the approval of the Engineer. No cleared or grubbed materials shall be used in backfills or embankment fills. All stumps, roots, and other objectionable material shall be grubbed up so that no roots larger than 3 inches in diameter remain less than 18 inches below the ground surface. All holes and depressions left by grubbing operations shall be filled with suitable material and compacted to grade, as recommended in Paragraph 3.06.
- C. Disposal shall be by methods satisfactory to WKUD; burning will be permitted only when the Developer/Contractor has obtained written permission from the local regulatory agency.
- D. The Developer/Contractor shall also remove from the site and satisfactorily dispose of all miscellaneous rubbish including, but not limited to, masonry, scrap metal, rock, pavement, etc. that is under the fill or to be removed as shown on the Drawings, specified herein, or directed by WKUD.
- E. Existing improvements, adjacent property, utility and other facilities, and trees, plants, and brush that are not to be removed shall be protected from injury or damage resulting from the Developer/Contractor's operations.
- F. Trees and shrubs, designated to remain or that are beyond the clearing and grubbing limit, which are injured or damaged during construction operations shall be treated or replaced at the Developer/Contractor's expense by experienced tree surgery personnel.

3.02 EROSION CONTROL

- A. Temporary measures shall be applied throughout the construction period to control and to minimize siltation to adjacent properties and waterways. Such measures shall include, but not be limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, slope drains and other methods.

- B. These temporary measures shall be applied to erodible material exposed by any activity associated with the construction of this project.
- C. Refer to “Section 02371 - Erosion and Sedimentation Control” for requirements. All requirements of the State of Tennessee shall be met.

3.03 EXCAVATION

- A. Excavation of every description and of whatever substances encountered within the grading limits of the project shall be performed to the lines and grades indicated on the Drawings. All excavation shall be performed in the manner and sequence as required for the work.
- B. All excavated materials that meet the requirements for fill, subgrade, or backfill shall be stockpiled within the site for use as fill or backfill, or for providing the final site grades. Where practicable, suitable excavated material shall be transported directly to any place in the fill areas within the limits of the work. All excavated materials, which are not suitable for fill, and the Developer/Contractor shall dispose of any surplus of excavated material, which is not required for fill.
- C. The site shall be kept free of surface water at all times. The Developer/Contractor shall install drainage ditches, dikes and shall perform all pumping and other work necessary to divert or remove rainfall and all other accumulations of surface water from the excavations. The diversion and removal of surface water shall be performed in a manner that will prevent flooding and/or damage to other locations within the construction area where it may be detrimental. The Developer/Contractor shall provide, install and operate sufficient trenches, sumps, pumps, hose piping, well points, deep wells, etc., necessary to depress and maintain the ground water level at least two (2) feet below the base of the excavation during all stages of construction operations. The ground water table shall be lowered in advance of excavation and maintained a minimum of two (2) feet below the lowest excavation subgrade made until the excavation is backfilled or the structure has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural ground water.
- D. Excavations for concrete structural slabs and footings on grade shall extend two (2) feet below the indicated bottom of slabs and footings. The over-excavation shall be backfilled with 18 inches, compacted thickness, of over lot fill material or suitable material as herein specified. The remaining six (6) inches of over-excavation shall be backfilled with porous fill material. The porous fill layer shall extend beyond the limits of the concrete slab a minimum of two (2) feet on all sides as indicated on the Drawings. The porous fill shall be crushed stone or gravel and shall have the following U.S. Standard Sieve gradation:

Sieve	1-1/2	1	3/4	1/2	3/8
% Passing	Min 100	95±5	58±17	Max 15	Max 5

- E. Excavations for the construction shall be carefully made to the depths required. Bottoms for footings and grade beams shall be level, clean and clear of loose material, the lower sections true to size. Bottoms of footings and grade beams, in all locations, shall be at a minimum depth of 30 inches below adjacent exterior finished grade or 30 inches below adjacent existing grade, whichever is lower, whether so indicated or not.

- F. In excavations for structures where the ground is spongy or otherwise unsuitable for the contemplated foundation, the Developer/Contractor shall remove such unsuitable material and replace it with suitable material properly compacted.
- G. Sheeting and shoring shall be provided as necessary for the protection of the work and for the safety of the personnel. The clearances and types of the temporary structures, insofar as they affect the character of the finished work, will be subject to the review of WKUD, but the Developer/Contractor shall be responsible for the adequacy of all sheeting, bracing and coffer damming. All shoring, bracing and sheeting shall be removed, as the excavations are backfilled in a manner such as to prevent injurious caving; or, if so, directed by WKUD, shall be left in place. Sheeting left in place shall be cut off 18 inches below the surface.
- H. Excavation for structures, which have been carried below the depths indicated without specific instructions, shall be refilled to the proper grade with suitable material properly compacted, except that in excavation for columns, walls or footings, the concrete footings shall extend to this lower depth. All work of this nature shall be at the Developer/Contractor's expense.

3.04 FILL

- A. All existing fill below structures and paved areas must be stripped. The upper six (6) inches of the natural subgrade below shall be scarified and recompacted at optimum moisture to at least ninety-five percent (95%) of Standard Proctor Density ASTM D 698 (latest revision).
- B. All vegetation, such as roots, brush, heavy sods, heavy growth of grass and all decayed vegetable matter, rubbish and other unsuitable material within the area upon which fill is to be placed shall be stripped or otherwise removed before the fill is started. In no case will such objectionable material be allowed to remain in or under the fill area. Existing fill from excavated areas on site shall be used as fill for open and/or planted areas. Additional fill stockpiled at the site can be used for structural fill if approved by WKUD. Any additional material necessary for establishing the indicated grades shall be furnished by the Developer/Contractor and approved by WKUD. All fill material shall be free from trash, roots and other organic material. The best material to be used in fills shall be reserved for backfilling pipelines and for finishing and dressing the surface. Material larger than 3 inches maximum dimension shall not be permitted in the upper 6 inches of the fill area. Fill material shall be placed in successive layers and thoroughly tamped or rolled in a manner approved by WKUD, each layer being moistened or dried such that the specified degree of compaction shall be obtained. No fill shall be placed or compacted in a frozen condition or on top of frozen material. No fill material shall be placed when free water is standing on the surface of the area where the fill is to be placed and no compaction of fill will be permitted with free water on any point of the surface of the fill to be compacted.
- C. Where concrete slabs are placed on earth, all loam and organic or other unsuitable material shall be removed. Where fill is required to raise the subgrade for concrete slabs to the elevations as indicated on the Drawings, such fill shall consist of suitable material and shall be placed in layers. Each layer shall be moistened or dried such that the specified degree of compaction shall be obtained. All compaction shall be accomplished in a manner and with equipment as approved by WKUD. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for adjacent fill.

3.05 BACKFILLING

- A. After completion of footings, grade beams and other construction below the elevation of the final grades and prior to backfilling, all forms shall be removed and the excavation shall be cleaned of all trash and debris. Material for backfilling shall be as specified for suitable material, placed and

compacted as specified hereinafter. Backfill shall be placed in horizontal layers of the thickness specified and shall have a moisture content such that the required degree of compaction is obtained. Each layer shall be compacted by mechanical tampers or by other suitable equipment to the specified density. Special care shall be taken to prevent wedging action or eccentric loading upon or against the structure. Trucks and machinery used for grading shall not be allowed within 45 degrees above the bottom of the footings or grade beams.

- B. The trenches shall be backfilled following visual inspection by WKUD and prior to pressure testing. The trenches shall be carefully backfilled with the excavated materials approved for backfilling, or other suitable materials, free from large clods of earth or stones. Each layer shall be compacted to a density at least equal to that of the surrounding earth and in such a manner as to permit the rolling and compaction of the filled trench with the adjoining earth to provide the required bearing value, so that paving, if required, can proceed immediately after backfilling is completed.

3.06 COMPACTION

- A. Suitable material as hereinbefore specified shall be placed in maximum 8" horizontal layers. Compaction shall be performed by rolling with approved tamping rollers, pneumatic-tired rollers, three-wheel power rollers or other approved equipment. The degree of compaction required is expressed as a percentage of the maximum dry density obtained by the test procedure presented in ASTM D-698. Laboratory moisture density tests shall be performed on all fill material. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction. Compaction requirements shall be as specified below:

Fill Utilized For	Required Density (%)	Maximum Permissible Lift Thickness as Compacted, Inches
Backfill & Utility Trenches Under Foundations & Pavements	95-100	8
Backfill Around Structures	95-100	8
Field and Utility Trench Backfill under Sidewalks and Open Areas	90-100	8

- B. Field density tests shall be performed in sufficient number to ensure that the specified density is being obtained. Tests shall be in accordance with ASTM Standards D 1556 or D 2922/D 3017 and shall be performed as authorized by WKUD. Payment for field density tests shall be by the Developer/Contractor. Developer/Contractor shall provide suitable notification for coordination of testing. Delays due to the lack of adequate advance notification shall be the responsibility of the Developer/Contractor.

3.07 SITE GRADING

- A. Where indicated or directed, topsoil shall be removed without contamination with subsoil and spread on areas already graded and prepared for topsoil, or transported and stockpiled convenient to areas for later application, or at locations specified. Topsoil shall be stripped to full depth and, when stored, shall be kept separate from other excavated materials and piled free of roots, stones, and other undesirable materials.

- B. Following stripping, fill areas shall be scarified to a minimum depth of six (6) inches to provide bond between existing ground and the fill material. Material should be placed in successive horizontal layers not exceeding twelve (12) inches uncompacted thickness. In general, layers shall be placed approximately parallel to the finished grade line.
- C. In general, and unless otherwise specified, the Developer/Contractor may use any type of earth moving equipment he has at his disposal, provided such equipment is in satisfactory condition and of such type and capacity that the work may be accomplished properly and the grading schedule maintained. During construction, the Developer/Contractor shall route equipment at all times, both when loaded and empty, over the layers as they are placed, and shall distribute the travel evenly over the entire area.
- D. The material in the layers shall be of the proper moisture content before rolling or tamping to obtain the prescribed compaction. Wetting or drying throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on the fill thus affected shall be delayed until the material has dried to the required moisture content. If the material is too dry, it shall be sprinkled with water and manipulated to obtain the uniform moisture content required throughout a layer before it is compacted.
- E. Each layer of the fill shall be compacted by rolling or tamping to the standard specified in Paragraph 3.06 and not less than 90% maximum density at optimum moisture content as determined by field density tests made by the Standard Proctor method in accordance with ASTM D 698. In general, and unless otherwise specified, the Developer/Contractor may use any type of compaction equipment such as sheepsfoot rollers, pneumatic rollers, smooth rollers and other such equipment he has at his disposal, provided such equipment is in satisfactory condition and is of such design, type, size, weight, and quantity to obtain the required density in the embankment. If at any time the required density is not being obtained with the equipment then in use by the Developer/Contractor, WKUD may require that different and/or additional compaction equipment be obtained and placed in use at once to obtain the required compaction.
- F. Samples of all fill and embankment materials, both before and after placement and compaction, will be taken by WKUD, and from the tests made on such samples, certain corrections, adjustments, and modifications of methods, materials, and moisture content will be directed to obtain uniformity with the governing specifications for compaction and construct properly the fill and embankment.
- G. The Developer/Contractor shall be responsible for the stability of all embankments and shall replace any portion which has become displaced due to carelessness or negligence on the part of the Developer/Contractor.

3.08 TOPSOIL

- A. Provide all labor, materials, equipment and services required for furnishing and placing topsoil. Samples of topsoil shall be submitted to the Engineer for review before topsoil is placed. The material shall be good quality loam and shall be fertile, friable, mellow; free from stones larger than one (1) inch, excessive gravel, junk metal, glass, wood, plastic articles, and roots and shall have a liberal amount of organic matter. Light sandy loam or heavy clay loam will not be acceptable.
- B. The topsoil shall be 3 inches thick in all areas to be seeded. No topsoil shall be placed until the area to be covered is excavated or filled to the required grade. Imported backfill material will be stockpiled on site for structure backfilling and topsoiling.

END OF SECTION

SECTION 02371 - EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. The Developer/Contractor shall be responsible for construction of Best Management Practices for control of erosion and sediment, as recognized by the Tennessee Department of Environment and Conservation, Division of Water Resources. The Developer/Contractor shall be responsible for maintaining the BMPs through the construction project and longer if necessary. The Developer/Contractor shall be responsible for inspecting and reporting the adequacy of the BMPs per the guidelines established by the Division of Water Resources. The Developer/Contractor must designate an individual to be responsible for erosion and sediment control measures and ensure that person is properly trained and responsible for meeting the TDEC requirements for inspections, reporting, etc.
- B. This Section does not intend to direct the Developer/Contractor's means and methods for erosion and sediment control but does place all responsibility on the Developer/Contractor for proper construction, maintenance and inspection of his erosion and sediment control BMPs. Any fines that may be received by the Owner due to a Notice of Violation that resulted from improper erosion or sediment control practices during construction of the Work shall be borne by the Developer/Contractor.
- C. The Developer/Contractor shall maintain all areas where excavation and backfill operations are being performed or have been performed in order that siltation and bank erosion will be kept to a minimum during construction. BMPs recognized by the Division of Water Resources are described in the Tennessee Erosion and Sediment Control Handbook, Latest Edition, prepared by John C. Price and Robert Karesh under the direction of the Tennessee Department of Environment and Conservation, Division of Water Resources, as conditions exist. BMPs generally include:
1. Vegetative Practices,
 2. Structural Practices, and
 3. Stream Alteration Practices

Specific techniques for each Practice are identified in the Erosion and Sediment Control Handbook. For each technique offered in the Handbook the Developer/Contractor will find:

1. Definition of technique,
2. Purpose for use,
3. Conditions for use,
4. Design Criteria for technique,
5. Construction Specifications for technique,
6. Maintenance measures for technique.

1.02 STORM WATER POLLUTION PREVENTION PLAN

- A. If the disturbed area is one acre or greater, Developer/Contractor and Owner Developer shall submit to the State of Tennessee a Notice of Intent (NOI) for a Construction Storm Water Discharge Permit. Prerequisites for submission of a NOI include documentation of an ARAP, if particular project necessitates such, and development of a Storm Water Pollution Prevention Plan (SWPPP). Plan shall be prepared in accordance with Tennessee General Permit

No. TNR10-0000 Storm Water Discharges for Construction Activities and is the Developer/Contractor's responsibility.

Determination of the required type and extent of erosion control features, methods, etc., necessary for meeting the State requirements, shall be the responsibility of the Developer/Contractor regardless of the methods shown on the SWPPP.

- B. General components for a SWPPP include a Site Description, Storm Water Runoff Controls, Erosion and Sediment Controls, Stabilization Practices, Structural Practices, Storm Water Management, Maintenance Plan, and Inspections.
- C. If required, the Owner and Developer/Contractor shall execute a Construction Activity – Storm Water Discharges Notice of Intent (NOI) and a Notice of Termination (NOT) when an SWPPP is required. The NOI and NOT must be submitted to the:

Tennessee Department of Environment and Conservation
Knoxville Environmental Field Office
Division of Water Resources
3711 Middlebrook Pike
Knoxville, TN 37921

The Developer/Contractor shall pay any Fee associated with submission of the Notice of Intent or SWPPP.

- D. Within 30 days of submission of the Notice of Intent, the Division of Water Resources shall issue a Notice of Coverage for the project and allow the project to be constructed under Tennessee General Permit No. TNR10-0000: Storm Water Discharges from Construction Activities. The Division of Water Resources may deny the coverage and require submittal of an application for an individual NPDES Permit based on review of the NOI or other information. Developer/Contractor shall not begin construction activities (i.e., the initial disturbance of soils associated with clearing, grading, excavation activities, or other construction activities) prior to receipt of the NOC if it is required.
- E. Deficient Performance
 - 1. If at any time it is determined by WKUD that the erosion and sediment control measures are not capable of preventing sediment from leaving the construction site under storm conditions, then additional control measures shall be implemented. Additional control measures shall be implemented to a level that State criteria are met.
 - 2. If at any time the Developer/Contractor is fined by the State or other agency due to improper implementation or maintenance of erosion and sediment control measures, the Developer/Contractor is responsible for paying the fine as well as any additional expenses for A/E services.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Developer/Contractor shall meet State requirements for Construction Along or Across a Stream and be responsible for securing any required Construction Storm Water or ARAP Permits.
- B. Final erosion protection measures shall be the Developer/Contractor's responsibility.

- C. Reference the Tennessee Department of Environment and Conservation, Division of Water Resources Tennessee Erosion and Sediment Control Handbook, August 2012, or latest revision, for Best Management Practices Guidelines.

PART 2 - PRODUCTS

2.01 EROSION AND SEDIMENT CONTROL MATERIALS

Refer to Tennessee Department of Environment and Conservation, Division of Water Pollution Control's Tennessee Erosion and Sediment Control Handbook, August 2012, or latest revision for product definitions, purposes of use, and construction specifications.

PART 3 - EXECUTION

3.01 EROSION AND SEDIMENT CONTROL INSTALLATION

Refer to Tennessee Department of Environment and Conservation, Division of Water Resources Tennessee Erosion and Sediment Control Handbook, August 2012, or latest revision for conditions for use, construction details, recommended maintenance, and inspection criteria.

3.02 MAINTENANCE OF CONTROLS AND PERFORMANCE

- A. Erosion and sediment controls shall be inspected as previously mentioned in this specification section. Replace straw bales, which deteriorate, filter stone which is dislodged, erosion control blanket which is damaged, and make other necessary repairs.
- B. Should any of the temporary erosion and sediment control measures employed by the Developer/Contractor fail to produce results which comply with the requirements of the local, state, or federal authority, the Developer/Contractor shall immediately take whatever steps are necessary to correct the deficiency at his own expense.
- C. Remove all temporary erosion and sediment controls as final landscaping and grading is performed.

3.03 INSPECTION

The Developer/Contractor is responsible for the inspections to meet TDEC requirements; the Developer/Contractor shall use the required forms and shall utilize a qualified inspector at the frequencies required by TDEC regulations. Records shall be maintained at the site by the Developer/Contractor's designated person.

END OF SECTION

SECTION 02400 - BORING AND JACKING

PART 1 - GENERAL

1.01 SCOPE OF WORK

Provide all labor, materials, equipment and services required to furnish and install all bored and jacked carrier pipes in encasement pipes under railroad, highway, road, and other paved surfaces as shown on the Drawings and/or specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02300 - Earthwork
- B. Piping is specified in “Section 02510 - Water Distribution Piping”, “Section 02530 - Gravity Sewer Piping”, “Section 02531 - Sewage Force Mains”.

1.03 SUBMITTALS

- A. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction, shall be submitted on all items specified herein to WKUD for review before ordering.
- B. At the time of submission, the Developer/Contractor shall, in writing, call the WKUD’s attention to any deviations that the submittals may have from the requirements of the Standard Specifications.

PART 2 - PRODUCTS

2.01 CARRIER PIPE

Carrier pipe shall be as shown on the Drawings and as specified in the Detailed Specifications unless otherwise noted.

2.02 CASING PIPE

- A. Casing pipe shall be steel, plain end, minimum yield point strength of 35,000 psi and conform to ASTM A 252 Grade 2 or ASTM A 139 Grade B without hydrostatic tests. The casing pipe shall meet the latest approved “Specifications for Pipelines for Carrying Flammable and Non-flammable Substances”. The steel pipe shall have welded joints and be in at least 18-foot lengths. The casing pipe shall be coal tar epoxy coated. Field butt welds shall be fully welded the entire circumference of the casing with full weld penetration of the steel.
- B. The diameter of the casing pipe shall, as a minimum, be as follows:

Carrier Pipe Nominal Diameter (inches)	6	8	10	12	16	18	24	27	30	33	36
Casing Pipe Nominal Diameter (inches)	12	16	18	20	26	28	36	40	46	48	50

- C. The wall thickness of the casing pipe shall be as follows:

Casing Pipe Nominal Diameter (Inches)								
Under 16	16 to 22	24 to 28	30	36	38	42	48	50
Casing Pipe Nominal Thickness (Inches)								
.250	.375	.375	.406	.469	.500	.562	.625	.656

However, should casing pipe thickness be specified or required on Highway or Railroad permit approval sheets, said permit thickness requirement shall govern. Permit approval sheets will be made available to the Developer/Contractor.

2.03 CASING SPACERS

- A. Stainless Steel Casing Spacers: Stainless steel casing spacers shall be bolt-on style with a shell made in two (2) sections of heavy T-304 stainless steel. Connecting flanges shall be ribbed for extra strength. The shell shall be lined with a PVC liner .090" thick with 85-90 durometer. All nuts and bolts are to be 18-8 stainless steel. Runners shall be made of ultra-high molecular weight polymer with inherent high abrasion resistance and a low coefficient of friction. Runners shall be supported by risers made of heavy T-304 stainless steel. The supports shall be mig welded to the shell and all welds shall be fully passivated. Stainless steel casing spacers shall be made by Cascade Waterworks Mfg. Co., or approved equal.
- B. Solid Polyethylene Casing Spacers (to be used with PVC pipe only): Solid polyethylene casing spacers shall be bolt-on style with a shell made in two (2) sections. Carrier pipe shall be wrapped with rubber strap inside casing space to prevent slippage. All nuts and bolts are to be 18-8 stainless steel. Anti-seize shall be applied on all stainless-steel bolts. Solid polyethylene casing spacers shall be made by Calpico Inc., PSI, or approved equal.
- C. Casing spacers for PVC sewer pipe shall be of the joint restraining design spanning across the pipe bell and preventing the two sections of pipe from separating. The spacers shall be specifically designed for use with PVC pipe.

2.04 CASING END SEALS

Wrap-around end seals - Wrap-around end seals shall be made of a waterproof flexible coal tar membrane reinforced with fiberglass. The two exposed edges of the wrap-around seal shall be adhesively bonded forming a watertight seal. The ends of the wrap shall be sealed on the casing and carrier pipe by stainless steel bands. Wrap-around end seals shall be made by Calpico Inc., or approved equal.

PART 3 - EXECUTION

3.01 CROSSINGS - GENERAL

- A. Where designated on the drawings, crossings beneath roadways, driveways or other paved surfaces not to be disturbed shall be accomplished by boring and jacking a casing pipe.
- B. Steel casing pipe for crossings shall be bored and/or jacked into place to the elevations shown on the drawings. All joints between lengths shall be solidly butt-welded with a smooth non-obstructing joint inside. The casing pipe shall be installed without bends. The carrier pipe shall be installed after the casing pipe is in place, and shall extend a minimum of two (2) feet beyond each end of the casing to facilitate making joint connections. The carrier shall be braced and centered with casing

spacers within the casing pipe to preclude possible flotation. Casing spacers shall be installed as shown on the Drawings. The height of the supports and runners combined shall be sufficient to keep the carrier pipe at least 0.75" from the casing pipe wall at all times. Spacer skids shall be sized and trimmed to maintain a maximum clearance of 0.5" between the skid and casing pipe.

- C. At each end of the casing pipe, the carrier pipe shall be sealed with casing end seals. The end seals shall extend a minimum of 12 inches in each direction from the end of the casing pipe.

3.02 BORING AND JACKING

- A. The Developer/Contractor shall excavate his own pits, as he/she may deem necessary, and shall set his/her own line and grade stakes. The Developer/Contractor shall verify permits before any excavating is commenced.
- B. The boring method shall consist of pushing the pipe into the earth with a boring auger rotating within the pipe to remove the spoil.
 - 1. The boring operation shall be progressed on a 24-hour basis without stoppage (except for adding lengths of pipe) until the leading edge of the pipe has reached the receiving pit.
 - 2. The front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger from leading the pipe so that there will be no unsupported excavation ahead of the pipe.
 - 3. The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered. If the obstruction cannot be removed without excavation in advance of the pipe, the pipe shall be abandoned in place and immediately filled with grout.
 - 4. The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than 2 inches. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe by more than approximately 1 inch, grouting or other approved methods must be used to fill such voids.
 - 5. The face of the cutting head shall be arranged to provide a reasonable obstruction to the free flow of soft or poor material.
 - 6. Any method, which does not have this boring arrangement, will not be permitted. Developer/Contractor's boring arrangement plans and methods must be submitted to, and approved by, WKUD.
- C. Insurance to be furnished by the Developer/Contractor to cover this type of work shall be adequate to meet the requirements of the Railroad and/or State or County Highway Departments. Insurance shall consist of comprehensive general liability and automobile liability insurance.
- D. Before construction, the Developer/Contractor shall furnish a statement of his/her experience of such work, or if inexperienced, shall advise WKUD as to whom he/she will sublet the work and give a statement of the experience of the subcontractor, which shall be satisfactory to the WKUD.
- E. Disposal of the excavated materials shall be provided by an approved manner.

3.03 DEVELOPER/CONTRACTOR'S RESPONSIBILITIES

- A. Obtain a copy of the Railroad Crossing Permit and/or Highway Encroachment Permit before beginning construction.
- B. Arrange and attend a preconstruction meeting at the construction site with the WKUD Inspector, Railroad or Highway Inspector, Engineer, and Developer/Contractor being present.

END OF SECTION

SECTION 02508 – HORIZONTAL DIRECTIONAL DRILLING

PART 1-GENERAL

1.01 SCOPE OF WORK

Provide all labor, materials, equipment and services required to utilize the trenchless technology of horizontal directional drilling (HDD) for the installation of below grade casing pipe options for water and casing/carrier pipe for sewer and appurtenances as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Piping is specified in “Section 02510 - Water Distribution Piping”, “Section 02530 - Gravity Sewer Piping”, “Section 02531 - Sewage Force Mains”.

1.03 EXISTING CONDITIONS

- A. All new piping which ties into existing lines must be made compatible with that piping.
- B. So that piping conflicts may be avoided, Developer/Contractor shall locate the utility (vertically & horizontally) well ahead of the pipe laying operation to confirm exact locations of existing piping before installing any new piping.
- C. Developer/Contractor shall provide all fittings and adapters necessary to complete all connections to existing piping.

1.04 SUBMITTALS

- A. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction, shall be submitted on all items specified herein to WKUD for review before ordering.
- B. At the time of submission, the Developer/Contractor shall, in writing, call WKUD's attention to any deviations that the submittals may have from the requirements of the Standard Specifications.
- C. Work Plan - Prior to beginning work, the Developer/Contractor must submit to WKUD a general work plan outlining the procedure and schedule to be used. Work Plan should be realistic and document the thoughtful planning required to successfully complete the project.
- D. Bore Plan – Prior to beginning the work, the Developer/Contractor shall submit a drawing indicating the pilot bore plan.
- E. Equipment - Developer/Contractor shall submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Specifications for any drilling fluid additives that the Developer/Contractor intends to use shall be submitted for review by WKUD.
- F. The Developer/Contractor shall submit calculations to verify that the specified pipe wall thickness (DR) is sufficient to withstand the installation (i.e. pull back force).

1.05 QUALITY ASSURANCE

- A. The requirements set forth in this document specify a wide range of procedural precautions necessary to ensure that the very basic, essential aspects of a proper directional bore installation are adequately controlled. Strict adherence shall be required under specifically covered conditions outlined in this specification. Adherence to the specifications contained herein, or the Engineer's approval of any aspect of any directional bore operation covered by this specification, shall in no way relieve the Developer/Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under the Contract.
- B. Use of horizontal directional drilling for installing piping specified in this Standard Specification shall be in accordance with the latest revision of ASTM F-1962.

PART 2 – PRODUCTS

2.01 EQUIPMENT

The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a mixing and delivery system for drilling fluid of sufficient capacity to successfully complete the installation, a guidance system to accurately guide boring operations, control and containment of drilling fluid, along with trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of the project.

2.02 DRILLING SYSTEM

- A. Drilling Rig - The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the installation. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations.
- B. Drill Head - The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.
- C. Mud Motors (if required) - Mud motors shall be of adequate power to turn the required drilling tools.
- D. Drill Pipe - Shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.

2.03 GUIDANCE SYSTEM

- A. The Guidance System shall be of a proven type and shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance system shall be capable of tracking all required depths in any soil condition and rock encountered along the proposed installation route.

- B. The guidance system shall be setup and operated by personnel trained and experienced with this system. The Operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

2.04 DRILLING FLUID (MUD) SYSTEM

- A. Mixing System - A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water and appropriate additives. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be sized for adequate storage of the mud mixture. Mixing system shall continually agitate the drilling fluid during drilling operations.
- B. Drilling Fluids - Drilling fluid shall be composed of clean water and an appropriate additive. Water shall be from a clean source with a pH of 8.5 – 10 and/or as per mixing requirements of the Manufacturer. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. The water and additives shall be mixed thoroughly and be absent of any clumps or clods. No hazardous additives may be used. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall.
- C. Delivery System - The mud pumping system shall have a minimum capacity to supply mud in accordance with the drilling equipment pull-back rating at a constant required pressure. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. A berm, minimum of 12" high, shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage facilities.

2.05 OTHER EQUIPMENT

- A. Pipe Rollers - Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe.
- B. Pipe Rammers - Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of WKUD.
- C. Restrictions - Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by WKUD prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the utility placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the project.

2.06 HIGH DENSITY POLYETHYLENE PIPE

- A. High density polyethylene pipe shall be used for the installation of below grade casing pipe options for water and casing/carrier pipe for sewer and appurtenances.

B. General: High density polyethylene pipe shall be “Driscopipe” as manufactured by Phillips Product Company, Inc., PLEXCO as manufactured by Chevron, POLYPIPE, or equal.

C. Materials for Polyethylene Pipe:

1. The polyethylene pipe and fittings shall be made of polyethylene resins classified in ASTM D 1248 as Type III, Category 5, Grade P34 (pipe designation PE 3408 defined per ASTM D 3035), having specific base resin densities of 0.941 g/cc minimum and 0.955 g/cc maximum respectively; and having melt index less than 0.15 grams/10 min.
2. Pipe made from these resins must have a long-term strength rating of 1,600 psi or more.
3. The polyethylene resin shall contain antioxidants and shall be stabilized with carbon black against ultra-violet degradation to provide protection during processing and subsequent weather exposure.
4. The polyethylene resin compound shall have a resistance to environmental stress cracking as determined by the procedure detailed in ASTM D 1693, Condition B with sample preparation by procedure C of not less than 200 hours.
5. Polyethylene shall have cell classification of 345434C as defined by ASTM 3350-84.

D. Polyethylene Pipe and Fittings:

1. The pipe shall be designed for a normal internal working pressure and earth cover over top of the pipe to suit the conditions of proposed use.
2. Each length of pipe shall be marked, at no more than 10-foot intervals, with the following information:
 - Nominal Pipe Size
 - Type Plastic Material - PE3408
 - Pipe Pressure Rating
 - Manufacturer’s Name, Trademark and Code
3. All pipe shall be made from virgin material. No rework compound.
4. Pipe shall be homogenous throughout, and be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.
5. Fittings for the polyethylene pipe line shall be molded or fabricated from the same material as specified hereinbefore for the high-density polyethylene pipe.
6. Fittings for bends 22-1/2° or greater shall be provided as shown on the Drawings. For alignment changes of less than 20° deflection, the pipe may be laid in curves with a radius of 100 feet or greater.
7. All run-of-the-pipe fittings shall be fusion welded into the pipeline. Tee branches shall be of the size shown on the Drawings and shall be furnished with flanged ends per ANSI B-16.1. All fittings shall be factory made.

8. Fittings shall be capable of withstanding the same pressure and loading conditions specified for the pipe.
 9. Wye branches shall be true wyes.
- E. Pipe Jointing:
1. Pipe to be joined by leak proof, thermal, butt fusion joints. All fusion must be done by personnel trained by the pipe supplier using tools approved by the pipe supplier.
 2. The fusion machine shall have hydraulic pressure control for fusing 2 pipe ends together; it shall include pressure fusion indicating gauges to correctly monitor fusion pressures. The machines correctly monitor fusion pressures. The machines shall be equipped with an electric or gasoline engine powered facing unit to trim irregularities from the pipe ends. The heating plate on the fusion machine shall be electrically heated and thermostatically controlled and shall contain a temperature gauge for monitoring temperature.
 3. Joint strength must be equal to that of adjacent pipe as demonstrated by tensile test. In addition, results of tensile impact testing of joint should indicate a ductile rather than a brittle fracture. External appearance of fusion bead should be smooth without significant juncture groove.
 4. Threaded or solvent cement joints and connections are not permitted.
- F. Joining, Terminating or Adapting by Mechanical Means:
1. The polyethylene pipe shall be connected to systems or fittings of other materials by means of an assembly consisting of a polyethylene flange adapter butt-fused to the pipe, a backup ring of either cast iron, steel, or high silica aluminum alloy made to ANSI B-16.1 dimensional standards (with modified pressure ratings), bolts of compatible material (insulated from the fittings where necessary) and a gasket of reinforced black rubber, or other material approved by the Engineer, cut to fit the joint. In all cases, the bolts shall be drawing up evenly and in line.
 2. Termination of valves, or fittings such as tees, bonds, etc., made of other materials shall be by the flange assemblies specified hereinbefore. The pipe adjacent to these joints and to joints themselves must be rigidly supported for a distance of one pipe diameter or 1 foot, whichever is greater, beyond the flange assembly.
 3. Appurtenances must be placed on their own foundations, unsupported by the pipe, in accordance with the detail plans.
- G. Tools and Procedures:
1. Fusion jointing and other procedures necessary for correct assembly of the polyethylene pipe and fittings will be done only by personnel trained in those skills by the pipe supplier.
 2. Only those tools designed for aforementioned procedures and approved by the pipe supplier shall be used for assembly of pipe and fittings to insure proper installation.
- H. Standard Dimension Ratio (SDR) for Polyethylene Pipe:

All pipe for casing applications shall be SDR 11 (200 psi) unless greater pressure rating is required for particular applications.

PART 3 -EXECUTION

3.01 GENERAL

- A. WKUD must be notified 48 hours in advance of starting work. WKUD's approval for beginning the installation shall in no way relieve the Developer/Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. It shall be the responsibility of the Developer to provide inspection personnel at such times as appropriate.
- B. The Developer/Contractor shall be fully responsible for all damages resulting from his failure to comply with all applicable state, federal and local regulations, and requirements of these specifications.

3.02 DRILLING PROCEDURE

- A. Site Preparation - Prior to any alterations to work-site, Developer/Contractor shall photograph or video tape entire work area, including entry and exit points. One copy shall be given to WKUD and one copy to remain with Developer/Contractor for a period of one year following the completion of the project. Work site as indicated on drawings, within right-of-way, shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. Developer/Contractor shall confine all activities to designated work areas.
- B. Drill Path Survey - Entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If Developer/Contractor is using a magnetic guidance system, drill path will be surveyed for any surface geomagnetic variations or anomalies.
- C. Environmental Protection – Developer/Contractor shall have in place silt fence between all drilling operations and any drainage, wetland, waterway or other area designated for such protection by contract documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Developer/Contractor shall adhere to all applicable environmental regulations. Also, all erosion control facilities shall be in accordance with Standard Specification “Section 02371 – Erosion and Sedimentation Control”, hereinafter, and the standard detail drawing for erosion control included in the contract drawings.
- D. Safety - Developer/Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner.
- E. Pipe Joining shall be as required in this specification along with “Section 02510 – Water Distribution Piping”, “Section 02530 – Gravity Sewer Piping”, “Section 02531 – Sewage Force Mains” piping specification, hereinafter. Pipe will be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe.
- F. Pilot Hole - Pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100'. In the event that pilot does deviate from bore path more than 5% of depth in 100', Developer/Contractor will notify WKUD and WKUD may require Developer/Contractor to pull-

back and re-drill from the location along bore path before the deviation. In the event that a drilling fluid fracture, inadvertent returns or returns loss occurs during pilot hole drilling operations, Developer/Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and then wait another 30 minutes. If mud fracture or returns loss continues, Developer/Contractor will cease operations and notify WKUD. WKUD and Developer/Contractor will discuss additional options and work will then proceed accordingly.

- G. Reaming - Upon successful completion of pilot hole, Developer/Contractor will ream bore hole to a minimum of 25% greater than outside diameter of pipe using the appropriate tools. Developer/Contractor will not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.
- H. Pull-Back - After successfully reaming bore hole to the required diameter, Developer/Contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel. Once pullback operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations Developer/Contractor will not apply more than the maximum safe pipe pull pressure at any time. In the event that pipe becomes stuck, Developer/Contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If pipe remains stuck, Developer/Contractor will notify WKUD. WKUD and Developer/Contractor will discuss options and then work will proceed accordingly.

3.03 PIPE TESTING

All pipe testing shall be as required in “Section 02510 – Water Distribution Piping”, “Section 02530 – Gravity Sewer Piping”, “Section 02531 – Sewage Force Mains” piping specification, hereinafter.

3.04 SITE RESTORATION

Following drilling operations, Developer/Contractor will de-mobilize equipment and restore the worksite to original condition. All excavations will be backfilled and compacted to 95% of original density. Landscaping will be restored to original. All mud shall be disposed of by the DEVELOPER/CONTRACTOR.

END OF SECTION

SECTION 02510 - WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 SCOPE OF WORK

Provide all labor, materials, equipment and services required for furnishing and installing all piping and appurtenances specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02515 – Valves & Utility Services
- B. Section 02517 - Hydrants

1.03 EXISTING CONDITIONS

- A. All new piping, which ties into existing lines, must be made compatible with that piping and be rated for working pressure experienced.
- B. So that piping conflicts may be avoided, Developer/Contractor shall open up his trench well ahead of the pipe laying operation to confirm exact locations of existing piping before installing any new piping.
- C. Developer/Contractor shall provide all fittings and adapters necessary to complete all connections to existing piping.

1.04 JOB CONDITIONS

- A. Whenever pipe-laying is not actively in progress, open ends of all installed pipe and fittings shall be fitted with a watertight plug.
- B. Separation of Sewers and Water Mains:
 - 1. Parallel Installation of Sewers and Water Mains
 - a. Whenever possible the sewer shall be installed at least 10 feet horizontally from water mains, the distance measured from edge to edge.
 - b. If local conditions prevent a horizontal separation of 10 feet, the sewer shall be installed in a separate trench so that the top of the sewer pipe is at least 18 inches below the bottom of the water main.
 - c. If neither of these conditions can be met, the sewer shall be constructed of push-on or mechanical joint ductile iron pipe, and the pipe pressure tested to assure watertightness prior to backfilling.

2. Crossing of Sewers and Water Mains:
 - a. Whenever possible the sewer shall be installed so that the minimum distance between the outside of the sewer pipe and the outside of the water pipe is at least 18 inches. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
 - b. Water mains passing under sewers shall, in addition, be protected by providing that the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer
 - c. If local conditions prevent this separation, the sewer shall be constructed of push-on or mechanical joint ductile iron pipe, and the pipe pressure tested to assure watertightness prior to backfilling.
 - d. Where the water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.

PART 2 - PRODUCTS

2.01 PVC PIPE

- A. Water lines 2 inches in diameter shall be constructed of PVC pipe unless otherwise indicated in the Construction Drawings.
- B. All plastic pipe shall be SDR 13.5, Class 315 polyvinyl chloride plastic as defined by ASTM D2241.
- C. All pipe shall have NSF approval and be manufactured in accordance with ASTM D2241. The following test shall be run for each machine on each size and type of pipe being produced, as specified below:
 1. Flattening Test: Once per shift in accordance with ASTM D2412. Upon completion of the test, the specimen shall not be split, cracked, or broken.
 2. Acetone Test (Extrusion Quality Test): Once per shift in accordance with ASTM D2152. There shall be no flaking, peeling, cracking, or visible deterioration on the inside or outside surface after completion of the tests.
 3. Quick Burst Test: Once per 24 hours in accordance with ASTM D1599.
 4. Impact Test: For pipe 2 inches, once each 2 hours in accordance with ASTM D2444.
 5. Wall Thickness and Outside Dimensions Tests: Once per hour in accordance with ASTM D2122.
 6. Bell Dimensions Test: Once per hour in accordance with ASTM D3139.
- D. If any specimen fails to meet any of the above-mentioned tests, all pipe of that size and type manufactured between the test periods must be scrapped and a full set of tests rerun.

- E. Furnish a certificate from the pipe manufacturer stating that they are fully competent to manufacture PVC pipe of uniform texture and strength and in full compliance with these specifications and further stating that they have manufactured such pipe and done so in sufficient quantities to be certain that it will meet all normal field conditions. In addition, the manufacturer's equipment and quality control facilities must be adequate to ensure that each extrusion of pipe is uniform in texture, dimensions, and strength. Also furnish a certificate from the manufacturer certifying that the pipe furnished for this project meets the requirements of these specifications.
- F. All pipe shall be manufactured in the United States of America. All pipe for any one project shall be made by the same manufacturer.
- G. All 2-inch pipe shall be furnished in the manufacturer's standard laying lengths of 20 feet. The contractor's methods of storing and handling the pipe shall be approved by the Owner. All pipe shall be supported within 5 feet of each end; in between the end supports, there shall be additional supports at least every 15 feet. The pipe shall be stored away from heat or direct sunlight. The practice of stringing pipes out along the proposed water line routes will not be allowed without Owner approval.
- H. Each piece of pipe shall be labelled with the following:
 - 1. Nominal Size
 - 2. Type of Material
 - 3. SDR or Class
 - 4. Manufacturer
 - 5. NSF Seal of Approval
- I. Pipe that fails to comply with the requirements set forth in these specifications shall be rejected.
- J. The pipe shall have push-on joints designed with grooves in which continuous molded rubber ring gaskets can be placed. Gaskets shall be made of vulcanized natural or synthetic rubber; no reclaimed rubber will be allowed. Gasket materials shall meet the requirements of ASTM F477. The gaskets shall be of the manufacturer's standard design dimensions and of such size and shape as to provide a positive seal under all combinations of joint and gasket tolerance. The gasket and annular groove shall be designed and shaped so that when the joint is assembled, the gasket will be radially compressed to the pipe and locked in place against displacement, thus forming a positive seal.
- K. The spigot end of each pipe shall be beveled so that it can be easily inserted into the gasket joint, which in turn shall be designed so that the spigot end may move in the socket as the pipe expands or contracts. The spigot end shall be striped to indicate the distance into which it is to be inserted into the socket. Each joint shall be able to accommodate the thermal expansions and contractions experienced with a temperature shift of at least 75° F.
- L. Enough lubricant shall be furnished with each order to provide a coat on the spigot end of each pipe. This lubricant shall be nontoxic, impart no taste or smell to the water, have no harmful effect on the gasket or pipe material, and not support or promote any bacterial growth. The lubricant containers shall be labeled with the manufacturer's name.
- M. Joints shall be manufactured in accordance with ASTM D3139 except that the thickness of the bell shall be, as a minimum, equal to that of the barrel. Joints shall be either integral bell and ring joints with rubber compression gaskets as manufactured by the Clow Corporation, H&W, or

Vulcan Plastic Corporation; twin gasket couplings as manufactured by the Certain-Teed Products Corporation, or Owner approved equal. However, the pipe and bell must be made by the same manufacturer.

- N. Standard and special fittings shall be ductile iron, full body fittings as specified in Part 2.1. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110 for full body fittings. The gaskets shall be duck tipped transition gaskets for use with I.P.S. outside diameter PVC pipe.

2.02 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe shall conform to ANSI/AWWA C151/A21.51, latest revision, with push-on joints incorporating a single molded gasket unless otherwise noted on the Drawings. All water lines 4" or larger shall be pressure class 350 ductile iron pipe, unless otherwise noted.
- B. The interior of the pipe shall be cement-mortar lined with seal coat in accordance with ANSI/AWWA C104/A21.4, latest revision. Thickness of the lining shall be as set forth in the ANSI/AWWA C104/A21.4 specification unless otherwise directed by WKUD. The exterior of all pipe, unless otherwise specified, shall receive either coal tar or asphalt base coating a minimum of 1 mil thick. Interior lining system shall be NSF approved.
- C. Each piece of pipe shall bear the manufacturer's name or trademark, the year in which it was produced and the letters "DI" or the word "DUCTILE". Pipe manufacturer shall furnish notarized certificate of compliance to the above AWWA or ANSI specifications.
- D. Fittings shall be ductile iron and have mechanical-joints in accordance with ANSI/AWWA C110/A21.10, latest revision, unless otherwise specified. All fittings shall be appropriate for the class and type of pipe being joined. Fittings shall conform to the details and dimensions shown therein. Fittings shall have interior cement-mortar lining as specified hereinbefore for the pipe. Compact ductile iron fittings meeting the requirements of ANSI/AWWA C153/A21.53, latest revision, will also be acceptable. Each fitting shall be certified by the manufacturer to have been tested and to have met the requirements of the governing standard specifications. Fittings shall be manufactured in the United States of America. All fittings shall be restrained with a restrained mechanical-joint gland. Restrained mechanical-joint connection shall be as specified in this section of the Specifications and be compatible for ductile iron pipe.
- E. Joints for ductile iron pipe and fittings, as described hereinbefore, shall be rubber-gasket joints and be in accordance with ANSI/AWWA C111/A21.11, latest revision. Joints shall have the same pressure rating as the pipe or fitting of which they are a part. Joints shall be installed per the manufacturer's recommendations.
- F. Provide ANSI/AWWA C110/A21.10 mechanical joint plugs or caps, and locked or restrained pipe joints where indicated on Drawings. Fittings under structures shall be mechanical joint with retainer glands.

2.03 RESTRAINED JOINT DUCTILE IRON PIPE

- A. Restrained joint ductile iron pipe shall conform to ANSI/AWWA C151/A21.51, latest revision, with locking gasket type push-on joints unless otherwise noted on the Drawings. All water lines 4" or larger shall be pressure class 350 ductile iron pipe, unless otherwise noted.

- B. The interior of the pipe shall be cement-mortar lined with seal coat in accordance with ANSI/AWWA C104/A21.4, latest revision. Thickness of the lining shall be set forth in the aforementioned specification unless otherwise directed by WKUD. The exterior of all pipe, unless otherwise specified, shall receive either coal tar or asphalt base coating a minimum of 1 mil thick. Interior lining system shall be NSF approved.
- C. Each piece of pipe shall bear the manufacturer's name or trademark, the year in which it was produced and the letters "DI" or the word "DUCTILE". Pipe manufacturer shall furnish notarized certificate of compliance to the above AWWA or ANSI specifications.
- D. Fittings shall be ductile iron in accordance with ANSI/AWWA C110/A21.10, latest revision with the exception of the manufacturer's proprietary design dimensions. All fittings shall be appropriate for the class and type of pipe being joined. Fittings shall have interior cement-mortar lining as specified hereinbefore for the pipe. Compact ductile iron fittings meeting the requirements of ANSI/AWWA C153/A21.53, latest revision, will also be acceptable. Each fitting shall be certified by the manufacturer to have been tested and to have met the requirements of the governing standard specifications. Fittings shall be manufactured in the United States of America. All fittings shall be restrained with a restrained mechanical-joint gland. Restrained mechanical-joint connection shall be as specified in this section of the Specifications and be compatible for ductile iron pipe.
- E. Joints for ductile iron pipe and fittings, as described hereinbefore, shall be rubber-gasket joints and be in accordance with ANSI/AWWA C111/A21.11, latest revision. Joints shall have a working pressure rating equal to the pipe pressure rating. Joints shall be installed per the manufacturer's recommendations.
- F. Fittings shown on the Plans are intended to convey the general configuration but the Contractor shall furnish all fittings required. When fittings are used, refer to the table on the Plans for associated required restrained joint lengths. Pipe at ends left for future connections shall also have restrained push-on joints
- G. Restrained joint pipe shall be Fast-Grip Restrained Joint as manufactured by American Ductile Iron Pipe or approved equal. Restrained joints shall be designed for a working pressure equal to the pipe pressure rating.
- H. Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly.
- I. All restrained joint pipe and fittings shall be fabricated by the same pipe manufacturer.
- J. Where spigot end of restrained joint pipe connects with valves or other items that have mechanical-joint ends, connection shall be made with a restrained mechanical-joint gland. Restrained mechanical-joint connection shall be as specified in this Section of the Specifications.
- K. All carrier pipe in steel casings shall be restrained joint ductile iron pipe unless otherwise noted.

2.04 WATER SERVICE PIPING AND TUBING

Water service pipe shall be copper tubing ASTM B-88-62, AWWA C800, Type K, seamless, suitable for use in underground water services. Copper service tubing shall be utilized for all service lines. Fittings shall be as outlined in AWWA C800.

2.05 LOCATOR WIRE

All water lines shall be laid with No. 12 coated solid copper wire. The wire shall be laid just below or beside the pipe. Wire shall be continuous with ends stubbed out of metal valve boxes a minimum of 6". Should any splices be necessary in long runs, wire shall be stripped back at least 1 inch and connected with solid brass split-bolt connectors, tightened very firmly and wrapped with protective tape several times. No wire nuts shall be used. The wire shall not be laid in a manner, which will allow it to touch the water pipe.

2.06 CONCRETE PIPE ANCHORS, THRUST BLOCKS, CRADLE OR ENCASEMENT

- A. Where required by the Standard Specifications or as directed by WKUD, concrete pipe anchors, thrust blocks, cradles or encasements shall be installed.
- B. Concrete used for anchors, thrust blocks, cradle or encasement shall be Class "B" and have a minimum 28-day compressive strength of 3000 psi. Reinforcing bars shall be as installed as indicated on the details.

2.07 CONNECTION OF NEW WATER MAINS TO EXISTING SYSTEM

The Developer/Contractor shall connect the new water main to existing water main where shown on the Drawings or as directed by WKUD, and shall furnish all necessary equipment and materials required to complete the connection. Connections shall be made and restrained to accept a 250-psi working pressure.

2.08 MECHANICAL JOINT RESTRAINT

- A. Mechanical joint restraint shall be furnished and installed where shown on the Plans. The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pullout as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be made of grade 60-42-10 ductile iron conforming to ASTM A536 latest revision. The wedges shall be ductile iron heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of the latest revision. Torque limiting twist-off nuts shall be used to insure proper actuation of the restraining wedges. The mechanical joint restraint shall be appropriate for the class and type of pipe being joined and shall be UL listed.
- B. The mechanical joint restraint shall be MEGALUG restraint as manufactured by EBAA Iron Sales Inc., or approved equal.

PART 3 - EXECUTION

3.01 EXCAVATION FOR PIPELINE TRENCHES

- A. Unless otherwise directed by WKUD, trenches in which pipes are to be laid shall be excavated in open cut to the depths required by field conditions or as specified by WKUD. In general, this shall be interpreted to mean that machine excavation in earth shall not extend below an elevation

permitting the pipe to be properly bedded. Installation shall be in accordance with ANSI/AWWA C600 or ASTM F-645 except as modified herein.

- B. If the foundation is good firm earth and the machine excavation has been accomplished as set out hereinbefore, the remainder of the material shall be excavated by hand, then the earth pared or molded to give full support to the lower quadrant of the barrel of each pipe. Where bell and spigot are involved, bell holes shall be excavated during this latter operation to prevent the bells from being supported on undisturbed earth. If for any reason the machine excavation in earth is carried below an excavation that will permit the type of bedding specified above, then a layer of granular material shall be placed so that the lower quadrant of the pipe will be securely bedded in compact granular fill.
- C. Excavation may be undercut to a depth below the required invert elevation that will permit laying the pipe in a bed of granular material to provide continuous support for the bottom quadrant of the pipe. When this method is used, the bedding shall be as set out in Paragraph 3.02 hereinafter.
- D. Trenches shall be of sufficient width to provide free working space on each side of the pipe and to permit proper backfilling around the pipe. Trenches in rock excavation shall be sufficient in width to allow working room for installation of repair sleeves or clamps at a later date.
- E. All excavated materials shall be placed a minimum of two feet (2') back from the edge of the trench.
- F. Before laying the pipe, the trench shall be opened far enough ahead to reveal obstructions that may necessitate changing the line or grade of the pipeline. Unless specifically directed otherwise by WKUD or where required to uncover or determine the presence of underground obstructions, not more than three hundred (300) feet of trench shall be opened ahead of the pipe laying, and not more than two (200) feet of open ditch shall be left behind the pipe laying.
- G. The requirements of the Knox County and Tennessee State Highway Departments regarding the length of open trench left overnight shall also apply to water line laid along the rights-of-way for all roads and streets.
- H. The trench shall be straight and uniform so as to permit laying pipe to lines and grades given by the Developer's Engineer. It shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled. Dry conditions shall be maintained in the excavations until the backfill has been placed. During the excavation, the grade shall be maintained so that it will freely drain and prevent surface water from entering the excavation at all times. When required, temporary drainage ditches shall be installed to intercept or direct surface water, which may affect work. All water shall be pumped or drained from the excavation and disposed of in a suitable manner without damage to adjacent property or to other work.
- I. Unless otherwise indicated on the Plans, or directed by WKUD, all pipeline shall have at least 36" of cover. Any line, including bores, within the traveled shoulder or pavement of the State Highway or other road/parking areas (including existing and proposed traffic areas) shall have a minimum depth of cover of 48". To allow for access by WKUD for maintenance procedures, the maximum cover shall be 60" unless special permission is received from WKUD for greater depths of cover. All depths of cover are measured to the top of pipe. No departure from this policy shall be made except at the order of WKUD.
- J. All barricades, lanterns, watchmen, and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavations and other obstructions shall be provided by and at the expense of the Developer/Contractor. All excavation shall be

accomplished in accordance with applicable safety laws and regulations; WKUD, as previously stated, does not assume responsibility of any degree or sort for acts of the Developer/Contractor.

- K. Unless otherwise directed by WKUD, lines and grades shall be set to conform to those shown on the Plans as a minimum. Field setting of lines and grades shall be the responsibility of the Developer/Contractor.

3.02 PIPE BEDDING

- A. The pipe shall be uniformly and continuously supported throughout the entire length on a firm, stable material. All pipe shall be supported on a bed of granular material, unless the trench has been prepared in accordance with Paragraph 3.01B. In no case shall pipe be supported directly on rock. Bedding shall be provided in earth bottom trenches, as well as rock bottom trenches. Bedding material shall be free from large rock, foreign material, frozen earth, and shall be acceptable to WKUD. Bedding shall be a minimum of 6" below pipe barrel when rock is encountered. When rock is encountered, backfill the space below grade for pipelines with crushed stone or other approved material, and tamp to the proper grade and make ready for construction.
- B. In all cases, the foundation for pipes shall be prepared so that the entire load of the backfill on top of the pipe will be carried on the barrel of the pipe so that none of the load will be carried on the bells.
- C. Where flexible pipe is used, the bedding shall be placed up to at least 12 inches above the top of the pipe. The bedding material and procedures shall conform to ASTM D 2321 and any Technical Specifications set out hereinafter. Granular bedding shall be No. 57 crushed stone, fine gravel, or sand.
- D. Where undercutting and granular bedding is involved, it shall be of such depth that the bottom of the bells of the pipe will be at least three inches above the bottom of the trench as excavated.
- E. In wet, yielding mucky locations where pipe is in danger of sinking below grade or floating out of line or grade, or where backfill materials are of such a fluid nature that such movements of the pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective. When ordered by WKUD, yielding and mucky materials in subgrades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe. In such cases, the trench bottom shall be brought back up to proper grade with bedding material. Crushed stone or other such granular material, if necessary, shall replace poor subgrade material, and shall be classified as "Special Pipe Bedding".
- F. Installation shall be in accordance with ASTM D 2321 except as modified hereinafter.

3.04 SPECIAL PIPE BEDDING

Granular material for "Special Pipe Bedding" where required shall be No. 57, crushed stone.

3.05 LAYING PIPE

- A. The laying of pipe in finished trenches shall be commenced at the lowest point so the spigot ends point in the direction of flow. The pipe shall be laid in a straight line and grade without kinks or sages, and shall be laid in a workmanlike manner.

- B. All pipes shall be laid with ends abutting and true to line and grade as shown on the drawings. Supporting of pipes shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipes on blocks be permitted.
- C. The trench shall be excavated to the required depth and width; bell holes and/or jointing holes shall be dug in advance of pipe-laying. Bell holes and/or jointing holes shall be large enough so that the bell or hub will clear the ground and leave ample room for making and inspecting the joints.
- D. Before each piece of pipe is lowered into the trench, it shall be thoroughly swabbed out and inspected to ensure that it is clean. Each piece of pipe shall be lowered separately unless WKUD gives special permission otherwise.
- E. Care shall be taken to prevent injury to the pipe coating both inside and out. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe as per latest revision of AWWA Specification C600.
- F. Pipe shall not be laid on solid rock. A pad of granular material, as specified in Paragraph 3.02 "Pipe Bedding", shall be used as pipe bedding. Irregularities in subgrade in an earth trench shall be corrected by use of granular material.
- G. When required to provide proper bedding, unsuitable materials in subgrades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe.
- H. Open ends of unfinished pipelines shall be securely plugged or closed at the end of each day's work or when the line is left temporarily at any other time, so as to exclude earth, animals or other material, and precautions taken to prevent flotation of pipe by runoff into trench.
- I. No backfilling (except for securing pipe in place) over pipe will be allowed until WKUD has had an opportunity to make an inspection of the joints, alignment and grade, in the section laid.
- J. Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions, or wherever long radius curves are permitted, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer, and shall be approved by WKUD.

3.06 BACKFILLING PIPELINE TRENCHES

- A. Backfilling shall begin after line construction is completed, inspected, and approved by WKUD. Backfilling of pipeline trenches shall be accomplished as shown on the Drawings and with details set forth hereinafter. Before final acceptance, the Developer/Contractor shall level off all trenches or to bring the trench up to grade. The Developer/Contractor shall also remove from roadways, rights-of-way and/or private property all excess earth or other materials resulting from construction. In the event that pavement is not placed immediately following trench backfilling in paved areas, the Developer/Contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times. Under existing or proposed pavement, all trench backfill shall be in accordance with Method C. All other trench backfill shall be in accordance with Method A or B.

B. Method "A" - Backfilling in Open Terrain:

Backfilling of pipeline trenches in open terrain shall be accomplished in the following manner:

1. The lower portion of the trench, from the pipe bedding to a point 12" above the top of the pipe, shall be backfilled with materials acceptable to WKUD such as fine loose earth, sandy soil or loam, or granular material, free from clods, vegetable matter, debris, stone and/or other objectionable materials. This material shall be placed in even layers simultaneously on each side of the pipe in a manner approved by WKUD, and shall be carefully compacted to avoid displacement of the pipe. Layers shall not exceed 6" depth (before compaction). Each layer shall be thoroughly and completely tamped into place before placing the succeeding layer. Compaction shall be accomplished by hand tamping or by approved mechanical methods. Do not use power operated tampers to tamp that portion of the backfill around the pipe within 1' above the pipe.
2. The upper portion of the trench above the compacted portion shall be backfilled with material, which is free from large rock. Incorporation of rock having a volume exceeding one-half cubic foot is prohibited. Individual stones shall not exceed 6" in maximum dimension. Backfilling this portion of the trench may be accomplished by any means approved by WKUD. Sufficient earth material shall be incorporated in such backfill to completely fill all voids. The trench backfill shall be heaped over or leveled to satisfy requirements of the particular location until final cleanup is accomplished, or as directed by WKUD.

C. Method "B" - Backfilling under Dirt Entrances:

Backfilling of pipeline trenches under dirt entrances shall be accomplished in the following manner.

1. The lower portion of the trench, from the pipe bedding to a point 12 inches above the top of the pipe, shall be backfilled with materials acceptable to WKUD such as fine loose earth, sandy soil or loam, or granular material, free from clods, vegetable matter, debris, stone and/or other objectionable materials. This material shall be placed in even layers simultaneously on each side of the pipe in a manner approved by WKUD, and shall be carefully compacted to avoid displacement of the pipe. Layers shall not exceed 6" depth (before compaction). Each layer shall be thoroughly and completely tamped into place before placing the succeeding layer. Compaction shall be accomplished by hand tamping or by approved mechanical methods. Do not use power operated tampers to tamp that portion of the backfill around the pipe within 1' above the pipe.
2. The middle portion of the trench, from a point 12" above the top of the pipe to a point 6" below the grade line, shall be backfilled with material free from rock and of materials acceptable to WKUD. This material shall be placed and compacted in layers of approximately 6 inches. Water (puddling) may be used as required to obtain maximum compaction.

As an alternative, the Developer/Contractor may backfill the middle portion of the trench with crushed stone, fine gravel, or sand in lieu of materials, which require compaction.
3. The upper portion of the trench shall be temporarily backfilled, compacted and maintained until such time as the driveway surface is restored to a stable condition.

D. Method "C" - Backfilling under Streets, Roads, and Driveways (Existing or Proposed):

Backfilling of pipeline trenches under streets, roads and driveways shall be accomplished in the following manner:

1. The lower portion of the trench from the pipe bedding to a point 6" below the bottom of the existing or proposed pavement or concrete sub-slab shall be backfilled with No. 57 stone, firmly compacted into place.
 2. The upper portion of the trench, from a point 6" below the bottom of the pavement or concrete sub-slab to grade, shall be backfilled with No. 57 stone, firmly compacted into place. At such time that pavement replacement is accomplished; the excess base course shall be removed as required. Where future roadwork is proposed the upper portion of the trench above the proposed pavement may be backfilled in accordance with Method "A".
- E. When directed by WKUD, the Developer/Contractor shall wet backfill material to assure maximum compaction.

Before final acceptance, the Developer/Contractor will be required to level off all trenches or to bring the trench up to grade. The Developer/Contractor shall also remove from roadways, rights-of-ways and/or private property all excess earth or other materials resulting from construction.

In the event that pavement is not placed immediately following trench backfilling in streets, highways, and driveways the Developer/Contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

Wherever excavation has been made within easements across private property, the top 6" of backfill material shall consist of fine loose earth (topsoil quality) free from large clods, vegetable matter, debris, stone, and/or other objectionable materials.

3.07 SETTLEMENT OF TRENCHES

Whenever lines are in, or cross, driveways and streets, the Developer/Contractor shall be responsible for any trench settlement, which occurs within these rights-of-way within one (1) year from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, the Developer/Contractor at no cost to WKUD shall replace it. Repair of settlement damage shall meet the approval of WKUD.

3.08 INSPECTION OF LINES DURING CONSTRUCTION

- A. The Developer/Contractor shall notify WKUD when pipe will be received on the job so that arrangements may be made for inspecting the unloading and stringing, as well as inspecting the pipe proper and examining for the stamp of the independent laboratory. In order to avoid damage to pipe, it is recommended that the pipe be delivered in bundles and kept bundled until it is needed. No pipe (or other materials or equipment) shall be stored on private property without the permission of the property owner.
- B. Before the Developer/Contractor backfills any of the lines, they shall be first inspected by WKUD; and WKUD shall give the Developer/Contractor permission to proceed with the backfilling. If any joints, pipes, or other workmanship or materials are found to be defective, they shall be removed and replaced by the Developer/Contractor.

3.09 CONCRETE THRUST BLOCKS, CRADLE, ANCHORS OR ENCASEMENT

- A. Concrete thrust blocks, cradle, anchors or encasement shall be placed where shown on the Drawings, required by the Specifications, or as directed by WKUD.
- B. For cradle and encasement, concrete shall be 3000 psi and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed.
- C. For thrust blocks and anchors, concrete shall be 3000 psi, and shall be formed or be sufficiently stiff to maintain the forms indicated on the Details.
- D. In tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints.

3.10 BITUMINOUS CONCRETE HIGHWAY, STREET AND DRIVEWAY REPLACEMENT

- A. The Developer/Contractor shall replace those sections of existing roads, streets and driveways required to be removed to install the pipelines under this contract. He shall construct same to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to the operations.
- B. Prior to trenching, the pavement shall be scored or cut to straight edges at least twelve (12) inches outside each edge of the proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be re-cut and trimmed to square, straight edges after the pipeline has been installed and prior to placing the new base and pavement.
- C. Backfilling of the trench shall be in accordance with Method "C" as described hereinbefore. Base course for the paving shall be dense graded crushed limestone furnished and placed in accordance with the current requirements of the Standard Specifications for Road and Bridge Construction of the Department of Transportation, to a depth of six (6) inches in roads and streets and four (4) inches in driveways.

3.11 UNPAVED DRIVEWAY (CRUSHED STONE) SURFACE REPLACEMENT

- A. The Developer/Contractor shall replace those sections of existing driveways and parking areas required to be removed to install the pipe lines under this contract. He shall construct same to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to the operations.
- B. Material for backfilling of the pipeline trench shall be crushed stone in accordance with Method "C" as described hereinbefore.

3.12 REMOVING AND REPLACING CONCRETE CURB AND GUTTER OR SIDEWALK

- A. The Developer/Contractor shall remove the curb and gutter or sidewalk when encountered when required for laying the pipe. Only that portion of the curb and gutter or sidewalk needed to lay the pipe shall be removed.
- B. Where concrete curb and gutter or sidewalk is removed or disturbed during the construction work, it shall be replaced, using 3000 psi concrete, in fully as good or better condition than that which existed prior to the Developer/Contractor's operation.

3.13 REPLACEMENT OF EXISTING MAIL BOXES, CULVERTS, CLOTHES LINE POSTS, FENCES AND OTHER SUCH FACILITIES

- A. Existing mail boxes, drainage culverts, clothes line posts, fences and the like shall not be damaged or disturbed unless necessary, in which case, they shall be replaced in as good condition as found as quickly as possible. Existing materials may be reused in replacing such facilities when materials have not been damaged by the Developer/Contractor's operations. Existing facilities damaged by Developer/Contractor's operation shall be replaced with new materials of the same type at the Developer/Contractor's expense.
- B. Replacement of paved drainage ditches within highway right-of-way shall be accomplished in accordance with Department of Transportation specifications.

3.14 PORTLAND CEMENT CONCRETE DRIVEWAY REPLACEMENT

- A. Wherever Portland cement concrete driveways are removed, they shall be reconstructed to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than existed prior to the operation.
- B. The existing concrete paving shall be sawed or cut to straight edges a minimum of 12-inches outside the edges of the trench or broken out to an existing joint, or as directed by WKUD. The concrete pavement shall be equal to the existing pavement thickness but not less than 6 inches in thickness for driveways.
- C. Pavement shall be reinforced with 6 x 6 #10-10 wire mesh and shall be constructed with 3000 psi concrete.

3.15 RIP-RAP STREAM BANK SLOPE PROTECTION

The Developer/Contractor shall install riprap stream bank slope protection at locations directed by WKUD. Riprap slope protection shall be 12-inches thick and shall meet State D.O.T. Standard Specifications.

3.16 TESTING

- A. All water lines shall be given a hydrostatic test. Testing of lines shall comply with AWWA standard C600 and in accordance with the provisions listed below, and/or in accordance with manufacturer's installation procedures.

- B. The test pressure of the installed pipe shall be a minimum of 250 psi or 1.5 times the working pressure whichever is greater.
- C. Allowable leakage shall be no greater than:

$$L = \frac{(P^{1/2})(S \times D)}{148,000}$$

where,

L = Leakage (gal/hr.)

S = Length of pipe (feet)

D = Diameter of Pipe (inches)

P = Test pressure (psi)

Pipelines of whatever material shall be tested at the pressures as shown and the allowable leakage shall not exceed the requirements of the following table:

Allowable Leakage

Pipe Size (in)	Min Test Pressure (psig.)	per 1000 Feet (gal/hr.)
24	250	2.56
20		2.14
16		1.71
12		1.28
8		0.85
6		0.64
4		0.43
2		0.21

- D. Developer/Contractor shall furnish all recording gauges, recording pressure charts, pumps, water meters, and other equipment required for measuring water used during leakage test and maintain said equipment in condition for accurate testing as determined by WKUD. Recording pressure charts shall be required throughout the duration of the test and shall be turned over to WKUD at conclusion of tests.
- E. Duration of test shall be not less than two (2) hours.
- F. Where leaks are visible at exposed joints and/or evident on the surface where joints are covered, the pipe shall be rejoined and leakage must be minimized, regardless of total leakage as shown by test.

- G. All pipe, fittings, valves, and other materials found to be defective under test shall be removed and replaced at no expense to WKUD.
- H. Lines, which fail to meet tests, shall be repaired and retested as necessary until test requirements are complied with.
- I. Where nonmetallic joint compounds are used, pipelines should be held under normal operating pressure for at least three days before testing.
- J. WKUD will provide initial water for testing the pressure piping. Should the first test fail to pass, all additional water required for subsequent tests shall be furnished at the Developer/Contractor's expense.
- K. For HDPE lines, when performing the hydrostatic test, follow the manufacturer's recommendations or test HDPE lines as directed by WKUD.

3.17 CLEAN UP

Upon completion of installation of the piping and appurtenances, the Developer/Contractor shall remove all debris and surplus construction materials resulting from the Work. The Developer/Contractor shall grade the ground along each side of pipe trenches in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line.

3.18 DISINFECTION OF POTABLE WATER LINES

The new potable water lines shall not be placed in service, either temporarily or permanently, until they have been thoroughly disinfected in accordance with ANSI/AWWA C651-23 latest revision, the following requirements, and to the satisfaction of WKUD. All disinfection procedures shall meet WKUD and TDEC requirements.

After testing, a solution of hypochlorite using HTH or equal shall be introduced into the section of the line being disinfected sufficient to insure a chlorine dosage of at least 50 ppm in the lines. While the solution is being applied, the water should be allowed to escape at the ends of the line until tests indicate that a dosage of at least 50 ppm has been obtained throughout the pipe.

The chlorinated water shall be allowed to remain in the pipe for 24 hours. A residual of at least 25 ppm should be present in the pipe on initial test, then not less than 10 ppm minimum at the end of the 24-hour period. After the chlorinated water has remained in the line for 24 hours, the line will be flushed and refilled and WKUD will take bacteriological samples as per TDEC requirements. Two sets of samples will be taken 24 hours apart. If the tests are negative, then the line shall be thoroughly flushed and then may be connected to the system. If a positive sample is obtained, the disinfection procedure must be repeated until negative samples are obtained. WKUD will furnish the water required for the initial filling of the lines and for the first refill after flushing, but the Developer/Contractor shall pay for any other water required. All discharges of water during flushing, etc., shall meet TDEC requirements and are the responsibility of the Developer/Contractor. De-chlorination shall be provided by the Developer/Contractor.

END OF SECTION

SECTION 02515 – VALVES & UTILITY SERVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

Provide all labor, materials, equipment and services required to furnish and install all valves shown on the Drawings and/or specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02510 - Water Distribution Piping
- B. Section 02517 - Hydrants

PART 2 - PRODUCTS

2.01 GATE VALVES

- A. Gate valves shall conform to AWWA C515 standard as extended and/or modified herein. All gate valves shall be of the double disc or resilient wedge type, iron body, fully bronze mounted, non-rising stem and have a design working pressure of 350 psi. Valves shall be of standard manufacturer and of the highest quality both as to materials and workmanship.
- B. All gate valves shall be furnished with mechanical joint connections, unless otherwise shown on the Drawings or specified hereinafter. The gate valves shall be restrained with mechanical joint restraints.
- C. An epoxy coating conforming to AWWA C-550 shall be applied to the interior and exterior ferrous surfaces of the valve except for finished or seating surfaces. Coating shall be touched up in field as required.
- D. All gate valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working water pressure cast on the body of the valve.
- E. Each gate valve shall be installed in a vertical position with a roadway type valve box. Gate valves set with valve boxes shall be provided with a 2-inch square operating nut and shall be opened by turning to the left (counter-clockwise). There shall be a maximum 36” depth to valve operator nut. Developer/Contractor must use extension stems, if necessary, to raise operator nut within 36” of final grade.
- F. All gate valves shall be Mueller, American Valve, or approved equal.

2.02 BUTTERFLY VALVES (FOR LINES 14 INCHES AND LARGER)

- A. All butterfly valves shall be of the tight closing, rubber seat type with Buna-N rubber seats, which are recess mounted and securely fastened to the valve body or to the valve disc.

Seating surfaces shall be stainless steel. Valves shall be rated for 250 psi working pressure and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valve discs shall rotate 90 degrees from the fully open position to the tight shut position. Valves shall fully comply with the latest revision of AWWA C504 and NSF61, where applicable.

- B. Valve bodies shall be constructed of cast iron ASTM A126, Class B narrow body design and shall have integrally cast mechanical joint ends. Shafts shall be two-piece, stub type and keyed for actuator connection. Body thickness shall be strictly in accordance with AWWA C504. Valve shafts shall be constructed of 18-8 stainless steel or of approved construction.
- C. Disc shall be constructed of cast iron ASTM A48, Class 40 or ductile iron ASTM A536. All disc seating edges shall be stainless steel and be smooth and polished. Disc mounted seats shall be mechanically retained; body mounted seats shall be bonded to the valve body. Bonded-in seats must be simultaneously molded in, vulcanized and bonded to the body and the seat. Bearings shall be corrosion resistant and self-lubricating.
- D. Operators shall be permanently lubricated and sealed from ground water, with a two-inch square-operating nut clearly marked with “open” and a direction arrow.
- E. All operators shall be fully gasketed and grease packed and designed to withstand submersion in water to 10 psi. Valve shall open with a counterclockwise rotation of the operator, and operation shall closely resemble conventional distribution valve practice and shall minimize water hammer. Operator shall be equipped for buried service.
- F. Butterfly valves shall be supplied for mains 14” and larger where shown on the Plans unless otherwise noted.
- G. All surfaces of the valve shall be clean, dry and free from grease before painting. An epoxy coating conforming to AWWA C550 shall be factory applied to the interior and exterior ferrous surfaces of the valve except for finished or seating surfaces.
- H. Hydrostatic and leakage tests shall be conducted in strict accordance with AWWA C504, Section 5.
- I. Butterfly valves installed in the ground shall have the operator nut in a vertical position for use in a roadway type valve box as shown on the Plans.
- J. There shall be a maximum 36” depth to valve operator nut. Developer/Contractor must use extension stems, if necessary, to raise operator nut within 36” of the final grade.
- K. Butterfly valves shall be sized as shown on the Drawings and be as manufactured by Henry Pratt Co., DeZurik, or approved equal.

2.03 AIR RELEASE VALVES FOR WATER SERVICE

- A. Air release valves shall be furnished and installed as shown on the Plans. Valves shall be designed to automatically exhaust small quantities of air accumulated in the piping system, while the system is operating and pressurized.
- B. Valves shall be suitable for average working water pressure of 250 psi and shall be coated as per manufacturer’s recommendations for application with potable water.

- C. The main valve parts shall consist of a body, cover, needle or orifice button, float and seat. The needle or orifice button shall be Buna-N or Viton for tight shut-off and be resilient to resist leakage due to pipeline or pump vibrations.
- D. Materials of construction shall conform to ASTM specifications. The valve body and cover shall be cast iron with internal trim of stainless steel, bronze, Viton, or Buna-N. The float shall be stainless steel ASTM 240 T304.
- D. Air release valves shall be of the size indicated on the Plans. All air release valves shall be as manufactured by APCO Valve and Primer Corporation, Val-Matic Valve and Manufacturing Corp, ARI, Inc. or approved equal.

2.04 COMBINATION AIR VALVES FOR WATER SERVICE

- A. Combination air valves shall be furnished and installed as shown on the Plans. Valves shall be of the single housing type that combines the operating features of both an air and vacuum valve and air release valve.
- B. The air and vacuum portion shall be designed to automatically exhaust large quantities of air accumulated within the pipe system during filling and allow air to re-enter when the pipe is draining or when a negative pressure occurs. The discharge orifice shall be equal or greater than the inlet of the valve.

The air release portion shall be designed to automatically exhaust small quantities of air accumulated in the piping system, while the system is operating and pressured.

- C. The main valve parts shall consist of a body, cover, floats, and seats. The floats shall be stainless steel ASTM 240 T304. The air and vacuum seat shall be Buna-N and air release seat shall be stainless steel.

Materials of construction shall conform to ASTM specifications. The body and cover shall be cast iron.
- D. The combination air valve shall be able to withstand 250-psi operating pressure and shall be coated as per manufacturer's recommendations.
- E. The combination air valve shall be as manufactured by APCO Valve and Primer Corp., ValMatic Valve and Manufacturing Corp., or approved equal.

2.05 VALVE BOXES

- A. Valve boxes shall be 5-1/4-inch standard cast iron, two-piece, screw type valve box with drop cover marked "WATER". Valve boxes shall be accurately centered over valve operating nut, and backfill thoroughly tamped about them. They shall be set vertically and properly cut and/or adjusted so that the tops of boxes shall be in the same plane as the finished surface of the ground or street. Valve boxes shall be set at valve locations shown on the drawings or designated by WKUD.

Contractor shall also furnish and install at each valve a two-piece HDPE valve box alignment device (BOXLOK) as manufactured by EMMA Sales or approved equal.

- B. Valves/Valve boxes are not permitted to be installed in a paved area or roadway surface, unless approved by WKUD. Valve boxes inside a paving, walk, or road surface shall not be set on the valves but shall be supported on crushed stone fill.
- C. Wherever valve boxes fall outside of the roadway pavement, the top of the box shall be set in a concrete slab 24" x 24" x 6" thick with the top of the slab and box flush with the top of the ground as shown on the Plans. This provision shall apply to all new and all existing valve boxes, unless otherwise stated on the plans or ordered by WKUD.
- D. Valve boxes shall have extension stems, where necessary when operating nut is raised to be within 36" of the existing grade.
- E. Valve boxes and covers shall be as manufactured by Tyler Corporation, Opelika Foundry, Bingham & Taylor, or approved equal.

2.06 TAPPING SLEEVES AND VALVES

- A. Tapping sleeves for connections to existing water lines shall be of the cast iron, full body, mechanical joint type with flanged connection for valve together with a gate valve conforming to the requirements found in this section of the specification. The tapping sleeve and valve shall be suitable for working pressures of 250 psi.
- B. The Tapping sleeves and valves shall be cast iron and as manufactured by Mueller, American Valve and Hydrant, M & H, Kennedy, or approved equal.
- C. The valve shall be supplied with a two-piece valve box and operating nut.
- D. All existing water mains to be tapped shall be exposed in order to verify line sizes prior to ordering tapping sleeves and valves.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All valves shall be installed in accordance with WKUD Standard Drawing Details and with the manufacturer's recommendations.
- B. All valves shall be anchored in accordance with WKUD Standard Drawing Details. All valves shall be installed and restrained with mechanical joint restraint glands (Megalug).

END OF SECTION

SECTION 02517 - HYDRANTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

Provide all labor, materials, equipment and services required for furnishing and installing all hydrants and appurtenances specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02515 - Valves - Utilities Services
- B. Section 02510 - Water Distribution Piping

PART 2 - PRODUCTS

2.01 FIRE HYDRANTS

- A. The Developer/Contractor shall furnish and install fire hydrants and auxiliary gate valves where shown on the Drawings or directed by WKUD. Hydrants shall conform in all respects to the most recent requirements of AWWA C502. All hydrants shall have 6-inch mechanical joint shoe connection, two (2) 2-1/2-inch discharge nozzles with National Standard threads, and one (1) brass pumper nozzle with National Standard Fire Hose coupling screw threads together with caps fastened securely to each hydrant and threaded to fit nozzles. All connection threads shall comply with standard specifications of the American Insurance Association.
- B. Main valve shall have 5-1/4-inch full opening and be of the compression type opening against water pressure and closing with water pressure. The valve shall be faced with heavy impregnated waterproof ballast or other approved material. The hydrant shall be "dry type."
- C. Hydrants shall be cast iron bodies; fully bronze mounted and meet all the requirements of the latest AWWA specifications. Main valve shall have a threaded bronze seat ring assembly of such design that it is easily removable by unscrewing from a threaded bronze drain ring. Bronze drain ring shall have multiple ports providing positive automatic drainage as the main valve is opened or closed. Drainage waterways shall be completely bronze to prevent rust and corrosion.
- D. The operating nut shall be five (5) sided bronze or bronze with a five (5) sided ductile iron cap, and mounted so that a counter clockwise motion will open the valve. There must be cast on top an arrow and the word "Open" indicating the direction of turn to open the hydrant.
- E. Operating stem shall be equipped with anti-friction thrust bearing to reduce operating torque and assure easy opening. Stop shall be provided to limit stem travel. Stem threads shall be enclosed in a permanently sealed lubricant reservoir protected from weather and the waterway with O-ring seals.
- F. Hydrants shall be shop tested to 300-psi pressure with main valve both opened and closed. Under test the valve shall not leak, the automatic drain shall function and there shall be no leakage into the bonnet.
- G. Type of shoe connection shall be mechanical joint and size shall be six inches (6").

- H. Hydrants shall be painted with one (1) coat of red oxide epoxy primer and two (2) coats of yellow Hi-Build Epoxy.
- I. The waterway of hydrants shall be as free as possible of obstructions, sharp turns, corners, or other cause for resistance.
- J. Hydrants shall have a safety “breakable flange” section located above ground line. The distance from the finished ground line of the hydrant to the “break away flange” shall not be less than 2-inches or more than 6-inches.
- K. Each fire hydrant shall be equipped with a 6-inch gate valve and box.
- L. Hydrants shall be suitable for a working pressure of 250 psi, be UL listed, “AWWA Improved Type”, installed as shown on the Plans, and as manufactured by Mueller Company, American, M&H, or approved equal.

PART 3 - EXECUTION

3.01 SETTING OF FIRE HYDRANTS

A. General:

Fire hydrant assemblies shall be installed as shown on the Plans, unless otherwise indicated by WKUD.

B. Location:

1. Hydrants shall be located as shown or as directed so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.
2. When placed behind the curb, the hydrant barrel shall be set so that the pumper or hose nozzle cap will be a minimum of five feet (5') from the back of curb.
3. When set in the lawn space between the curb and the sidewalk or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within six inches (6") of the sidewalk.

C. Position:

All hydrants shall be set plumb with not less than six (6) cubic feet of crushed stone and shall have their nozzles parallel with the roadway, with the pumper nozzle facing toward the roadway. Hydrants shall be set to the established grade, with nozzles at eighteen inches (18") above the ground, as shown or as directed by WKUD.

D. Connection to Main:

Hydrants shall be connected to the main as shown on the Plans, unless otherwise directed by WKUD.

3.02 ANCHORAGE

The bowl of each hydrant shall be fully restrained to the main water line with Megalugs or a hydrant tee and swivel couplings, as shown on the Standard Details in the Drawings or as directed by WKUD.

3.03 FIRE HYDRANT WRENCHES

One (1) hydrant wrench shall be furnished for each ten (10) hydrants or less. The Developer/Contractor shall provide WKUD with one (1) carton of collision breakage repair parts for the hydrants.

END OF SECTION

SECTION 02700 - ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.01 SCOPE OF WORK

The asphalt concrete paving replacement work includes the construction of an aggregate base course, asphalt binder and wearing courses to match existing courses and as specified herein. This work is to replace paving disturbed by the construction and any damages to paving by Contractor's operations, as well as new pavement and driveways, within the limits shown on the plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions and General Requirements apply to the work specified in this section.
- B. Section 02300 - Earthwork

1.03 APPLICABLE STANDARDS

All references in this section to the standard specifications shall refer to the most recent Edition of Standard Specifications for Road and Bridge Construction with all amendments thereto as published by the Department of Transportation.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Weather Limitations: Apply prime and tack coats only when ambient temperature is above 50 degrees F., and when temperature has not been below 35° for 12 hours immediately prior to application. Do not apply when bases are wet or contains an excess of moisture.
- B. Construct asphalt concrete surface courses only when atmosphere temperature is above 40°F., and when base is dry. Base course may be placed when air temperature is above 30°F. and rising.
- C. Grade Control: Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

2.01 MATERIALS

All materials required for work in this section shall be as specified in the Standard Specifications as follows:

- A. Base Course: Section 303.
- B. Bituminous Concrete Surface and Bituminous Concrete Base: Section 402 and 403.

PART 3 - EXECUTION

3.01 INSPECTION

Pavement installer must examine the areas excavated and backfilled and conditions under which pavement is to be constructed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until satisfactory embankments and subgrade have been established to a uniform line, properly shaped and compacted.

3.02 BASE COURSE

- A. Base course for all new paving shall match existing depth or consist of a minimum nine (9) inches of dense graded aggregate.
- B. Base courses shall be constructed in accordance with Section 303 of the Standard Specifications.

3.03 PRIME COAT

Prior to placing the bituminous binder course, the granular base course shall be thoroughly cleaned and broomed and a prime coat of Refined Tar RT-2 shall be uniformly applied at the rate of 0.35 gallons per square yard by pressure distributor or other approved pressure spray method.

3.04 BITUMINOUS CONCRETE COURSES

- A. The bituminous base course shall be hot mixed, hot laid, bituminous concrete base, furnished and placed in accordance to match the existing depth or to a minimum compacted thickness of 3 inches.
- B. The surface course shall be hot mixed, hot laid, bituminous concrete in accordance to match existing depth or to a minimum compacted depth of 1-1/2 inches.
- C. Standard Specifications: All bituminous concrete paving work shall comply with Section 402 of the Standard Specifications, including the removal of pavement samples to be tested by an independent laboratory for composition and density to ensure quality control.

END OF SECTION

SECTION 02820 - CHAIN LINK SECURITY FENCES AND GATES

PART 1 - GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment necessary to furnish and install chain link fencing and gates according to the layout shown on the Plans. Height of the fencing fabric shall be as shown on Plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02300 - Finish Grading:
- B. Section 03300 - Concrete

1.03 SUBMITTALS

- A. Shop Drawings:

Indicate details of fabrication and installation, including but not limited to fence height, post spacing, dimensions, and unit weights and footing details.
- B. Manufacturer's Literature:
 - 1. Descriptive data of installation methods and procedures.
 - 2. Standard drawings of fence and gate installation.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. Deliver materials with manufacturer's tags and labels.
- B. Handle and store material as to avoid damage.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Framework shall conform to one of the following:
 - 1. Steel pipe with 1.8 ounces of zinc coating per square foot of surface area conforming to ASTM F1043 - Group IA; external coatings per F1043 paragraph 7.1.1 and internal coatings per F1043 paragraph 7.2.1.
 - 2. High strength steel pipe triple coated per ASTM F1043 - Group IC; external coatings per F1043 paragraph 7.1.2, and internal coatings per F1043 paragraph 7.2.4. All coatings to be applied after welding.

Pipe shall be straight, true to section and shall conform to the following weights:

Pipe Size Outside Diameter	Group 1A Weight (Lbs. per Ft.)	Group 1C Weight (Lbs. per Ft.)
1-5/8"	2.27	1.84
2"	2.72	2.28
2-1/2"	3.65	3.12
3"	5.79	4.64
3-1/2"	7.58	5.71
4"	9.11	6.56

- B. Fabric: Fabric shall be aluminized fabric manufactured in accordance with ASTM A-491 and coated before weaving with a minimum of 0.4 ounces of aluminum per square foot of surface area. The steel wire and coating shall conform to ASTM A-817. Fabric shall be 9 gauge, woven in a 2" diamond mesh. Top selvage to be twisted and barbed. Bottom selvage to be knuckled.

The aluminum coated wire shall have a tensile strength of at least 80,000 pounds per square inch.

2.02 COMPONENTS

Components of the fencing system shall be in accordance with the following requirements:

- A. Fence Posts:

Fabric Height	Group IA or Group IC	
	Line Post O.D.	Terminal Post O.D.
Under 6'	2"	2-1/2"
6' to 9'	2-1/2"	3"
9' to 12'	3"	4"

- B. Gate Posts:

Single Gate Width	Double Gate Width	Group IA or Group IC Post O.D.
Up to 6'	Up to 12'	3"
7' to 12'	13' to 25'	4"

- C. Rails and Braces: 1-5/8" O.D.

- D. Fittings:

1. Post Caps: Pressed steel, cast iron or cast aluminum alloy designed to fit snugly over posts to exclude moisture. Supply cone type caps for terminal posts and loop type for line posts. All fittings to conform to ASTM F-626.
 2. Rail and Brace Ends: Pressed steel, cast iron or cast aluminum alloy, cup-shaped to receive rail and brace ends.
 3. Top Rail Sleeves: Tubular steel, 0.051 thick x 7" long, expansion type.
 4. Tension Bars: Steel strip, 5/8" wide x 3/16" thick.
 5. Tension Bands: Pressed steel, 14-gauge thickness x 3/4" wide.
 6. Brace Bands: Pressed steel, 12-gauge thickness x 3/4" wide.
 7. Truss rods: Steel rod, 3/8" diameter merchant quality with turnbuckle.
 8. Barbed Wire Arms: Pressed steel, cast iron or cast aluminum alloy fitted with clips or slots for attaching three strands of barbed wire. Arms shall be set outward on a 45-degree angle and be capable of supporting a 250-pound load at outer barbed wire connecting point without causing permanent deflection.
- E. Tension Wire: Marcellled 7-gauge steel wire with minimum coating of 0.80 ounces of zinc or 0.40 ounces of aluminum per square foot of wire surface and conforming to ASTM A-824.
- F. Tie Wires: Aluminum, 9-gauge, alloy 1100-H4 or equal.
- G. Hog rings: Steel wire, 11 gauge, with a minimum zinc coating of 0.80 ounces per square foot of wire surface.
- H. Barbed Wire: Commercial quality steel, 12-1/2 gauge, two strand twisted line wire with 4-point barbs at 5-inch spacing. Coating shall consist of a minimum of 0.80 ounces of zinc per square foot of wire surface conforming to ASTM A-121 or a minimum of 0.30 ounces of aluminum per square foot of wire surface conforming to ASTM A-585.

2.03 CONCRETE MIX

- A. Concrete for footings shall be ASTM C-94 Portland Cement concrete with maximum 3/4" aggregate having a minimum compressive strength of 3,000 PSI at 28 days.

2.04 CANTILEVER SLIDE GATE

- A. Gate filler fabric shall be of the same as that used in fence. Barbed wire shall be installed along the top of the gate same as the fence. Cantilevered slide gate shall be of 3-post design with counter support spacing determined by the manufacturer. The cantilever gate system shall be chain link framing design, single opening with gate opening direction to the left, and posts sized to support the gate shown on the plans. Cantilever gate shall be TransPort by Ameristar, or equal.
- B. Frames:
1. The materials used for cantilever gate framing shall be manufactured from aluminum with yield strength of 25,000 psi, a tensile strength of 30,000 psi and a standard mill finish. The

top track shall be manufactured from aluminum with yield strength of 25,000 psi, a tensile strength of 30,000 psi and a standard mill finish.

2. Uprights shall be extended for barbed wire. Each gate section shall be supplied with truss cables for proper bracing.

C. Suspension and Lower Guide Rollers

Two upper suspension rollers and two lower guide rollers shall be included with each gate.

D. Latches and Keepers:

Cantilever Gate latch shall be extra heavy duty with U-bolts for round posts.

- E. Gate manufacturer and supplier shall be responsible for all hardware associated with attaching gates and removable panels.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Installation to conform to ASTM F-567.
- B. Post Spacing: Space line posts at intervals not exceeding ten feet.
- C. Post Setting: Set terminal, gate and line posts plumb in concrete footings of the dimensions shown on the Details. Top of footing to be 2" above grade and sloped to direct water away from posts.
- D. Bracing: Brace gate and terminal posts back to adjacent line posts with horizontal brace rails and diagonal truss rods.
- E. Top Rail: Install through line post loop caps connecting sections with sleeves to form a continuous rail between terminal posts.
- F. Top Tension Wire: If top rail is not required, stretch tension wire through loop caps and fasten to terminal posts.
- G. Bottom Tension Wire: Stretch between terminal posts 6" above grade and fasten to outside of line posts with tie wires.
- H. Fabric: Pull fabric taut with bottom selvage 2" above grade. Fasten to terminal posts with tension bars threaded through mesh and secured with tension bands at maximum 15" intervals. Tie to line posts and top rails with tie wires spaced at maximum 12" on posts and 24" on rails. Attach to bottom tension wire with top rings at maximum 24" intervals.
- I. Barbed Wired: Anchor to terminal extension arms, pull taut and firmly install in slots of line post extension arms.
- J. Gates: Install gates plumb, level and secure for full opening without interference. Anchor center stops and keepers in concrete.

- K. Fasteners: Install nuts for fittings, bands, and hardware bolts on inside of fence.

3.02 COMPLETION

- A. Adjust brace rails and tension rods for rigid installation.
- B. Tighten hardware, fasteners, and accessories.
- C. The area of installation shall be left free of debris caused by the installation of the fence.

END OF SECTION

SECTION 02920 - LAWNS AND GRASSES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

Provide all labor, materials, equipment, and services required for seeding of all disturbed areas caused by construction activities and for installation of sod where indicated on the Contract Drawings or specified herein.

1.02 RELATED DOCUMENTS

- A. Section 02300 - Earthwork
- B. Section 02371 - Erosion and Sediment Control

1.03 MAINTENANCE

- A. Maintenance shall begin immediately following the last operation of installation for each portion of lawn.
- B. Lawns shall be carefully monitored for a period of forty-five (45) days. At the end of this period an inspection will be made and any deficiencies, which may be attributable to the Developer/Contractor, will be noted. Another inspection will be made at the beginning of the next planting season, and, if any of the previously noted deficiencies still exist, Developer/Contractor shall repair.

1.04 INSPECTION FOR ACCEPTANCE

- A. The Inspection of the Work:

The inspection of the work of lawns to determine the completion of contract work exclusive of the possible replacement of plants, will be made by WKUD upon written notice requesting such inspection submitted by the Developer/Contractor at least ten (10) days prior to the anticipated date.

- B. Acceptance:

After inspection, the Developer/Contractor will be notified by WKUD of acceptance of all work of this Section, exclusive of the possible replacement of plants subject to guaranty, or if there are any deficiencies of the requirements of completion of the Work.

PART 2 - PRODUCTS

2.01 WATER

- A. Water used in this work shall be suitable for irrigation and free from ingredients harmful to plant life.
- B. Developer/Contractor shall furnish all necessary watering equipment.

2.02 TOPSOIL

The Developer/Contractor shall furnish and place sufficient topsoil for the seeding and installation of sod where sod is required by the Drawings.

2.03 FERTILIZER

A. Pre-Fertilizer:

Fertilizer shall be commercial grade pelleted or chip type, as “Agriform Blue Chip”, or equal, uniform in composition, dry and free flowing, of the following analysis:

Nitrogen	24.0% Minimum
Nitroform	14.0% Minimum
Phosphoric Acid	24.0% Minimum
Potash	8.0% Minimum
Iron (Metallic)	0.4% Minimum

Particle size not less than 2% through a number 48 mesh.

Fertilizer shall be delivered to the site in the original unopened container bearing the manufacturer’s guarantee analysis. Any fertilizer that becomes caked or damaged making it unsuitable for use; will not be accepted.

B. Commercial Fertilizer:

Commercial fertilizer for lawn areas shall be complete fertilizer, formula 10-10-10, for lawns and shall conform to the applicable state fertilizer laws. Fertilizer shall be uniform in composition, dry and free flowing and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guarantee analysis. Any fertilizer becoming caked or otherwise damaged making it unsuitable for use, will not be accepted. Fertilizer shall be applied at the rate of 25 pounds per 1,000 square feet.

C. Lime:

The lime used for lawn areas shall be agricultural limestone.

2.04 GRASS SEED

A. Seed mixtures shall closely match the area being repaired. Otherwise, the seed mixture to be sown shall be in the following proportions for the seeding dates specified:

Seeding Dates	Grass Seed	Percentages
February 1 to July 1	Kentucky 31 Fescue	80%
	Korean Lespedeza	15%
	English Rye	5%
June 1 to August 15	Kentucky 31 Fescue	55%
	English Rye	20%

June 1 to August 15	Korean Lespedeza	15%
	German Millet	10%
April 15 to August 15	Bermuda grass (hulled)	70%
	Annual Lespedeza	30%
August 1 to December 1	Kentucky 31 Fescue	70%
	English Rye	20%
	White Clover	10%
December 1 to February 1*	Kentucky 31 Fescue	70%
	Crown Vetch	25%
	English Rye	5%

Source: TDOT Standard Specifications

* This mixture of grass seed allowed only with written approval of WKUD

- B. For slopes steeper than 3 to 1 or where indicated on the drawings, the Developer/Contractor shall apply a seed mixture of:

Crown Vetch	25%
Kentucky 31 Fescue	70%
English Rye	5%

In addition to the mixture shown above, the area will be over seeded with Sericea Lespedeza at the rate of 15 pounds per acre. Use scarified Sericea Lespedeza between February 1 and July 1. Between July 1 and December use unhulled Sericea Lespedeza.

After seeding on these slopes, a fabric will be installed to cover the area and protect from erosion. The fabric will be North American Green S150 (supplier JenHill, Inc. ph. 423-5074174) or engineer approved equal.

- C. All seed shall be fresh and clean and shall be delivered mixed, in unopened packages, bearing a guaranteed analysis of the seed mixture.
- D. Germination must be certified to conform to the following minimums:

Purity	90%
Germination	85%

- E. Permanent seeding is not allowed during the months of December and January without written approval of the Engineer; however, temporary seeding or other means of ground stabilization may be required to address erosion conditions.

2.05 MULCH

- A. Clean straw applied at the rate of two (2) bales per 1,000 feet.
- B. Alternative mulch: Conwed Hydro Mulch, Silva-Fiber, or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. This work consists of furnishing all labor, equipment and materials and in performing all operations in connection with the fertilizing and seeding of all the finished graded areas not specified to be sodded or occupied by structures, roads, concrete slabs, sidewalks, walls, etc., and including grassed areas destroyed or damaged by the Developer/Contractor.
- B. The areas to be seeded shall be thoroughly tilled to a depth of at least 4" by discing, harrowing, or other approved methods until the condition of the soil is acceptable to the Engineer. After harrowing or discing, the seed bed shall be dragged and/or hand raked to finish grade. All rocks shall be removed.

3.02 FERTILIZER APPLICATION RATES

Apply fertilizer and agricultural limestone uniformly over the seed bed, and lightly harrow, rake, or otherwise incorporate them into the soil for a depth of approximately 1-inch. Fertilizer shall be 20 pounds of 10-10-10 or equivalent per 1,000 square feet. Agricultural limestone shall be applied at 100 lbs. per 1000 square feet. The incorporation of the fertilizer and the agricultural lime may be a part of the tillage operation and shall be applied no less than 24 hours nor more than 48 hours before the seed is to be sown.

3.03 SEEDING

- A. Seed shall be broadcast either by hand or approved sowing equipment at the rate of ninety (90) pounds per acre (two pounds per 1,000 square feet), uniformly distributed over the area. Broadcasting seeding during high winds will not be permitted. The seed shall be drilled or raked into a depth of approximately 2 inch and the seeded areas shall be lightly raked to cover the seed and rolled. Drilling seeding shall be done with approved equipment with drills not more than 3 inches apart. All ridges shall be smoothed out, and all furrows and wheel tracks likely to develop into washes, shall be removed.
- B. Areas seeded shall be protected until a uniform stand develops, when it will be accepted and the Developer/Contractor relieved of further responsibility for maintenance. Displaced mulch shall be replaced or any damage to the seeded area shall be repaired promptly, both in a manner to cause minimum disturbance to the existing stand of grass. If necessary to obtain a uniform stand, the Developer/Contractor shall re-fertilize, reseed and re-mulch as needed.
- C. Provide seed to match existing grass in residential lawns.
- D. WKUD shall inspect the seeding within sixty (60) days after planting and determine if it is acceptable. 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, consistent over the entire area. If an acceptable growth is not obtained on the first planting, reseeding and re-mulching will be required.

3.04 TIME OF PLANTING

Planting operations shall be conducted under favorable weather conditions during seasons normal for such work as determined by accepted practice in the locality of the project. At the option and on full responsibility of the Developer/Contractor, planting operations may be conducted under unseasonable conditions without additional compensation. See Part 2.04 of this Section.

3.05 MULCHING

- A. After the seed has been sown, the areas so seeded shall be mulched with clean straw at the rate of two (2) bales per 1,000 feet. Mulch on slopes shall be held in place with erosion control netting.
- B. Developer/Contractor may use Conwed Hydro Mulch, Silva-Fiber, or equal, instead of clean straw. If used, mulching material shall be applied at the rate of 1,500 pounds per acre. It may be applied with hydraulic equipment or may be added to the water slurry in a hydraulic seeder and the seeding and mulching combined in one operation.

3.06 CLEAN UP

All soil, peat or similar material which has been brought over paved areas by hauling operations or otherwise, shall be removed promptly, keeping these areas clean at all times. Upon completion of the planting, all excess soil, stone and debris not previously cleaned up shall be removed from the site or disposed of as directed by the Owner. All lawns shall be prepared for final inspection.

3.07 OTHER WORK

The Developer/Contractor also shall be responsible for the repair of any damage caused by his activities or those of his subcontractors, such as the storage of topsoil or other materials, operations or equipment, or other usages to all on-site areas outside the contract limits. Such repair operations shall include any regrading, seeding or other work necessary to restore such areas to an acceptable condition.

3.08 QUALITY CONTROL

Areas seeded shall be protected until a uniform stand develops, when it will be accepted and the Developer/Contractor relieved of further responsibility for maintenance. Displaced mulch shall be replaced or any damage to the seeded area shall be repaired promptly, both in a manner to cause minimum disturbance to the existing stand of grass. If necessary to obtain a uniform stand, the Developer/Contractor shall re-fertilize, reseed and re-mulch as needed. The Contractor/Developer shall be responsible for all repair and rework required due to trench settlement either before or after seeding has occurred.

END OF SECTION

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment and services required to furnish and install all cast-in-place concrete as specified herein.
- B. All concrete construction shall conform to all applicable requirements of ACI 301 (latest), Specifications for Structural Concrete for Buildings, except as modified by the supplemental requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 02300 - Earthwork

1.03 SUBMITTALS

The Developer/Contractor shall submit the following data.

- A. Concrete mix designs, test results and curves plotted to establish water-cement ratio if ACI 301-99 Section 4.2.3.4.G is followed.
- B. Proposed mix designs and all necessary substantiating data used to establish the proposed mix designs if ACI 301-99 Section 4.2.3.1 is followed.
- C. Mix designs shall be submitted for all mixes proposed or required to be used, including all mixes containing admixtures.

1.04 QUALITY ASSURANCE

The Developer/Contractor shall obtain and make available for reference, if necessary, the following publications:

- A. Specifications for Structural Concrete for Buildings ACI 301 (latest Revision).
- B. Field Reference Manual: Specifications for Structural Concrete for Buildings SP-15 (89).

Available from:

The American Concrete Institute
Publications Department
P.O. Box 19150
Detroit, Michigan 48219-0150

- C. Manual of Standard Practice - CRSI (Latest Edition).

- D. Placing Reinforcing Bars - CRSI (Latest Edition).
Available from:

Concrete Reinforcing Steel Institute
933 North Plum Grove Road
Schaumburg, Illinois 60173-4758

PART 2 - PRODUCTS

2.01 CLASSES OF CONCRETE AND USAGE

- A. Structural concrete of the various classes required shall be proportioned by either Method 1 or Method 2 of ACI 301 to produce the following 28-day compressive strengths:
1. Selection of Proportions for Class A Concrete:
 - a. 4,000 psi compressive for strength at 28 days.
 - b. Type II cement plus dispersing agent and air.
 - c. Max. (water)/(cement and dispersing agent) ratio = 0.45.
 - d. Min. cement content = 564 lbs. (6.0 bags)/cu. yd. concrete.
 - e. Nominal max. size coarse aggregate = No. 67 (3/4" max.) or No. 57 (1" max.). Walls with architectural treatment shall use No. 67 (3/4" max.).
 - f. Air content = 6% plus or minus 1% by volume.
 - g. Slump = 3" - 4" in accordance with ASTM C 143.
 2. Selection of Proportions for Class B Concrete:
 - a. 3,000 psi compressive strength at 28 days.
 - b. Type I cement plus dispersing agent and air.
 - c. Max. (water)/(cement and dispersing agent) ratio = 0.56.
 - d. Min. cement content = 470 lbs. (5.0 bags)/cu. yd. concrete.
 - e. Nominal max. size coarse aggregate = No. 67 (3/4" max.) or No. 57 (1" max.). Walls with architectural treatment shall use No. 67 (3/4" max.).
 - f. Air content = 6% plus or minus 1% by volume.
 - g. Slump - 3" - 4" in accordance with ASTM C 143.

- B. Concrete shall be used as follows:
 - 1. Class A concrete for all concrete work except as noted below.
 - 2. Class B concrete for fill concrete, thrust blocks and topping over hollow-core slabs, and where indicated on the Drawings.
- C. Type II cement conforming to ASTM C 150 shall be used in all structural concrete. The alkali content shall not exceed 0.6% calculated as sodium oxide. Cement for exposed to view concrete shall have a uniform color classification.
- D. Coarse aggregate for concrete shall be size No. 57, as specified in ASTM C33 unless a smaller size aggregate is required to conform to provisions of Section 4.2.2.3 of ACI 301. Coarse aggregate shall conform to all requirements of ASTM C33.
- E. Manufactured sand shall not be used as fine aggregate in concrete.

2.02 ADMIXTURES

- A. An air-entraining admixture shall be used on all concrete and shall be synthetic air entrainment such as that manufactured by Master Builders or approved equal. Certification attesting to the percent of effective solids and compliance of the material with ASTM C 260 shall be furnished, if requested.
- B. A water-reducing, set controlling admixture (nonlignin type) shall be used in all concrete. The admixture shall be a combination of polyhydroxylated polymers including catalysts and components to produce the required setting time based on job site conditions, specified early strength development, finishing characteristics required, and surface texture, as determined by the Engineer.
- C. Certification shall be furnished attesting that the admixture exceeds the physical requirements of ASTM C 494, Type A, water-reducing and normal setting admixture, and when required, for ASTM C 494, Type D, water-reducing and retarding admixture when used with local materials with which the subject concrete is composed.
- D. The admixture manufacturer, when requested, shall provide a qualified concrete technician employed by the manufacturer to assist in proportioning concrete for optimum use. He shall also be available when requested to advise on proper addition of the admixture to the concrete and on adjustment of the concrete mix proportions to meet changing job conditions.
- E. The use of admixtures to retard setting of the concrete during hot weather, to accelerate setting during cold weather, and to reduce water content without impairing workability will be permitted if the following conditions are met:

The admixture shall conform to ASTM C494, except that the durability factor for concrete containing the admixture shall be at least 100 percent of control, the water content a maximum of 90 percent of control and length change shall not be greater than control, as defined in ASTM C 494.

- F. Where the Developer/Contractor finds it impractical to employ fully the recommended procedures for hot weather concreting, WKUD may at his discretion, require the use of a set retardant admixture for mass concrete 2.5 feet or more thick for all concrete whenever the temperature at the time concrete is cast exceeds 80°F. The admixture shall be selected by the Developer/Contractor subject

to the review of WKUD. The admixture and concrete containing the admixture shall meet all the requirements of these Specifications. Preliminary tests of this concrete shall be required at the Developer/Contractor's expense.

- G. Admixtures shall be used in concrete design mixes in the same manner and proportions as in the field so that the effects of the admixtures are included in preliminary tests submitted to WKUD for review prior to the start of construction.
- H. When more than one (1) admixture is used, all admixtures shall be compatible. They should preferably be by the same manufacturer.
- I. Calcium chloride will not be permitted as an admixture in any concrete.

2.03 REINFORCEMENT

- A. The minimum yield strength of the reinforcement shall be 60,000 pounds per square inch. Bar reinforcement shall conform to the requirements of ASTM A 615. All bar reinforcement shall be deformed.
- B. Wire-mesh reinforcement shall be continuous between expansion joints. Laps shall be at least one full mesh plus 2 inches, staggered to avoid continuous lap in either direction, and securely wired or clipped with standard clips.
- C. Smooth dowels shall be plain steel bars conforming to ASTM A 615, Grade 60, or steel pipe conforming to ASTM A 120, Schedule 80. Pipe, if used, shall be closed flush at each end with mortar or metal or plastic cap. Dowels shall be installed at right angles to construction joints and expansion joints. Dowels shall be accurately aligned parallel to the finished surface, and shall be rigidly held in place and supported during placing of the concrete. One end of dowels shall be oiled or greased or dowels shall be coated with high-density polyethylene with a minimum thickness of 14 mils.
- D. Reinforcement supports and other accessories in contact with the forms for members which will be exposed to view in the finished work shall be of stainless steel or shall have approved high-density polyethylene tips so that the metal portion shall be at least one-quarter of an inch from the form or surface. Supports for reinforcement, when in contact with the ground or stone fill, shall be precast stone concrete blocks.
- E. Particular care shall be taken to bend tie wire ends away from exposed faces of beams, slabs and columns. In no case shall ends of tie wires project toward or touch formwork.

2.04 OTHER MATERIALS

- A. Anchorage items shall be of standard manufacture and of type required to engage with the anchors to be installed therein under other sections of the Specifications and shall be subject to approval by WKUD.
 - 1. Slots shall be galvanized dovetail-type as specified in Section "Masonry Work".
 - 2. Inserts shall be malleable iron or steel, and of sturdy design adequate strength for the load to be carried. All inserts shall be galvanized. Adjustable wedge inserts shall have an integral loop or strap at the back, or shall be slotted to receive a special-headed bolt not smaller than 5/8-inch in diameter and of the required length and fitted with hexagonal nut.

Other inserts shall be either threaded or slotted as required by their usage. Threaded inserts shall have integral lugs to prevent running.

3. Concrete anchors shall be an approved expansion type conforming to Federal Specification FF-S-325, Groups I, II, III, or VIII and shall be installed in strict accordance with the manufacturer's recommendations. Anchors shall develop ultimate shear and pull-out loads of not less than the following values in Class A concrete:

Bolt Diameter (Inches)	Min. Shear (Pounds)	Min. Pull-Out Load (Pounds)
1/2	4,500	4,600
5/8	6,900	7,700
3/4	10,500	9,900

- B. Epoxy bonding adhesive used to bond fresh plastic concrete to sound, hardened concrete shall meet the following Specification. Developer/Contractor shall furnish a notarized certification by the manufacturer that the proposed material meets the Specification.

1. Material:

The epoxy material shall consist of a 2-component system whose components conform to the following requirements:

- a. Component A - Component A shall be a modified epoxy resin of the epichlorohydrin bisphenol A condensation type, containing suitable viscosity control agents and having an epoxide equivalent of 180-200.
- b. Component B - The B component shall be primarily a reaction product of one mole of an aliphatic polyamine and two moles of mono-functional epoxide containing compounds modified with 2, 4, 6 tri (dimethylaminomethyl) phenol.
- c. The component ratio of B to A by volume shall be as specified by the manufacturer.

2. Properties of Mixed Components:

a.	Solids Content	100% by weight
b.	Pot Life	25-35 min. @ 73EF
c.	Tack-Free Time	4-5-1/2 hrs. @ 73EF
d.	Final Cure ASTM D 695 (75% ultimate strength)	3 days @ 73EF
e.	Initial Viscosity (A+B)	2,000 cps. min @ 73EF
f.	Color Mixed	Straw

3. Properties of Cured Material (Neat Material):

a.	Tensile Strength ASTM D 638	3,000 psi min. @ 14 days 73EF. cure
b.	Tensile Elongation ASTM D 638, modified	2 - 2% at 14 days 73EF. cure
c.	Compressive Strength ASTM D 695	12,500 psi min. at 73EF. cure
d.	Compressive Modules ASTM D 695	470,000 psi min. @ 28 days, 73EF cure
e.	28 days, 73EF cure ASTM D 695	5,500 psi min. @ 24 days 73EF cure
f.	Water Pick-up ASTM D 570	1.5 max.

C. Flashing reglets shall be as specified in Section 07530. Reglets shall be correctly placed into forms prior to placing concrete in formwork.

D. Pre-molded expansion-joint filler strips shall conform to ASTM D 1752 and shall be 3/8-inch thick unless otherwise shown.

E. Joint sealants shall conform to ANSI A 116.1. The following joint sealants are acceptable:

1. Colma by Sika Chemical Corporation
2. Hornflex by A.C. Horn, Inc.
3. Sonolastic by Sonneborn Division of Contech, Inc.

F. Nonshrink grout shall be Embecco 636 grout by Master Builders Company, Euco Firmix grout by the Euclid Chemical Company, or approved equal. The approved product shall be delivered to the site of the Work in the original sealed containers, each bearing the trade name of the material and the name of the manufacturer.

G. Hardeners and dust proofers shall be colorless, aqueous solution of zinc or magnesium fluosilicate. Each gallon of solution used for the first application shall contain not less than one pound of crystals. Each gallon of solution used for subsequent application shall contain not less than two pounds of crystals. Materials shall be reviewed by WKUD.

H. Porous fill shall be crushed rock or gravel of such size that all will pass a 1-1/2-inch screen and not more than 5 percent will pass a No. 4 screen, free from earth clay or other foreign substances.

I. Waterstops: Waterstops shall be styrene-butadiene rubber, standard (non-split) type, flat dumbbell shape (no center bulb), of size shown on Drawings, complete with fittings as required such as unions, vertical tees, vertical ells, flat crosses, flat ells, flat tees, etc. Waterstops shall be securely wired into place to maintain proper position during placement of fresh concrete. Care shall be taken in the installation of the waterstop and the placing of the concrete to avoid "folding" while concrete is being placed, and to prevent voids in the concrete surrounding the waterstop.

1. All materials, including adhesive, shall be W.R. Grace SERVICISED Construction Products; Williams Products, Inc.; Construction Gaskets, Inc.; or

approved equal, and shall be installed in accordance with the manufacturer's recommendations.

- J. Form Liners: Form liners for construction of fluted wall treatment shall be prefabricated plastic liners as manufactured by Greenstreak Plastic Products, Interform Company, or Symons Corporation.
1. Liners shall be fiberglass or ABS (acrylonitrile - butadiene - styrene) of such configuration as to obtain the fluted pattern shown or indicated on the Drawings.
 2. For purposes of designating type and quality of material required, form liners shall be pattern 361 trapezoidal liners as manufactured by Greenstreak Plastic Products.
 3. Preparation of forming materials, sealing of joints to prevent grout leakage and form release treatment (if required) shall be in strict compliance with the manufacturer's printed instructions and recommendations.

PART 3 - EXECUTION

3.01 FINISHES

A. Exposed to Public View Concrete Surfaces:

1. All concrete exposed to view in the completed structure shall be produced using materials and workmanship to such quality that only nominal finishing will be required. The provisions of paragraphs 6.2.2.1 and 6.3.6 of ACI 301 shall apply to all exterior exposed to public view concrete surfaces, including the outside surfaces of tanks.
2. Forms for exposed concrete surfaces shall be exterior grade, high-density overlay plywood, steel, or wood forms with smooth tempered hard-board form-liners.
3. Forms shall be coated with an approved release agent before initial pour and between subsequent pours, in accordance with the manufacturer's printed instructions. Form boards shall not be wet water prior to placing concrete.
4. Recessed joints in concrete shall be formed using lacquer-coated wood battens or forms, milled to indicated profiles. Battens and corner strips shall be carefully inspected before concrete is placed and damaged pieces replaced.
5. Chamfer strips shall be 1 inch radius with leg, polyvinyl chloride strips by Gateway Building Products, Saf-T-Grip Specialties Corp., Vinylex Corp., or approved equal.
6. Particular attention is directed to the requirements of paragraphs 5.3.3.3G and 6.3.3 of ACI 301. Form panels shall be provided in the maximum sized practicable in order to minimize form joints. Wherever practicable, form joints shall occur at recessed joints. All form joints in exterior exposed to view surfaces shall be carefully caulked with an approved nonstaining caulking compound. Joints shall not be taped. Form oil or other material, which will impart a stain to the concrete, shall not be allowed to contact concrete surfaces.
7. Care shall be taken to prevent chipping of corners or other damage to concrete when forms are removed. Exposed corners and other surfaces, which may be damaged by ensuing

operations, shall be protected from damage by boxing, corner boards or other approved means until construction is completed.

8. Form ties shall remain in the walls and shall be equipped with a water seal to prevent passage of water through the walls. Minimum set back of form ties shall be 1-1/2 inches from faces of wall. The hole left by removal of tie ends shall be sealed and grouted in accordance with the procedure described hereinafter in Par. 3.01.F.
9. All formed exposed to view concrete surfaces shall have a "smooth rubbed finish". Exterior vertical surfaces shall be rubbed to one foot below grade. Interior exposed to public view vertical surfaces of liquid containers shall be rubbed to one (1) foot below the minimum liquid level that will occur during normal operations.

- B. All vertical surfaces in liquid containing structures shall have a "smooth form" finish.

All "smooth form" concrete vertical surfaces shall be a true plane within 1/4 inch in 10 feet as determined by a 10-foot straightedge place anywhere on the surface in any direction. Abrupt irregularities shall not exceed 1/8 inch.

- C. Basin, flume, conduit and tank floors shall have a "troweled" finish unless shown otherwise on Drawings.
- D. Weirs and overflow surfaces shall be given a "troweled" finish.
- E. Exterior platforms, steps and landings, shall be given a "broom" finish. "Broom" finish shall be applied to surfaces, which have been steel-troweled to an even, smooth finish. The troweled surface shall then be broomed with a fiber-bristle brush in the direction transverse to that of the main traffic.
- F. Patching of holes due to removal of tie ends and other repairable defective areas, shall be as follows: Entire contact area of hole shall be coated with two-part moisture insensitive epoxy bonding compound as specified in Par. 2.04.B. in accordance with manufacturer's specifications, and prior to placing of freshly mixed patching mortar. Patching mortar shall be mixed and placed in general accordance with ACI Par. 5.3.7.5.
- G. For floors and slabs in which drains occur, special care shall be exercised to slope the floors uniformly to the drains. All floors with drains shall be sloped not less than 1/8-inch per foot unless otherwise shown. In all areas where quarry tile or other materials requiring more than 1/4-inch drop are to be overlaid, the concrete base slab shall be depressed as shown to provide a finished floor at the same elevation as surrounding areas.

3.02 TESTING

- A. All testing shall be in accordance with provisions of ACI 301. Testing services listed in ACI Sections 1.6.4 shall be performed by a testing agency acceptable to the Engineer and Owner.
- B. The testing services of ACI sections 1.6.4.2 and 1.6.4.3 shall be performed at the Developer/Contractor's expense. The Developer/Contractor shall be responsible for making concrete test cylinders, storing and protecting concrete cylinders and delivering cylinders to the Owner's testing laboratory.
- C. Testing services of ACI Section 1.6.4.4 shall be paid for by the Developer/Contractor. Test shall be made for each 50 cubic yards of concrete and/or each day concrete is placed.

3.03 ADDITIONAL REQUIREMENTS

- A. The vertical surfaces of footings shall be formed. Excavations and reinforcement for all footings shall have been inspected by the Engineer before any concrete is placed.
- B. The installation of underground and embedded items shall be inspected before slabs are placed. Pipes and conduits shall be installed below the concrete unless otherwise indicated. Fill required to raise the subgrade shall be placed as specified in "Section 02300 - Earthwork". Porous fill not less than 6 inches in compacted thickness shall be installed under all slabs, tank bottoms, and foundations. The fill shall be leveled and uniformly compacted to a reasonably true and even surface. The surfaces shall be clean, free from frost, ice, mud and water. Waterproof paper, polyethylene sheeting of nominal 4-mil minimum thickness, or polyethylene-coated burlap shall be laid over all surfaces receiving concrete.
- C. Concrete shall be placed in layers not over 18 inches deep and each layer shall be compacted by mechanical internal-vibrating equipment supplemented by hand spading, rodding and tamping as directed. Vibrators shall not be inserted into lower courses that have begun to set.
- D. Concrete that is truck mixed or transported in truck mixers or truck agitators shall be delivered to the site of the work and discharge completed in the forms within the time specified in Paragraph 10.7 of ASTM C 94 except that when the concrete temperature exceeds 85°F, the time shall be reduced to 45 minutes. Transit-mixed concrete that is completely mixed at the site of concrete placement or batched cement and aggregates transported to mixers shall be placed in the forms within 1-1/2 hours after cement has been added. Concrete shall be placed in the forms within 15 minutes after discharge from the mixer at the job site.
- E. If concrete is placed by pumping, no aluminum shall be used in any parts of the pumping system, which contact or might contaminate the concrete. Aluminum chutes and conveyors shall not be used.
- F. All concrete surfaces not in contact with forms shall be moist cured by the application of absorptive mats or double thickness of fabric kept continuously wet. Forms shall be kept continuously wet. Use of other curing methods will not be permitted unless written authorization is received from the Engineer.
- G. The unit of operation shall not exceed 30 feet for tank walls and walls exposed to weather, and 45 feet for other work in any horizontal direction and not less than 48 hours shall elapse between casting of adjoining units. Provision shall be made for jointing successive units as indicated or required to be made at spacing of approximately 25 feet. Additional construction joints required to satisfy the 25-foot spacing shall be located by the Developer/Contractor subject to the review of WKUD. The Developer/Contractor shall submit for review drawings separate from the steel reinforcing drawings, showing the location of all proposed construction joints. All construction joints shall be prepared for bonding by roughening the surface of the concrete in an acceptable manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface. Joints in walls and columns shall be maintained level. Concrete shall be placed in layers not over 18 inches deep and each layer shall be compacted by mechanical internal-vibrating equipment supplemented by hand spading, rodding and tamping as directed. Vibrators shall not be inserted into lower courses that have begun to set.

- H. Formwork for beam soffits and slabs and other parts that support the weight of concrete, shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified or permitted.
- I. Concrete Walks and Curbs:
1. Subgrade shall be true and well compacted at the required grades. Spongy and otherwise unsuitable material shall have been removed and replaced with approved material. Concrete walks shall be placed upon porous fill covered with waterproof paper, polyethylene sheeting of nominal 4-mil minimum thickness or polyethylene-coated burlap.
 2. Concrete walks shall be not less than 4 inches in thickness. Walks shall have contraction joints every 5 linear feet in each groove in the top surface of the slab to a depth of at least one-fourth the slab thickness with a jointing tool. Transverse expansion joints shall be installed at all returns, driveways, and opposite expansion joints in adjacent curbs. Where curbs are not adjacent, transverse expansion joints shall be installed at intervals of approximately forty (40) feet. Sidewalks shall receive a "broomed" finish. Scoring shall be in a transverse direction. Edges of the sidewalks and joints shall be edged with a tool having a radius not greater than 1/6 inch. Sidewalks adjacent to curbs shall have a slope of 1/4 inch per foot toward the curb. Sidewalks not adjacent to curbs shall have a slope of 1/4 inch per foot. The surface of the concrete shall show no variation in cross section in excess of 1/4 inch in 5 feet. Concrete walks shall be reinforced with 66-1010 welded wire fabric.
 3. Concrete curbs shall be constructed to the section indicated on the Standard Detail, and all horizontal and vertical curves shall be incorporated as indicated or required. Forms shall be steel. At the option of the Developer/Contractor, the curbs may be precast or cast-in-place. Cast-in-place curbs shall be divided into sections 8 to 10 feet in length using steel divider plates. The divider plates shall extend completely through the concrete and shall be removed. Precast curbs shall be cast in lengths of 4 to 5 feet. All exposed surfaces of concrete shall be finished smooth. All sharp edges and the edges of joints and divisions shall be tooled to 1/4-inch radius. Steel reinforcement shall be installed where the curb crosses pipe trenches or other insecure foundations. Such reinforcement shall consist of two (2) No. 4 deformed bars near the bottom of the curb and shall extend at least 24 inches beyond the insecure area. Transverse expansion joints shall be installed at all curb returns and at intervals of approximately 40 feet.
- J. Column base plates, bearing plates for beams and similar structural members, machinery and equipment bases shall, after being plumbed and properly positioned, be provided with full bearing with nonshrink grout. Concrete surfaces shall be rough, clean, free of oil, grease, and laitance and shall be moistened thoroughly immediately before grout is placed. Metal surfaces shall be clean and free of oil, grease and rust. Mixing and placing shall be in conformance with the material manufacturer's printed instructions. After the grout has set, exposed surfaces shall be cut back 1 inch and covered with a parge coat of mortar consisting of 1 part Portland cement, 2 parts sand and sufficient water to make the mixture place able. Parge coat shall have a smooth dense finish. Exposed surfaces of grout and parge coat shall be water cured with wet burlap for 7 days.
- K. Grout fill, which is formed in place by using rotating equipment as a screen, such as clarifiers and similar types of equipment, shall be mixed in proportions and consistencies as required by the manufacturer or supplier of the equipment.
- L. Water tightness:

1. The structures, which are intended to contain liquids and/or will be subjected to exterior hydrostatic pressures shall be so constructed that, when completed and tested, there shall be no loss of water and no wet spots shall show.
 2. As soon as practicable, after the completion of the structures, the Developer/Contractor shall fill them with water and if leakages develop or wet spots show, the Developer/Contractor shall empty such structures and correct the leakage in an approved manner. Any cracks, which appear in the concrete, shall be dug out and suitably repaired. Temporary bulkheads over pipe openings in walls shall be provided as required for the testing.
 3. After repairs, if any are required, the structures shall be tested again and further repaired, if necessary, until satisfactory results are obtained. All work in connection with these tests and repairs shall be at the expense of the Developer/Contractor.
 4. Waterstops shall be placed in other locations as indicated on the Drawings and as may be required to assure the water tightness of all containers of liquids. Special shop fabricated ells, tees and crosses shall be provided at junctions. Waterstops shall be extended at least 6 inches beyond end of placement in order to provide splice length for subsequent placement. In slabs and tank bottoms, water stops shall be turned up to be made continuous with waterstops at bottom of walls or in walls.
 5. Joints between pipe (except cast iron wall pipe) and cast-in-place concrete walls shall be sealed by means of a groove cast completely around the pipe; the groove shall be filled with a quick setting hydraulic compound similar and equal to Waterplug as made by Standard Dry Wall Products, Inc., mixed and applied in accordance with the manufacturer's instructions.
- M. Unless otherwise shown or directed, all pumps, other equipment, and items such as lockers, motor control centers and the like, shall be installed on concrete bases. The bases shall be constructed to the dimensions shown on the plans or as required to meet plan elevations. Where no specific plan elevations are required, the bases shall be 6 inches thick and shall extend 3 inches outside the metal equipment base. In general, the concrete bases shall be placed up to 1-inch below the metal base. The equipment shall then be properly shimmed to grade and the 1-inch void filled with non-shrink grout. Prior to the final set of the grout, it shall be cut back and the edge plastered with 1:2 cement mortar.
- N. Concrete which, in the opinion of WKUD, has excessive honeycomb, aggregate pockets or depressions will be rejected and the Developer/Contractor shall, at his own expense, remove the entire section containing such defects and replace it with acceptable concrete.
- O. Manhole or access steps shall be plastic, constructed of copolymer polypropylene meeting the requirements of ASTM D 2146 for Type II, Grade 16906 material. Step shall be reinforced with ASTM A 615, Grade 60, #4 deformed steel reinforcing bar, be 9" deep, 14" wide, provided with notched tread ridge, foot retainer lugs on each side of tread and penetration stops for press fit installation. Plastic steps shall be PS2-PF as manufactured by M.A. industries, Inc., Peachtree City, Georgia. Steps shall be installed by drilling 1" diameter holes, minimum 3-3/4 inches deep into the wall, and then driving steps into hole to the penetration stop, resulting in a press fit condition.
- P. Tank pressure relief valves shall be 6" diameter Neenah Foundry Company R-5001-1, American Valve & Hydrant B315.1, or equal, floor type, with outside hooks or inside self-contained lock;

quantity and spacing as shown on structural drawings. No part of pressure relief valves shall project above the neat line of the tank floor to prevent fouling of scraper mechanisms where used.

- Q. All existing contact surfaces with new patch shall be coated with moisture insensitive epoxy bonding adhesive, Sikadur Hi-Mod, Sonobond, or equal. Patch shall consist of base pour of 4,000 psi structural concrete, then a topping of non-shrink natural aggregate grout, Master Builders Masterflow 713, SonogROUT, or equal, mixed and placed in accordance with manufacturer's instructions, to the thicknesses shown on Drawings. Coat base pour with epoxy bonding adhesive prior to placing grout course.

END OF SECTION

SECTION 03400 - PRECAST CONCRETE

PART 1 - GENERAL

1.01 SCOPE OF WORK

Provide all labor, materials, equipment and services required to furnish and install all precast sections as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 03300 - Cast-in-Place Concrete:

1.03 SUBMITTALS

Shop drawings shall be submitted.

1.04 QUALITY ASSURANCE

- A. All precast concrete shall conform to all applicable provisions of "Section 03300 - Cast-in-Place Concrete."
- B. The following publications form a part of this Specification to the extent indicated by the reference thereto:
 - 1. ASTM C478.
 - 2. ASTM C 76.
 - 3. ASTM C850.

PART 2 - PRODUCTS

2.01 CIRCULAR PRECAST CONCRETE BARREL SECTIONS

- A. Circular precast concrete barrel section for wet wells, valve vaults or manholes shall conform to ASTM C 478 except sections deeper than 12 feet shall have reinforcing equal to that of ASTM C 76 Class III reinforced concrete pipe.
- B. AASHTO M-198-75 performed flexible butyl type joint sealant, Hamilton-Kent "Kent-Seal No. 2", K. T. Snyder Company "Rub'r-Nek", Press Seal Gasket "E-Z Stik," or equal; or joined with bituminous mastic joint sealing compound meeting Tennessee Department of Transportation Specifications. When making joints with mastic compound, prime and seal all joints with primer supplied with the joint compound. Joints shall be watertight. The outside surface of all below grade precast structures shall be coated with two (2) layers of bituminous coating applied at right angles to each other. Manholes shall be as specified in "02532 – Sanitary Sewer Manholes, Frames & Covers".

2.02 CONCRETE BASE AND TOP SLABS

- A. Reinforced concrete base and top slab shall be 4,000 psi concrete of the dimensions shown on the Drawings and conforming to the requirements of "Section 03300 – Cast-In-Place Concrete" hereinbefore.
- B. A precast concrete top slab may be used in lieu of the cast-in-place top slab shown on the Drawings. Reinforcing shall be equivalent to that shown on the Drawings. Access hatch and vent shall be cast in the top slab.

2.03 JOINT SEALERS

Joints shall be sealed with AASHTO M-198-75 performed flexible butyl type joint sealant, Hamilton-Kent "Kent-Seal No. 2", K. T. Snyder Company "Rub'r-Nek", Press Seal Gasket "E-Z Stik," or equal; or joined with bituminous mastic joint sealing compound meeting Tennessee Department of Transportation Specifications. When making joints with mastic compound, prime and seal all joints with primer supplied with the joint compound. Joints shall be watertight.

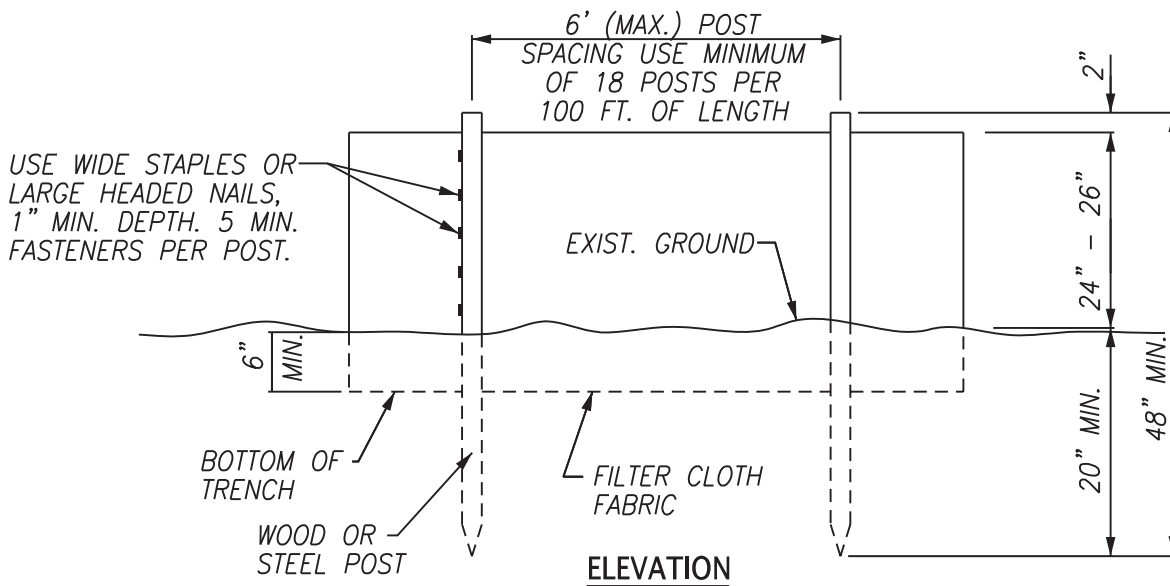
PART 3 - EXECUTION

3.01 JOINTS

- A. Joints shall be sealed with an approved sealant as specified in Part 2, and shall be mortared or grouted.
- B. When making joints with mastic compound, prime and seal all joints with primer supplied with the joint compound.
- C. Joints shall be watertight.

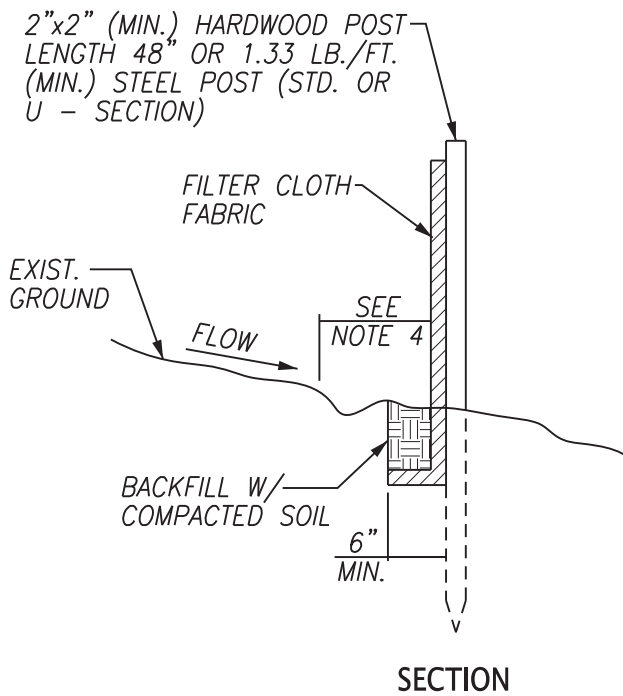
END OF SECTION

STANDARD WATER DETAILS



NOTES:

1. SILT FENCE SHALL BE PRE-ASSEMBLED AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS.
2. SILT FENCE SHALL HAVE AN APPROVED BACKING OR A BUILT-IN REINFORCED STRUCTURE AS RECOMMENDED BY THE MANUFACTURER TO SUPPORT THE GEOTEXTILE FABRIC.
3. ONCE PERMANENT VEGETATION IS ESTABLISHED, REMOVE THE SILT FENCE, BACKFILL TRENCH WITH TOPSOIL, AND APPLY SEED AND MULCH TO ALL DISTURBED AREAS. LEGALLY DISPOSE OF REMOVED FENCE OFF-SITE.
4. PLACE SILT FENCE AT LEAST 5 TO 7 FEET AWAY FROM STEEP OR LONG SLOPES TO IMPOUND STORMWATER RUNOFF.
5. POST SPACING SHALL BE 4 FEET MAXIMUM WITHIN A DRAINAGE CHANNEL.
6. TURN LAST 7 TO 10 FEET OF SILT FENCE UPHILL.



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APPROVED BY:	WKUD	DRAWN BY:	ARDURRA	Scale:	NTS
SILT FENCE				Date:	04/22/24
				DRAWING NUMBER:	G1

1/2" x 5" DIA
STEEL PLATE
DRILL FOR
PIPE SADDLE

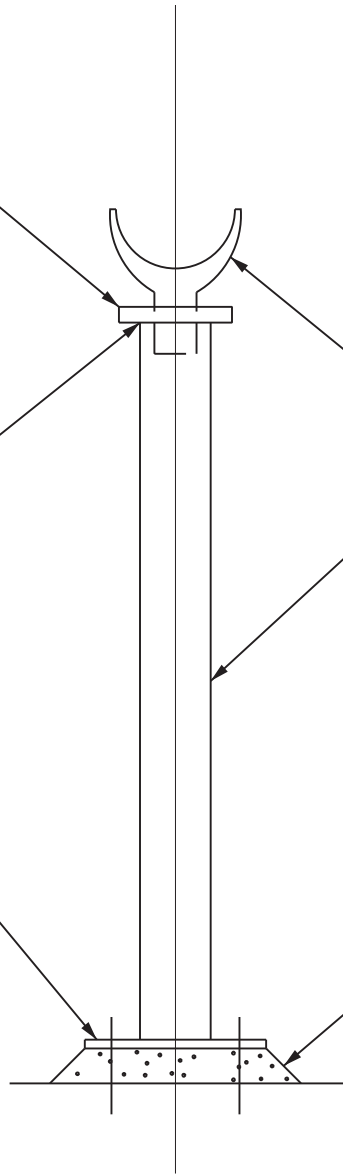
WELD

PIPE SADDLE, SELECT
TO FIT PIPE/FITTING
TO BE SUPPORTED

4" DIA STEEL PIPE
(ADJUST HEIGHT AS
REQUIRED- MAX. 3
FEET)

BASE PLATE
7"x7"x3/8"
W/(4) 3/4" DIA SS
EXPANSION BOLTS

1" GROUT (MIN)



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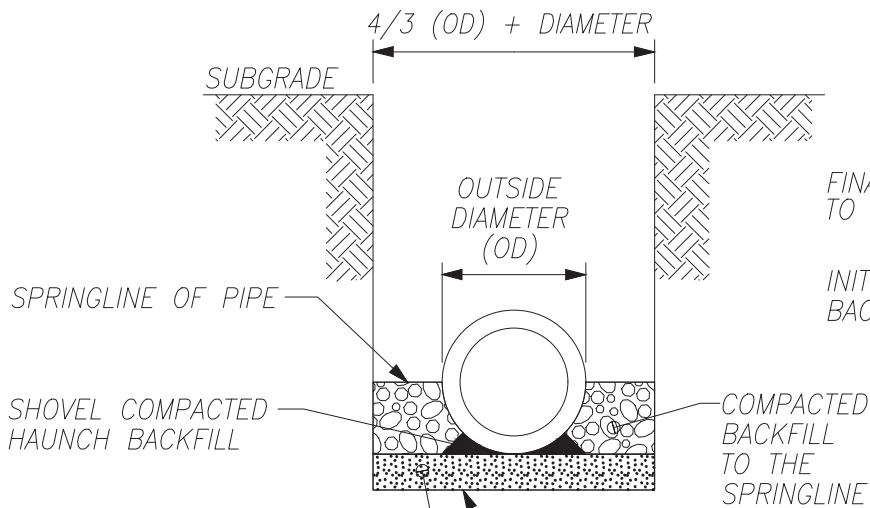
DRAWN BY: ARDURRA

Scale: NTS

PIPE SUPPORT DETAIL

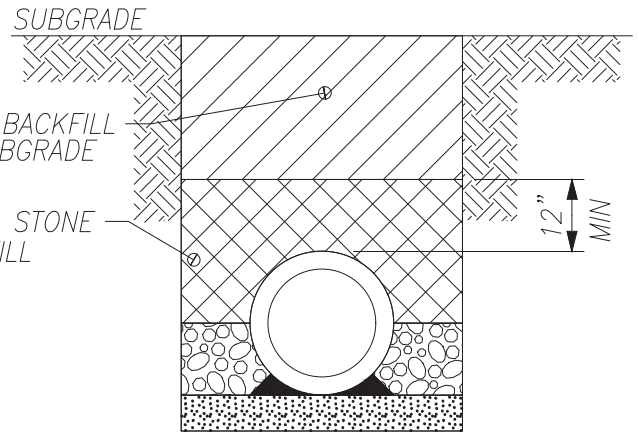
Date: 04/22/24

DRAWING NUMBER:
G2



COMPACTED BEDDING MATERIAL,
 4" DEEP FOR ≤15" DIAMETER
 6" DEEP FOR >15" & ≤36" DIAMETER
 8" DEEP FOR >36" DIAMETER

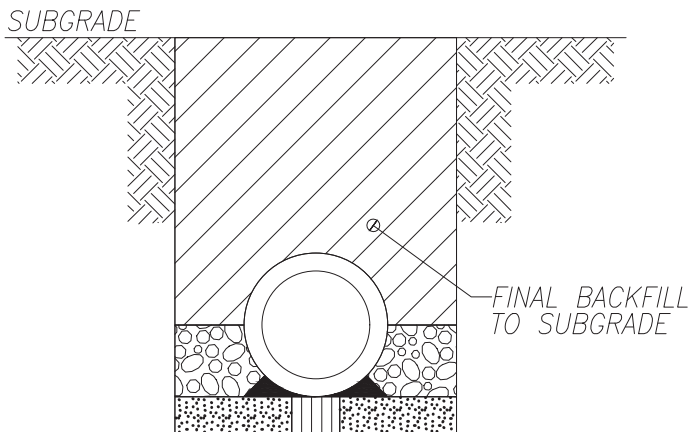
SMOOTH COMPACTED BOTTOM
 FREE OF LOOSE SOIL AND
 DEBRIS



BACKFILL FOR FLEXIBLE PIPE

NOTES:

1. TRENCH DESIGN AND SAFETY FOR PIPELINE CONSTRUCTION IS SOLELY THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL CONFORM WITH ALL APPLICABLE LOCAL, STATE, AND OSHA REGULATIONS.
2. BEDDING MATERIAL AND BACKFILL MATERIAL UP TO THE SPRINGLINE SHALL BE #57 OR #67 STONE.
3. REGARDLESS OF BACKFILL MATERIAL OR PIPE MATERIAL, PLACE BACKFILL IN 8" LOOSE LIFTS AND COMPACT STONE TO 100% OF THE STANDARD PROCTOR DENSITY AT 2% LESS THAN THE OPTIMUM MOISTURE CONTENT AS DETERMINED BY AASHTO T99 METHOD D. INITIAL BACKFILL SHALL BE #57 OR #67 STONE.
4. FINAL BACKFILL SHALL BE #57 OR #67 STONE UNDER PAVEMENTS & WITHIN 3' OF PAVEMENT.
5. FINAL BACKFILL BEYOND 3' OF PAVEMENT SHALL BE STRUCTURAL SOIL BACKFILL.

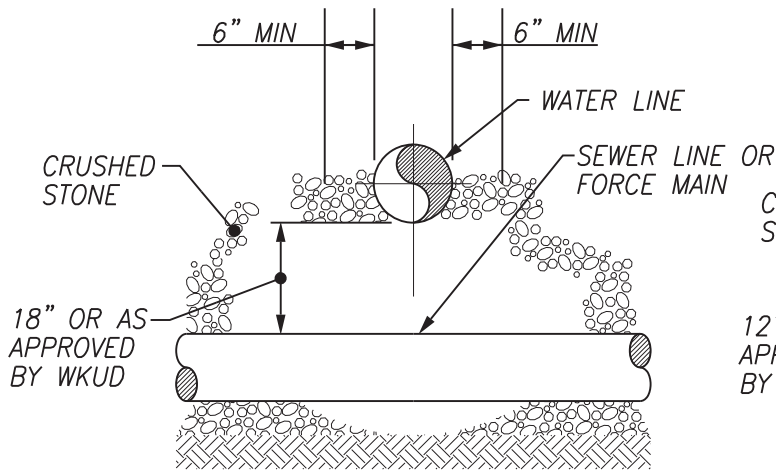


BACKFILL FOR RIGID PIPE

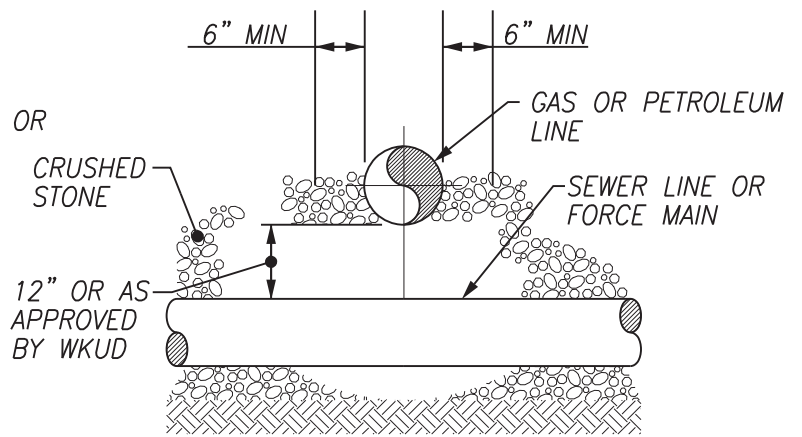


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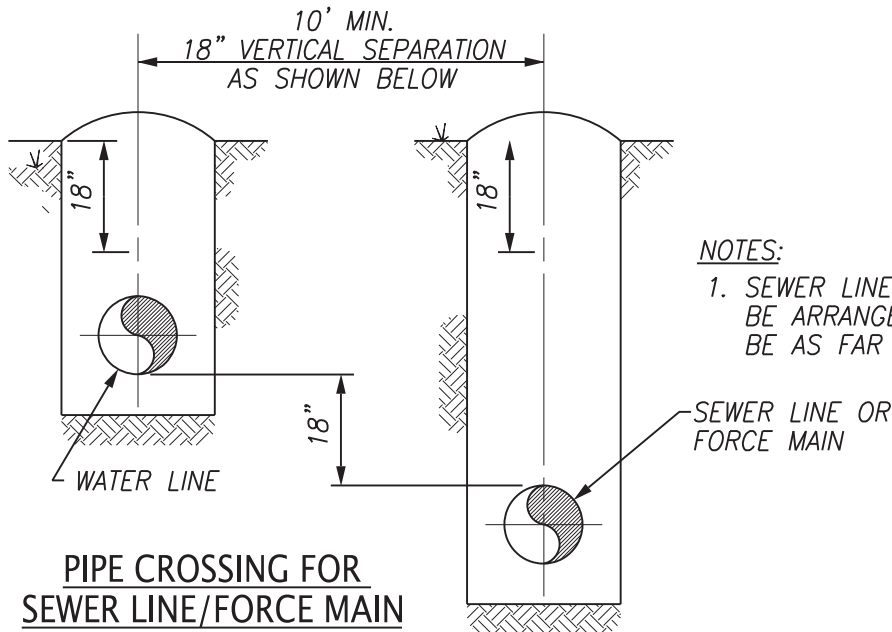
APPROVED BY: WKUD	DRAWN BY: ARDURRA	Scale: NTS
PIPE BEDDING AND BACKFILL		Date: 04/22/24
		DRAWING NUMBER: G:3



**SEWER LINE/FORCE MAIN
UNDER WATER LINE**



**SEWER LINE/FORCE MAIN UNDER
GAS TRANSMISSION LINE**



**PIPE CROSSING FOR
SEWER LINE/FORCE MAIN**

NOTES:

1. SEWER LINES AT WATER MAIN CROSSING SHALL BE ARRANGED SO THAT THE SEWER JOINTS WILL BE AS FAR AS POSSIBLE FROM WATER MAIN JOINTS



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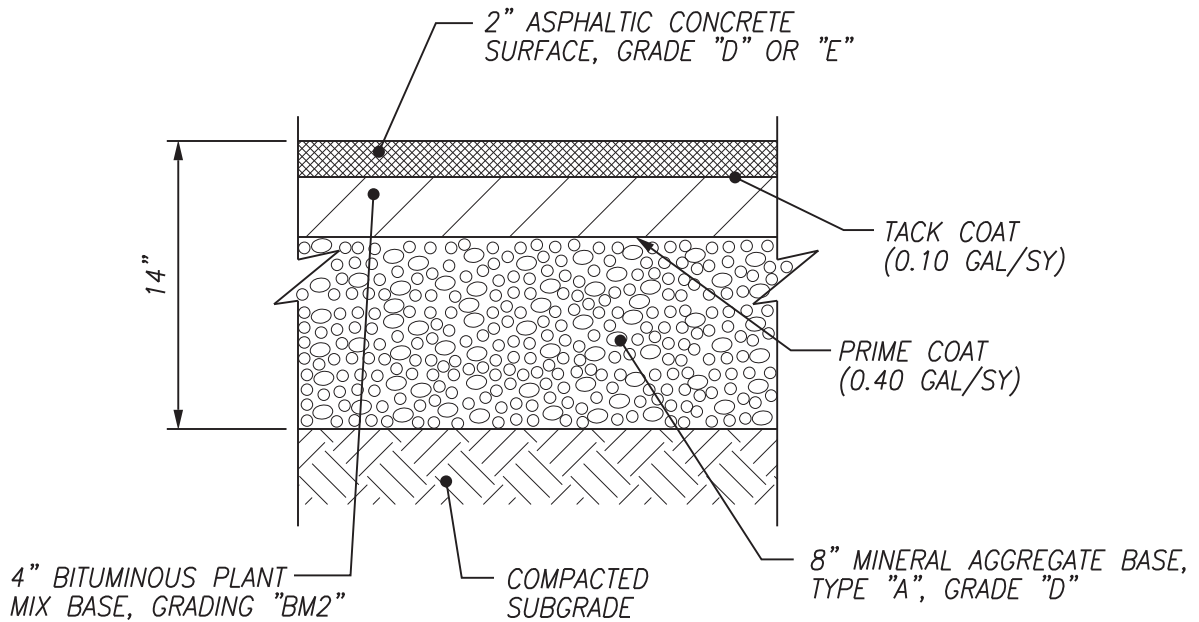
DRAWN BY: ARDURRA

Scale: NTS

PIPE SEPARATION

Date: 04/22/24

DRAWING NUMBER:
G4



NOTES:

1. PAVEMENT HAS NOT BEEN DESIGNED FOR CONSTRUCTION TRAFFIC/ACTIVITIES. USE OF THESE SURFACES FOR CONSTRUCTION ACTIVITIES SHALL BE DONE AT THE CONTRACTOR'S CONVENIENCE AND RISK. DAMAGE TO PAVEMENT RESULTING FROM THESE ACTIVITIES SHALL BE REPAIRED IN CONFORMANCE WITH THE INITIAL PAVEMENT SPECIFICATIONS.



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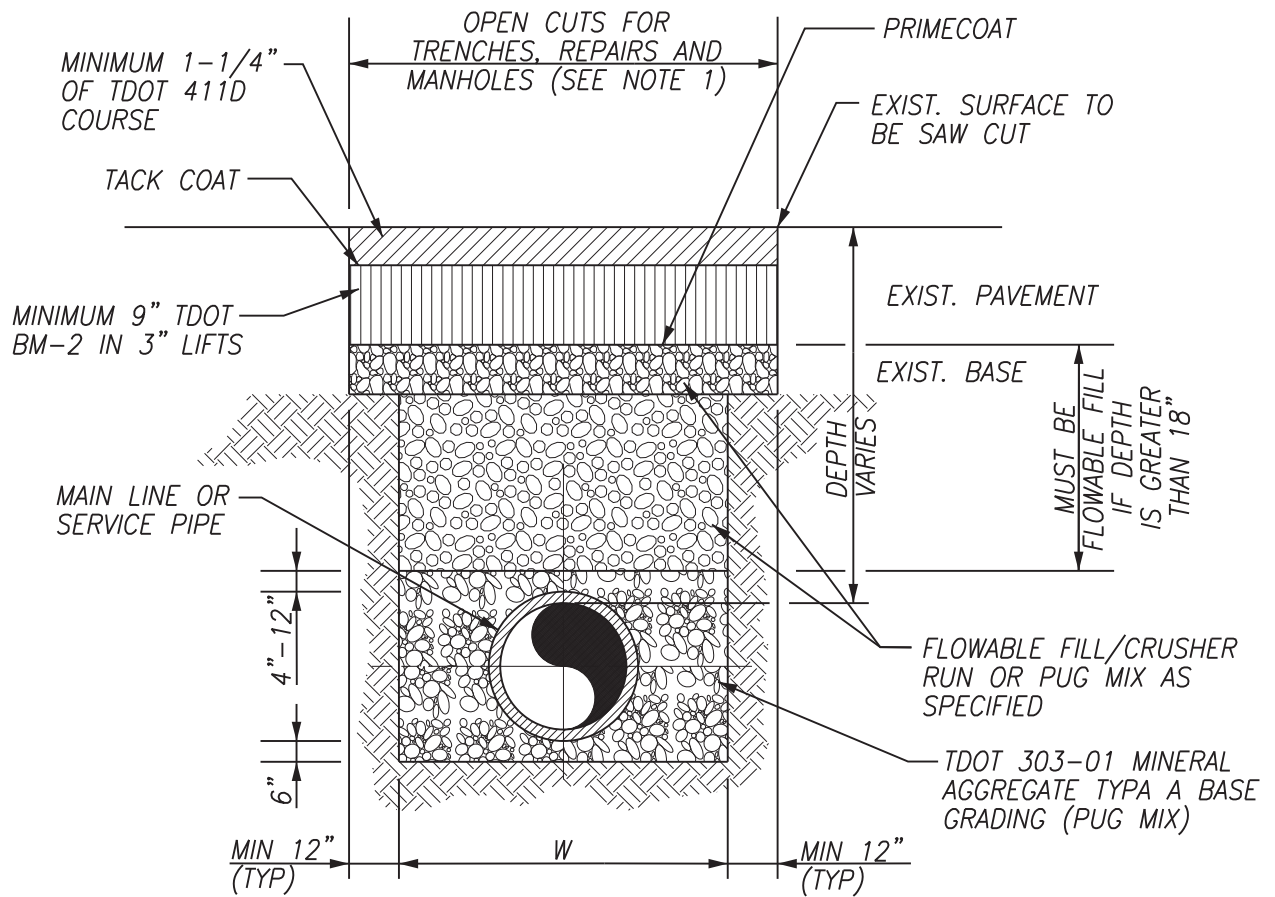
DRAWN BY: ARDURRA

Scale: NTS

ASPHALT PAVEMENT SECTION
(KNOX COUNTY ROADWAYS)

Date: 04/22/24

DRAWING NUMBER:
G5



NOTES:

1. AT THE DISCRETION OF THE OWNER, WHEN TRENCH PARALLELS CENTERLINE OF ROADWAY AND WIDTH IS EQUAL TO OR GREATER THAN HALF THE LANE WIDTH, THEN THE PAVEMENT WIDTH FOR THE SURFACE COURSE SHALL BE FOR AN OVERLAY OF THE ROADWAY ENTIRE LANE WIDTH.
2. PAVEMENT REPAIRS/REPLACEMENT SHALL BE THERMALLY BONDED WITH THE EXISTING ASPHALT EDGES.
3. EDGE TO BE SAWED WTH CONCRETE SAW TO A NEAT SQUARED EDGE. BROOM CLEANED BEFORE TACK COAT APPLIED.
4. EDGES TO BE TACKED WITH CRS-1 OR CRS-2.
5. CONTRACTOR/UTILITY RESPONSIBLE FOR REPLACEMENT OF ANY PAVEMENT MARKINGS DISTURBED OR COVERED BY OVERLAY.
6. TO BE REPAIRED IN ACCORDANCE WITH TDOT RULES AND REGULATIONS FOR ACCOMMODATING UTILITIES WITHIN HIGHWAY RIGHTS-OF-WAY, APPENDIX 8.



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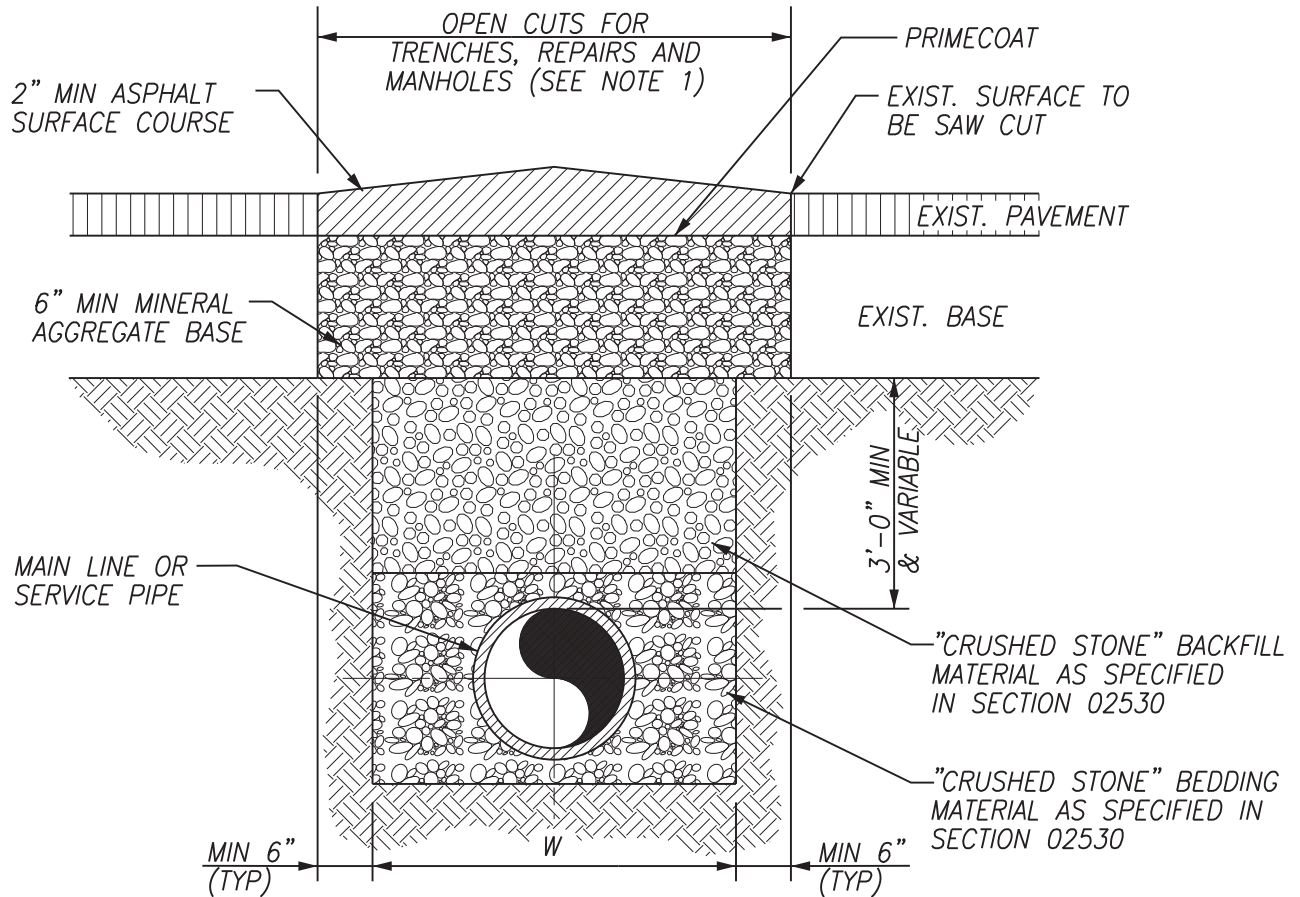
DRAWN BY: ARDURRA

Scale: NTS

**TYPICAL ASPHALT PAVEMENT
 REPLACEMENT TYPE "I"
 STATE HIGHWAYS**

Date: 04/22/24

DRAWING NUMBER:
G6.1



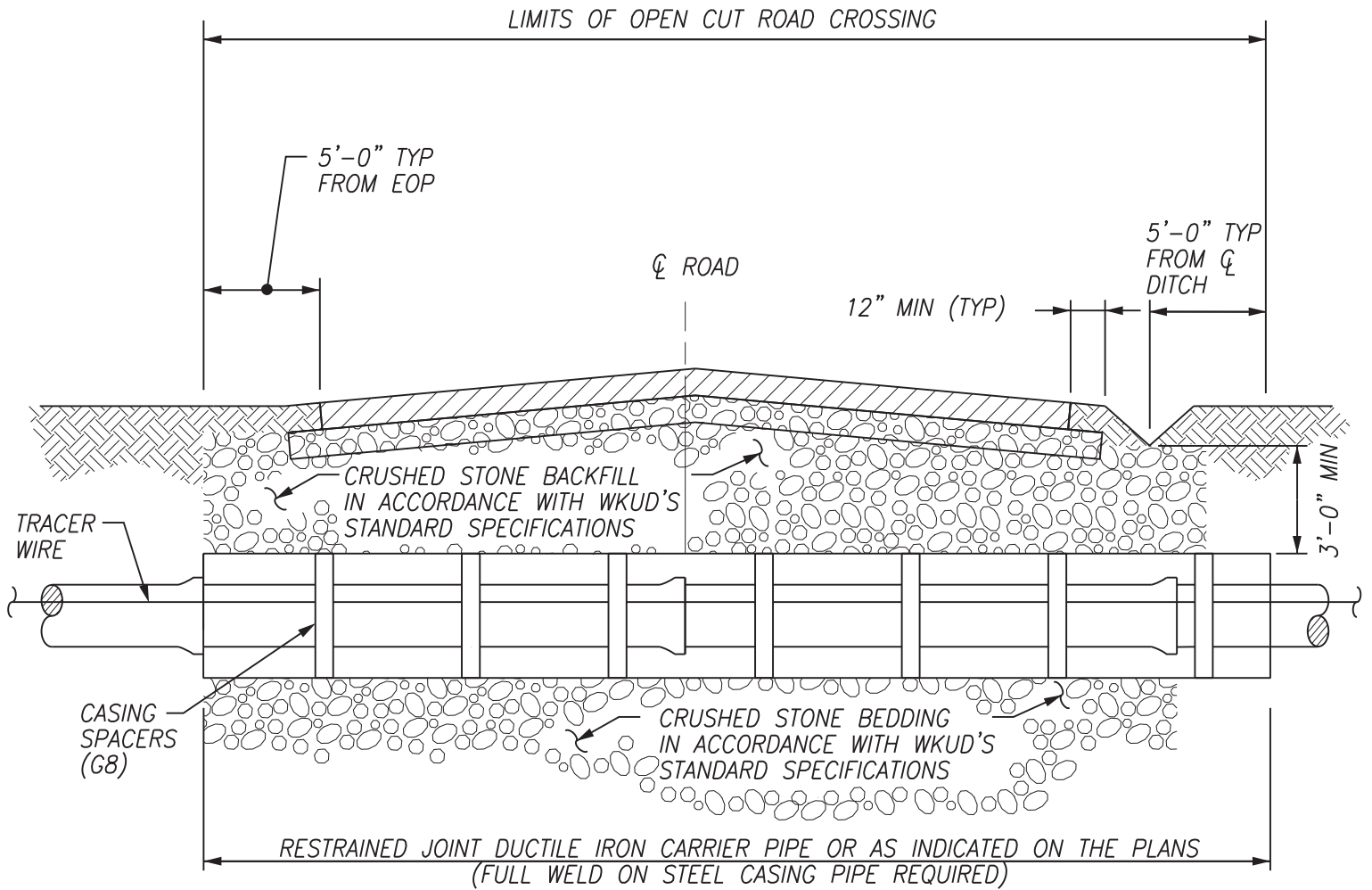
NOTES:

1. AT THE DISCRETION OF THE OWNER, WHEN TRENCH PARALLELS CENTERLINE OF ROADWAY AND WIDTH IS EQUAL TO OR GREATER THAN HALF THE LANE OR ROADWIDTH WIDTH, THEN THE PAVEMENT WIDTH SHALL BE FOR AN OVERLAY OF THE ENTIRE LANE OR ROADWAY WIDTH.
2. PAVEMENT REPAIRS/REPLACEMENT SHALL BE THERMALLY BONDED WITH THE EXISTING ASPHALT EDGES.



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TYPICAL ASPHALT PAVEMENT REPLACEMENT TYPE "II" OPEN CUT PARKING AREAS & DRIVEWAY CROSSING		Date: 04/22/24
		DRAWING NUMBER: G6.2



SECTION

NOTES:

1. ALL PIPING WITHIN THE LIMITS OF THE OPEN CUT ROAD CROSSING SHALL BE DIP TO MATCH THE SIZE OF PIPING SHOWN ON THE PLANS.



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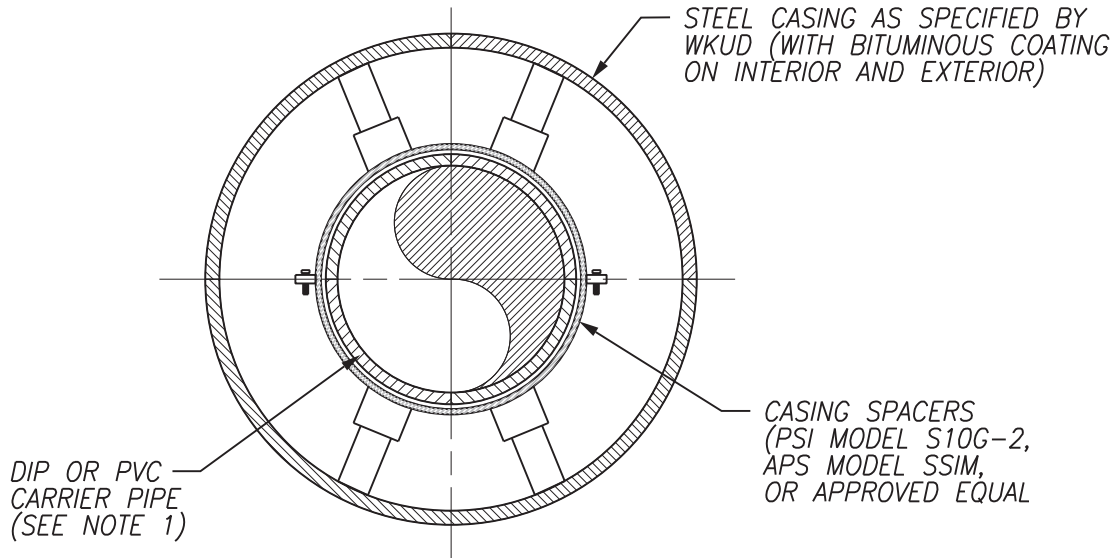
Scale: NTS

**TYPICAL OPEN CUT
ROAD CROSSING**

Date: 04/22/24

DRAWING NUMBER:

G7



NOTES:

1. CARRIER PIPE SHALL BE CLASS 350 DUCTILE IRON PIPE (WATER) OR RJB CERTA-LOK DR18 PRESSURE PIPE (235 PSI) (SEWER).
2. INSTALL CASING SPACERS IN STRICT COMPLIANCE WITH THE WRITTEN MANUFACTURER'S INSTRUCTIONS.
3. PROVIDE CASING END SEALS IN ACCORDANCE WITH WKUD REQUIREMENTS.
4. CONTRACTOR TO CONFIRM THAT ALL CASING SPACERS WILL FIT INSIDE OF SPECIFIED STEEL CASING AS SHOWN ON THE PLANS PRIOR TO ORDERING MATERIALS.
5. TRACER WIRE SHALL BE INSTALLED WITH CASING PIPE.
6. SPACERS SHALL BE SPACED EVENLY AT NO GREATER THAN 6 FEET APART
7. ENDS OF CASING PIPES MUST BE FULLY ROUND TO ALLOW CONTINUOUS WELDS FOR SMOOTH INSTALLATION OF CASING SPACERS.

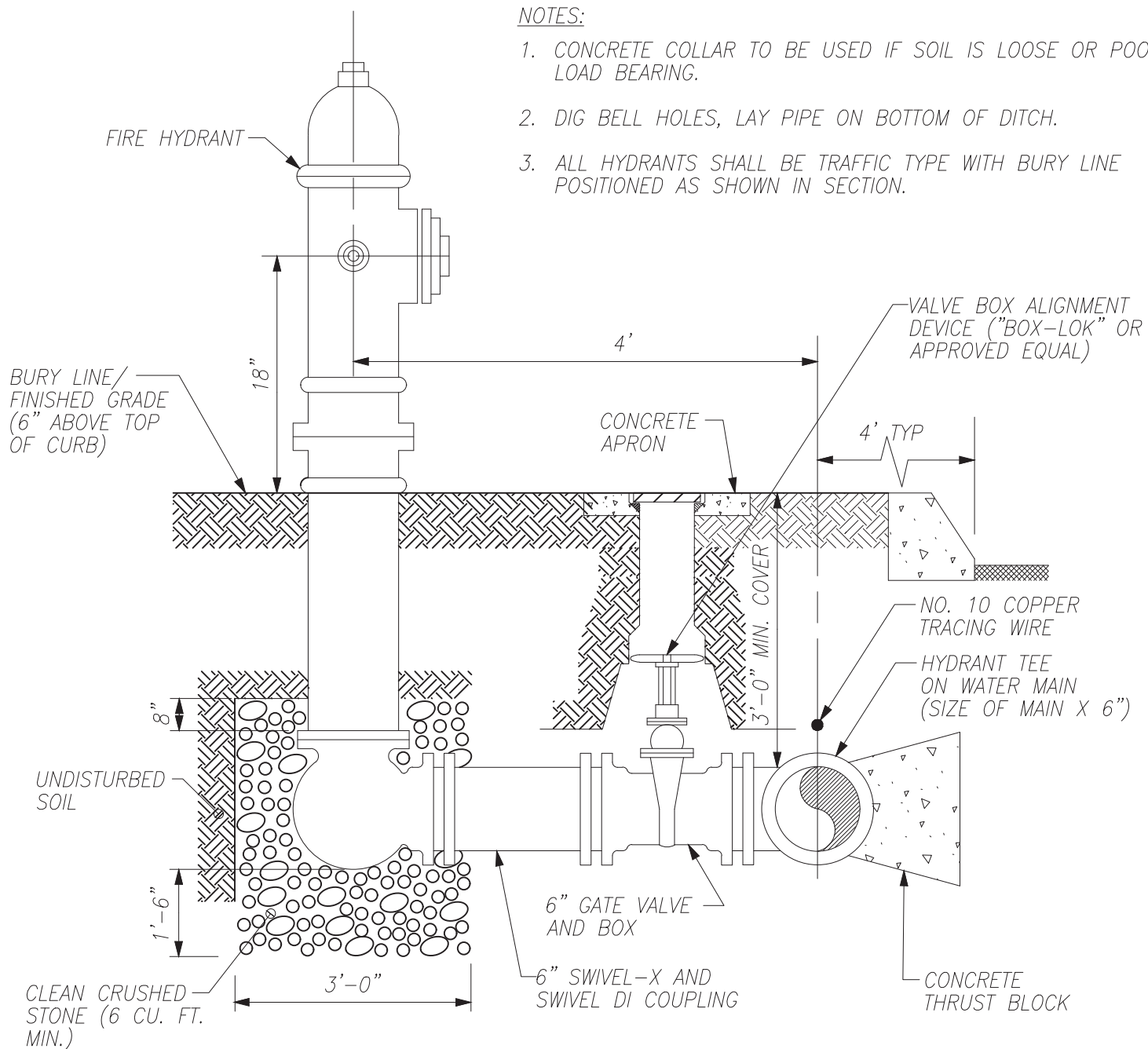


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APPROVED BY:	WKUD	DRAWN BY:	ARDURRA	Scale:	NTS
CASING AND SPACER DETAIL				Date:	04/22/24
				DRAWING NUMBER:	G8

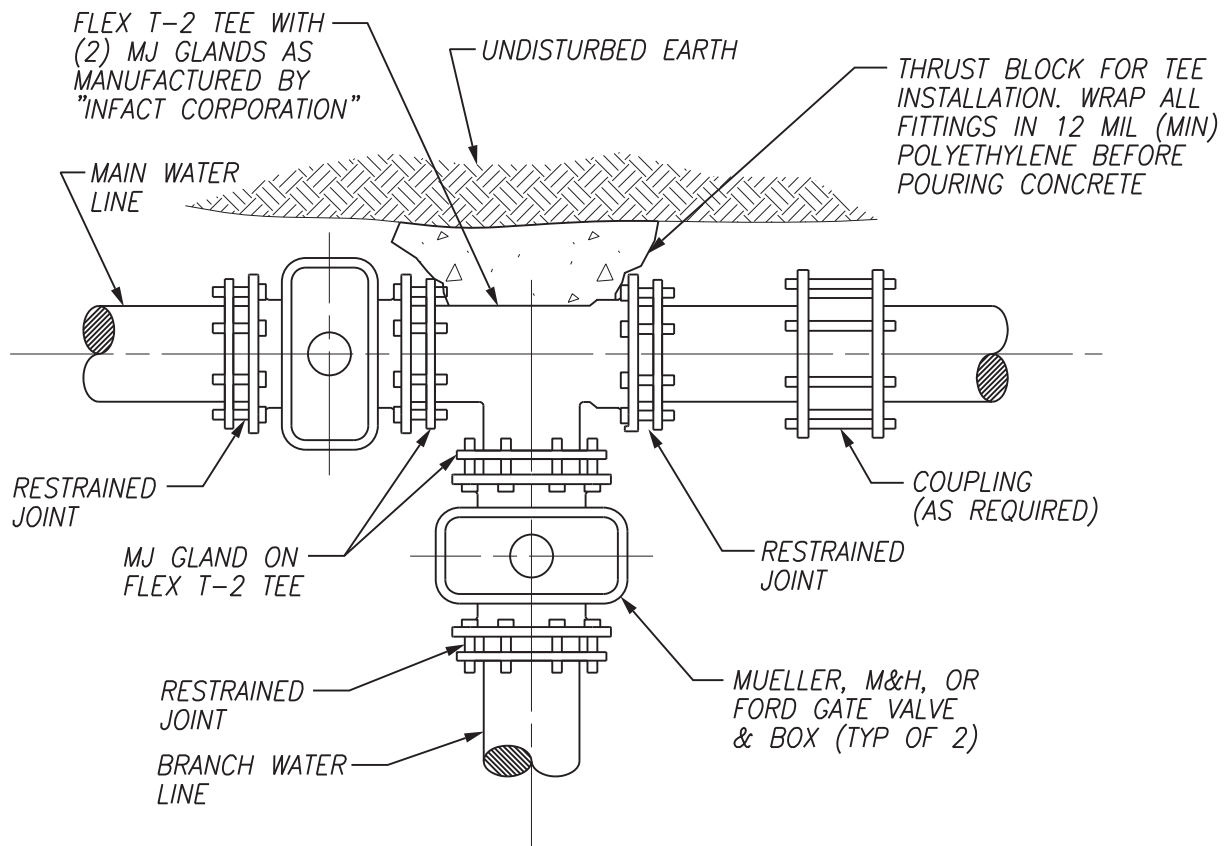
NOTES:

1. CONCRETE COLLAR TO BE USED IF SOIL IS LOOSE OR POOR LOAD BEARING.
2. DIG BELL HOLES, LAY PIPE ON BOTTOM OF DITCH.
3. ALL HYDRANTS SHALL BE TRAFFIC TYPE WITH BURY LINE POSITIONED AS SHOWN IN SECTION.



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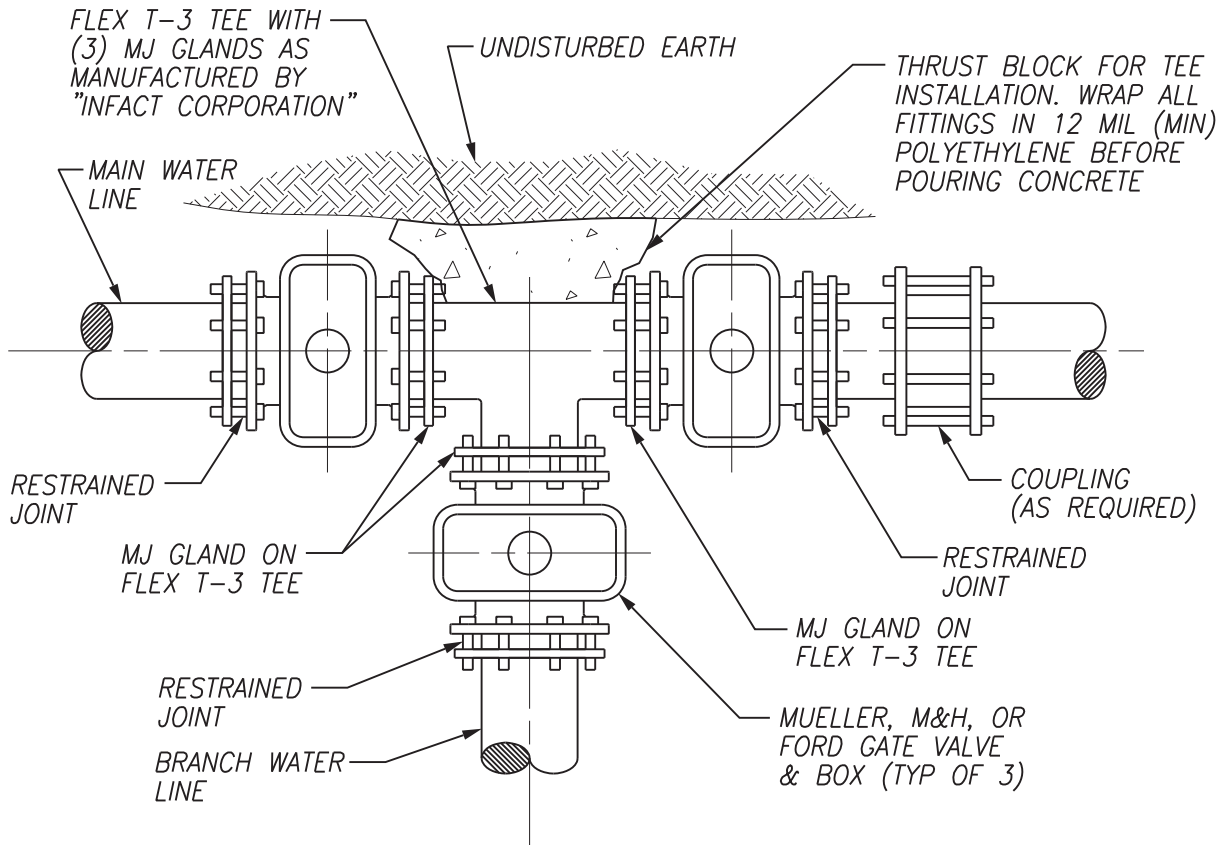
APPROVED BY: WKUD	DRAWN BY: ARDURRA	Scale: NTS
TYPICAL HYDRANT ASSEMBLY		Date: 04/22/24
		DRAWING NUMBER: W1



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APPROVED BY:	WKUD	DRAWN BY:	ARDURRA	Scale:	NTS
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TR-2 FLEX (GATE VALVE CLUSTER)	Date:	04/22/24
	DRAWING NUMBER:	W2.1



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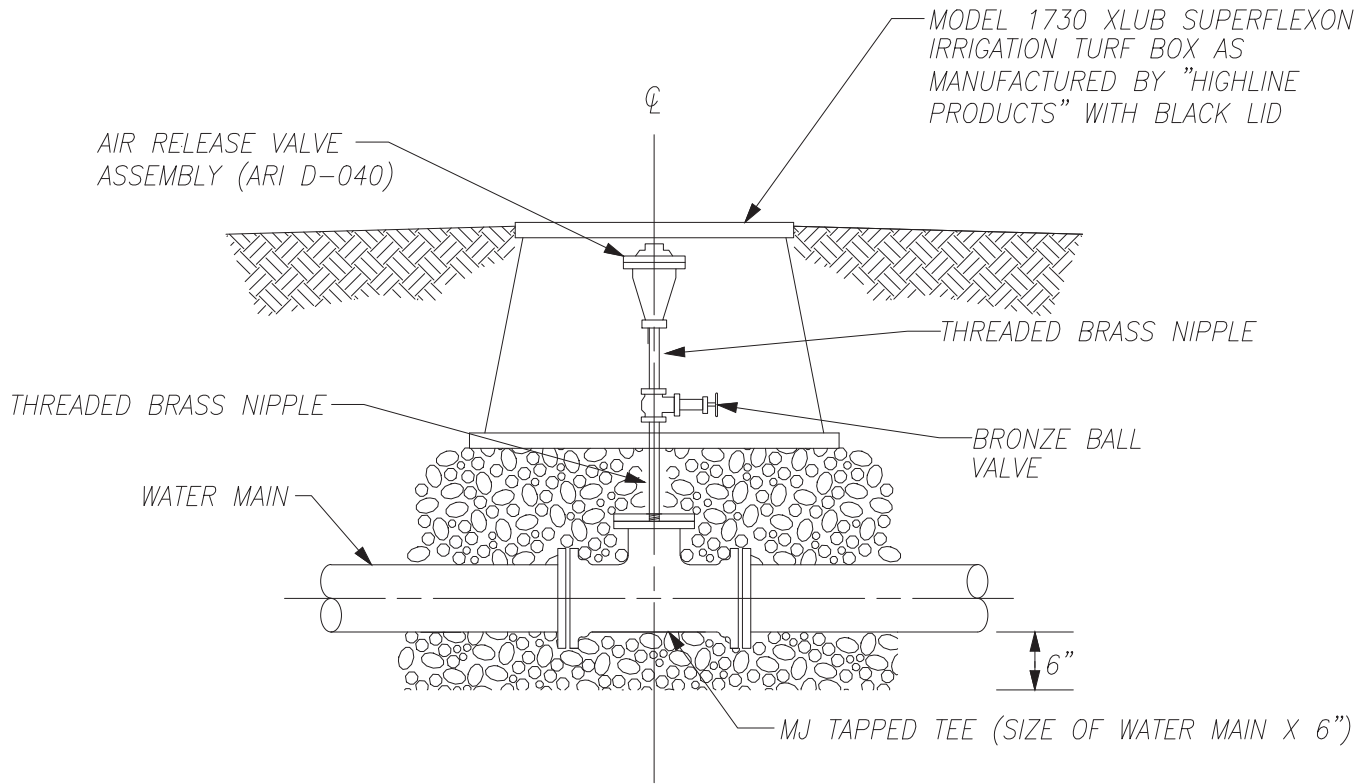
DRAWN BY: ARDURRA

Scale: NTS

**TR-3 FLEX (GATE
 VALVE CLUSTER)**

Date: 04/22/24

DRAWING NUMBER:
W2.2



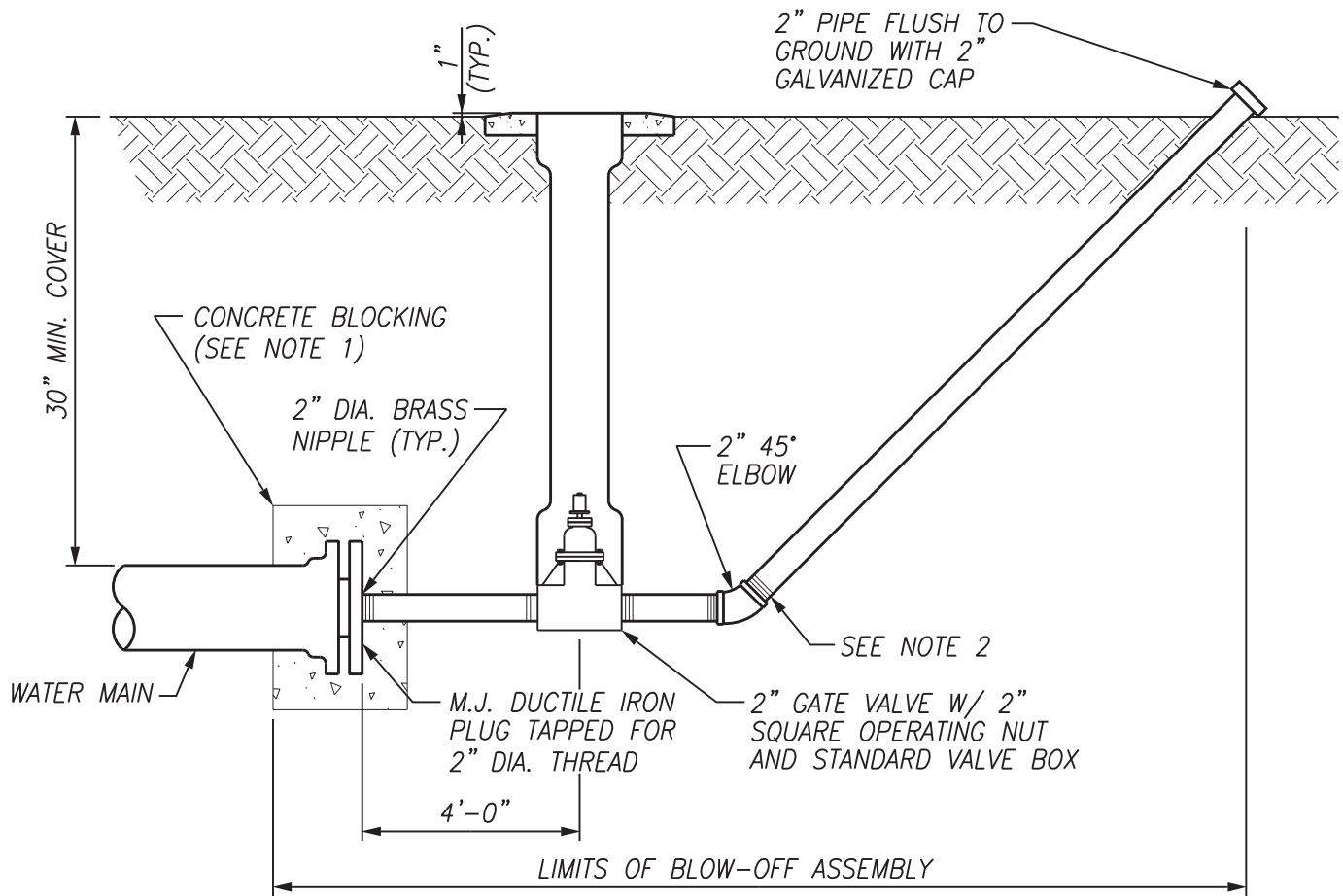
NOTES:

1. AIR RELEASE VALVES SHALL BE INSTALLED AT ALL HIGH POINTS ON WATER MAINS.
2. USE FOR $\frac{3}{4}$ ", 1", AND 2" AIR RELEASE VALVE INSTALLATIONS.



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AIR RELEASE VALVE ASSEMBLY		Date: 04/22/24
		DRAWING NUMBER: W3



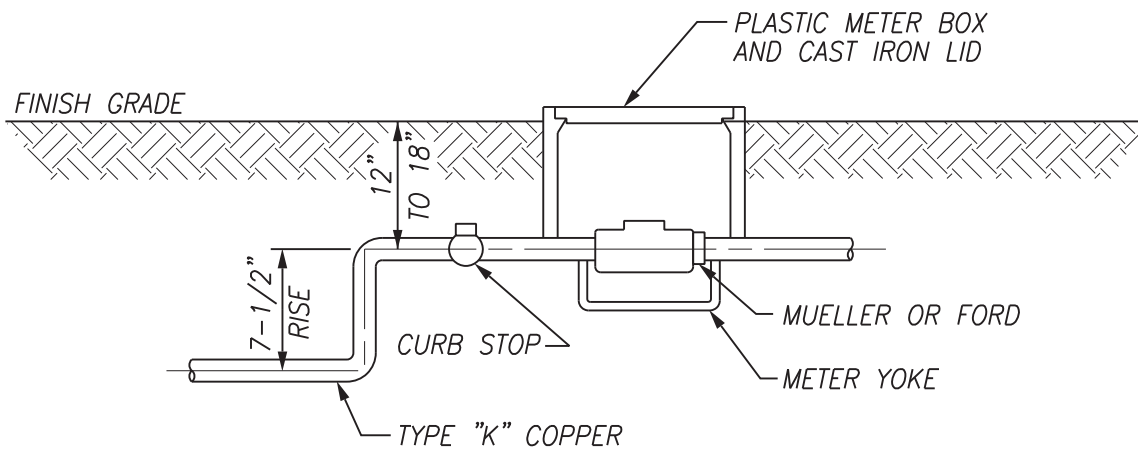
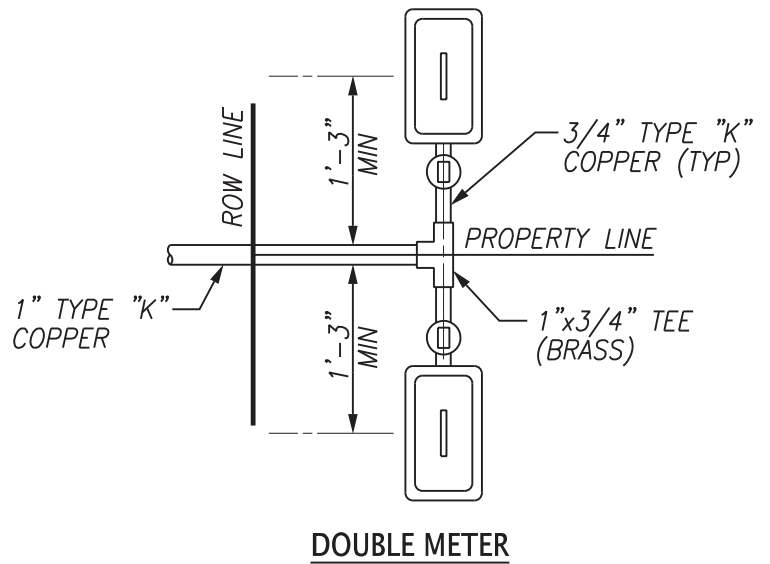
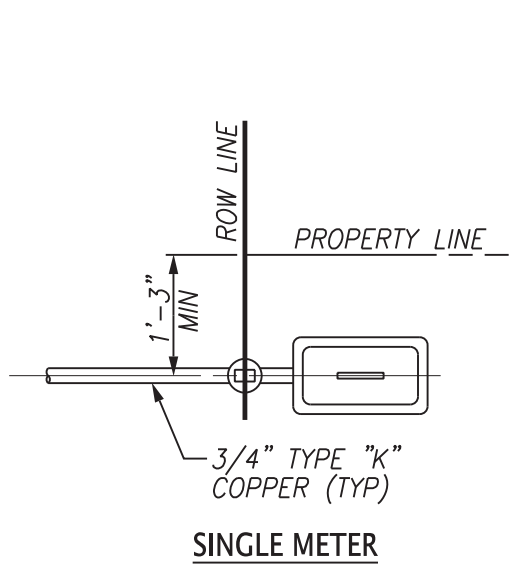
NOTES:

1. CONCRETE BLOCKING AT WATER MAIN PLUG FOR BLOW-OFF PIPE CONNECTION SHALL BE A MINIMUM OF 1'-6" THICK AND BE CUT A MINIMUM OF 1'-0" INTO UNDISTURBED SOIL ON EACH SIDE AND BELOW THE PIPE TRENCH.
2. ALL THREADED PIPE SHALL BE JOINTED USING RECTORSEAL. ALL EXPOSED THREADS AND ALL GALVANIZED IRON PIPE SHALL BE CLEANED OF ALL GREASE, OIL, DEBRIS & OTHER SOILING AND SHALL RECEIVE A HEAVY COAT OF COAL-TAR EPOXY COATING PRIOR TO BACKFILLING.



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APPROVED BY: WKUD	DRAWN BY: ARDURRA	Scale: NTS
BLOW-OFF ASSEMBLY		Date: 04/22/24
		DRAWING NUMBER: W4



NOTES:

1. CONTRACTOR TO COORDINATE FIELD LOCATION OF PROPOSED WATER METERS WITH WKUD.
2. CONTRACTOR RESPONSIBLE FOR RE-CONNECTING TO EXISTING WATER SERVICE LINE.
3. USE ROLLED COPPER FOR SERVICE LINE DIRECTION CHANGES (NO FITTINGS FOR BENDS).



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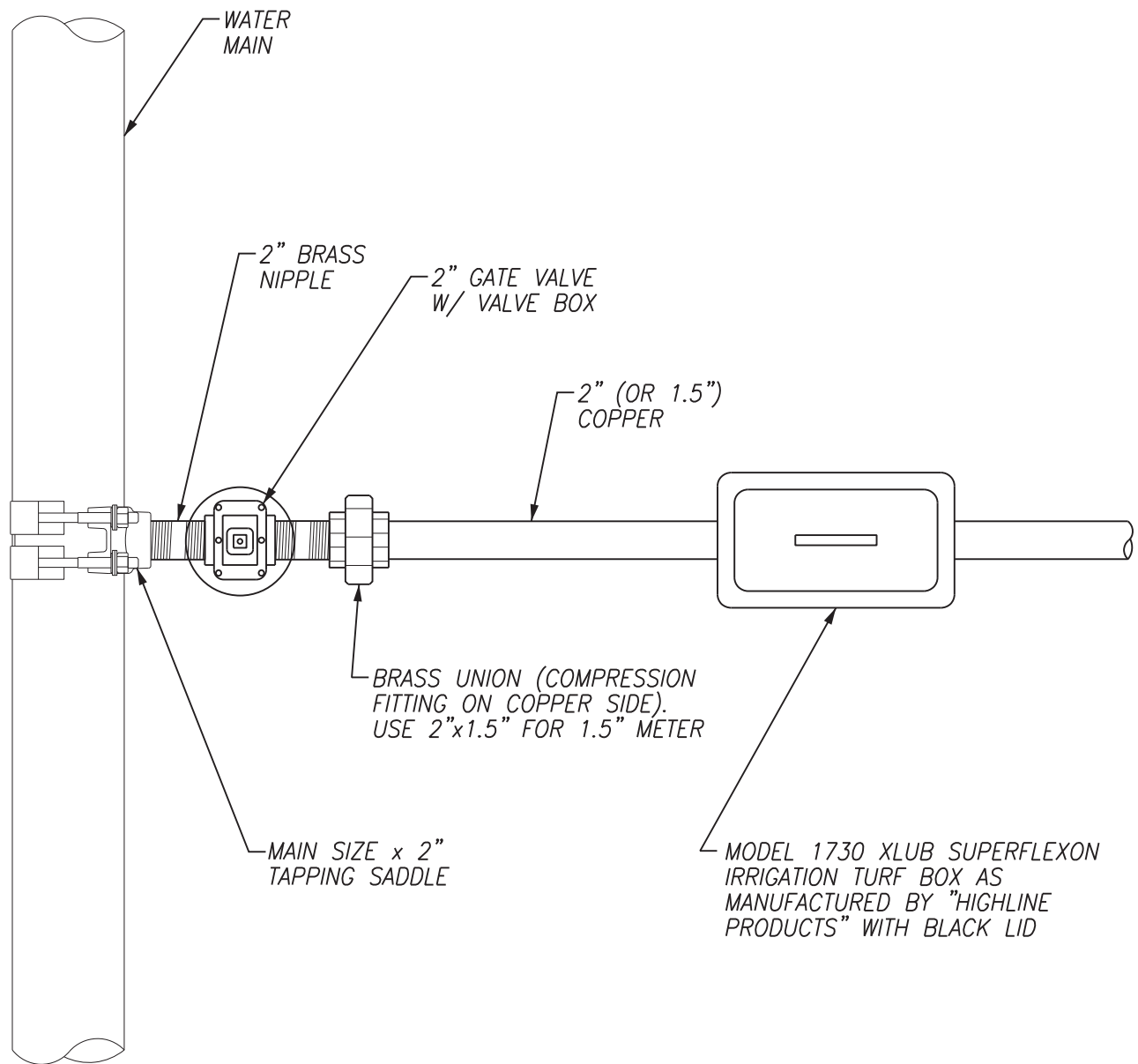
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Scale: NTS

**TYPICAL 3/4" METER
 SETTING DETAIL**

Date: 04/22/24

DRAWING NUMBER:
W5.1



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Scale: NTS

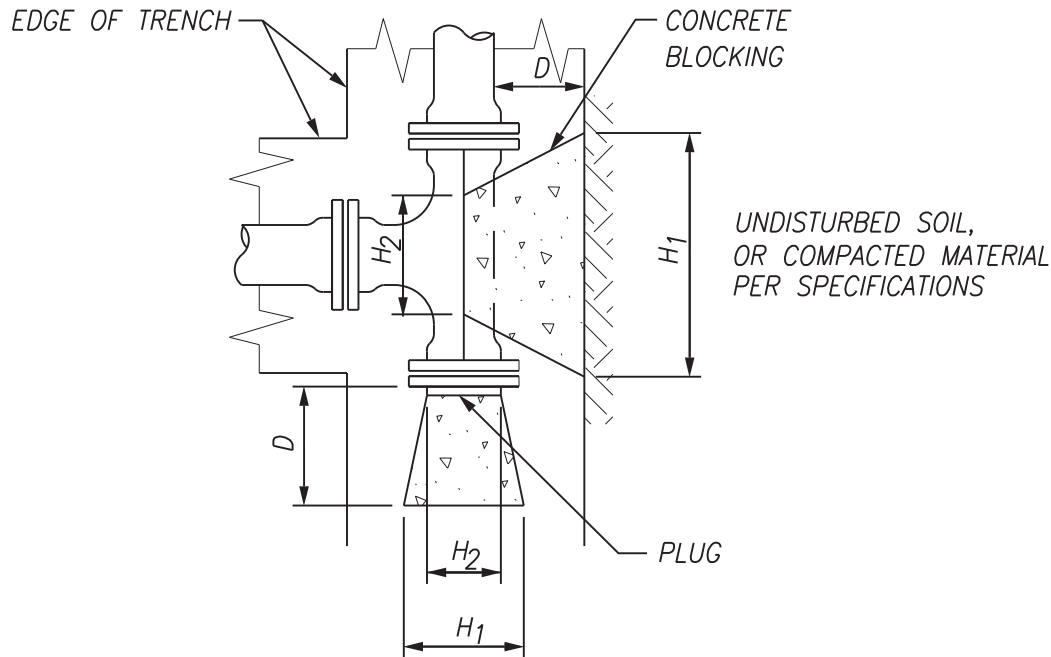
**TYPICAL 2" AND 1.5" METER
 SETTING DETAIL**

Date: 04/22/24

DRAWING NUMBER:
W5.2

TABLE OF DIMENSIONS FOR CONCRETE BLOCKING

SIZE PIPE (INCHES)	TEES, PLUGS, AND CROSSES				
	H ₁	H ₂	V	D	CU FT.
2&2-1/4	18	10	12	18	1.9
3 & 4	24	12	12	18	2.3
6	24	16	18	18	3.5
8	36	18	18	18	5.1
10	48	24	18	24	7.2
12	54	30	24	24	13.4



NOTES:

1. THRUST BLOCKING BASED UPON AN INTERNAL HYDROSTATIC PRESSURE OF 200 PSI AND AN ALLOWABLE SOIL BEARING CAPACITY OF 4000 POUNDS/SQUARE FOOT. SHOULD HYDROSTATIC PRESSURE BE GREATER AND/OR SOIL BEARING CAPACITY SHOULD BE LESS THAN THAT NOTED ABOVE, CONTRACTOR SHALL INCREASE SIZE AS REQUIRED AND PROVIDE CALCULATIONS TO SUPPORT SAID MODIFICATION.
2. WKUD SHALL APPROVE ALL THRUST BLOCKS.
3. WRAP ALL FITTINGS AND PIPE IN PLASTIC PRIOR TO PLACING CONCRETE.



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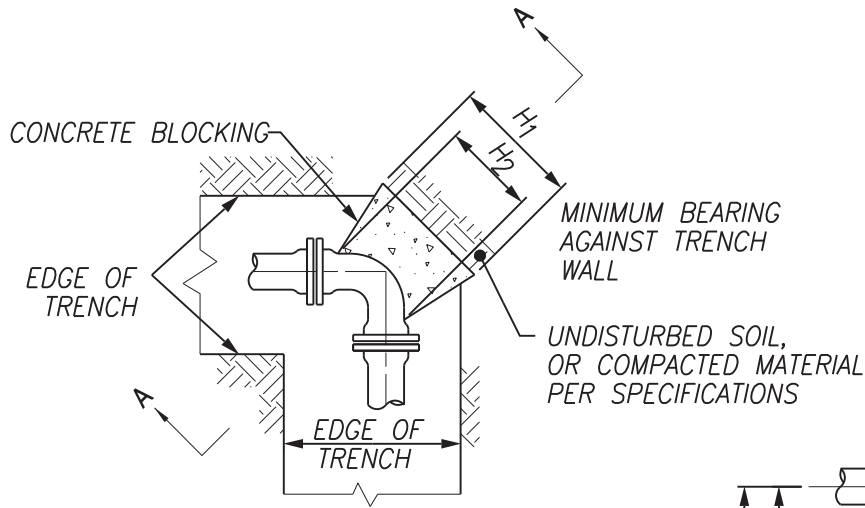
**TYPICAL THRUST BLOCKS
FOR TEES, PLUGS, AND CROSSES**

Date: 04/22/24

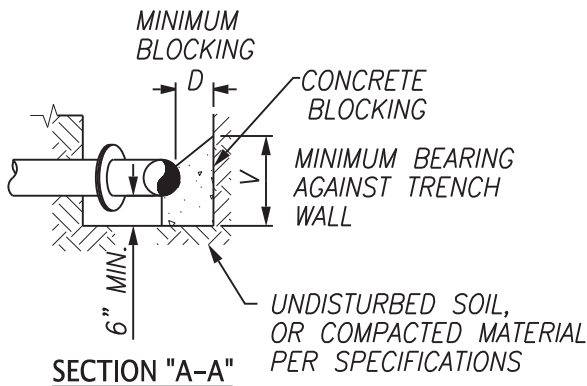
DRAWING NUMBER:
W6.1

TABLE OF DIMENSIONS FOR CONCRETE BLOCKING

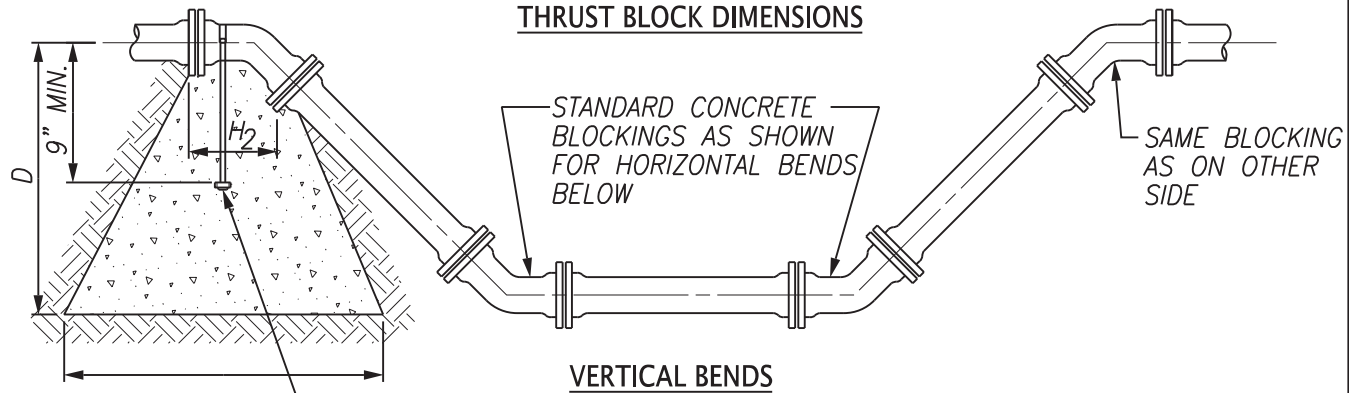
SIZE PIPE (INCHES)	90° BENDS					45° BENDS					22 1/2° BENDS					11 1/4° BENDS					SIZE PIPE
	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	
2&2-1/4	18	10	12	18	1.9	18	6	12	18	1.5	18	6	12	18	1.5	18	6	12	18	1.5	2&2-1/4
3 & 4	24	12	12	18	2.3	18	8	12	18	1.6	18	8	12	18	1.6	18	8	12	18	1.6	3 & 4
6	30	16	18	18	4.1	24	10	16	18	3.2	24	10	16	18	3.2	24	10	16	18	3.2	6
8	39	18	24	18	7.3	30	11	18	18	4.0	24	11	18	18	3.5	24	11	16	18	3.4	8
10	54	32	24	18	10.3	24	18	21	18	4.6	24	18	21	18	4.6	24	18	21	18	4.6	10
12	54	32	36	24	18.2	42	18	24	24	9.6	24	18	24	24	6.6	24	18	21	24	6.1	12



HORIZONTAL BENDS



SECTION "A-A"



3/4" THREADED ROD
W/HEX NUTS
AND 4"x4"x1/4"
PLATE WASHER

NOTES:

- THRUST BLOCKING BASED UPON AN INTERNAL HYDROSTATIC PRESSURE OF 200 PSI AND AN ALLOWABLE SOIL BEARING CAPACITY OF 4000 POUNDS/SQUARE FOOT. SHOULD HYDROSTATIC PRESSURE BE GREATER AND/OR SOIL BEARING CAPACITY SHOULD BE LESS THAN THAT NOTED ABOVE, CONTRACTOR SHALL INCREASE SIZE AS REQUIRED AND PROVIDE CALCULATIONS TO SUPPORT SAID MODIFICATION.
- WKUD SHALL APPROVE ALL THRUST BLOCKS.
- WRAP ALL FITTINGS AND PIPE IN PLASTIC PRIOR TO PLACING CONCRETE.



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KNOXVILLE, TN 37932
TELEPHONE 865.690.2521

APPROVED BY: WKUD

DRAWN BY: ARDURRA

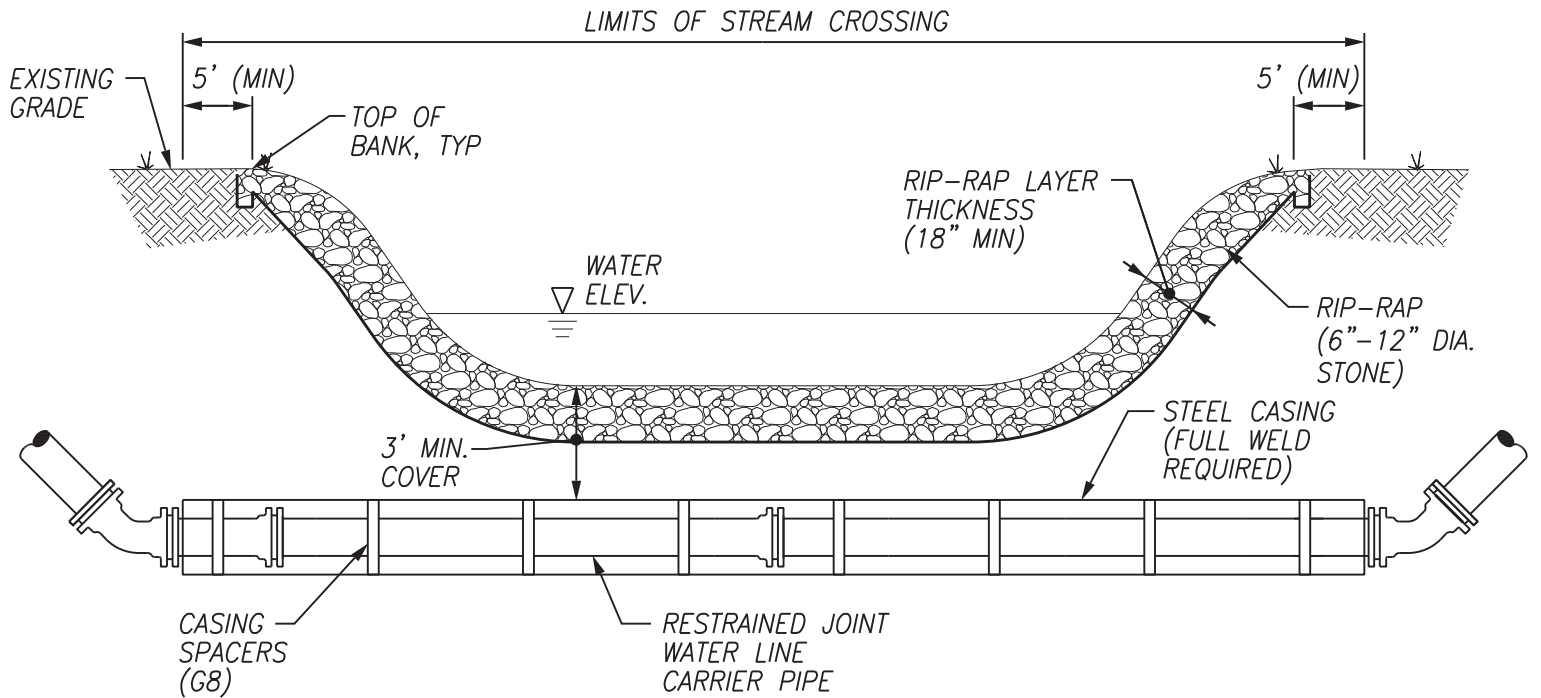
Scale: NTS

Date: 04/22/24

THRUST BLOCK AND ANCHOR BLOCK FOR BENDS

DRAWING NUMBER:

W6.2



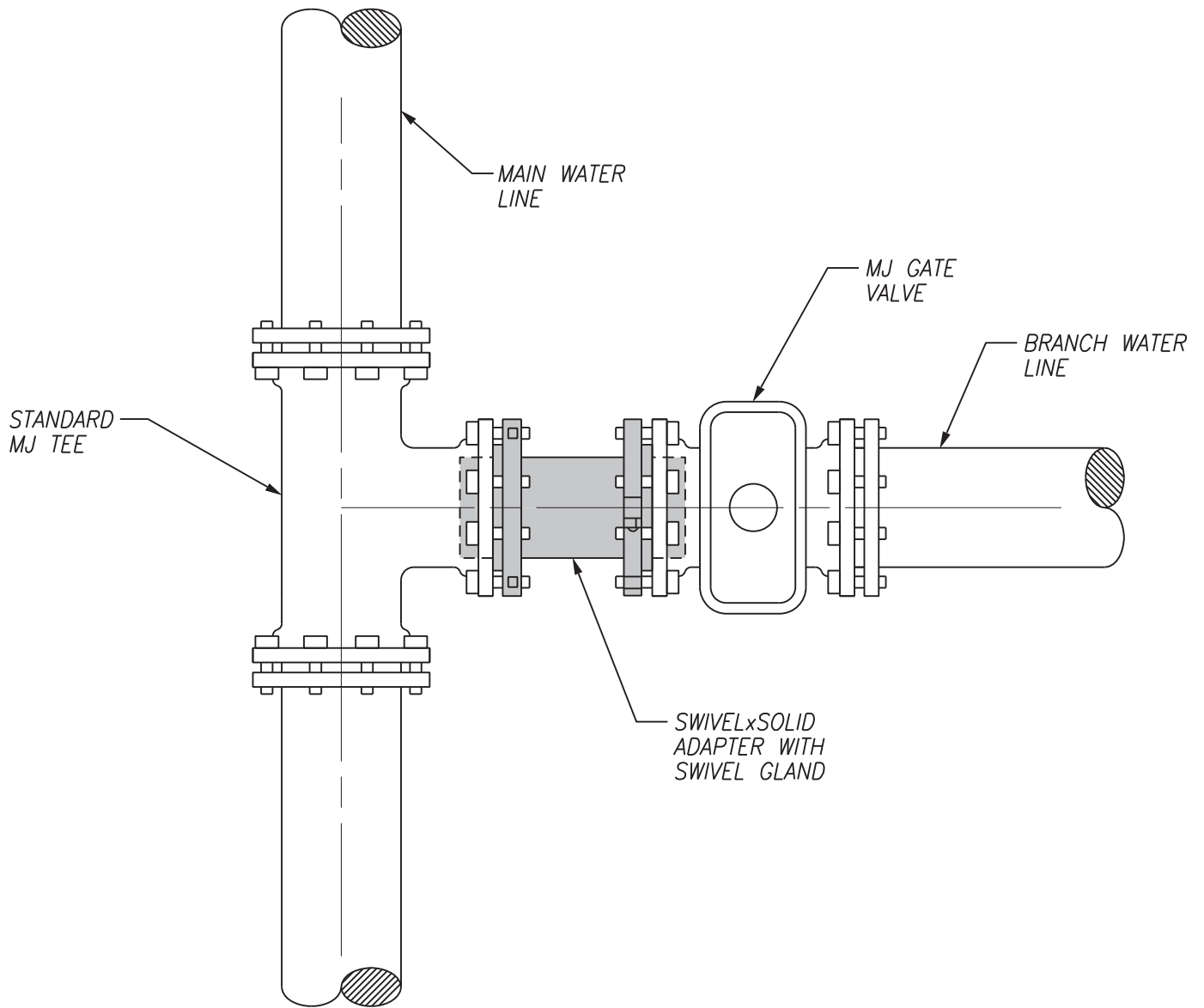
NOTES:

1. ALL PIPE AND FITTINGS SHALL BE RESTRAINED JOINT DUCTILE IRON WITHIN LIMITS OF THE STREAM CROSSING. RESTRAINING GASKETS SHALL BE "FIELD LOK 350" AS MANUFACTURED BY U.S. PIPE OR APPROVED EQUAL. MJ RESTRAINTS SHALL BE MEGALUG BY EBAA IRON, ROMAC INDUSTRIES, OR APPROVED EQUAL.
2. CONTRACTOR SHALL PERFORM PROPOSED WATER LINE CROSSING OF STREAMS IN STRICT ACCORDANCE WITH THE TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION AQUATIC RESOURCE ALTERATION (GENERAL) PERMIT FOR UTILITY LINE CROSSINGS OF STREAMS
3. CONTRACTOR TO INSTALL SAND BAG BERM (OR OTHER METHOD TO DIVERT STREAM FLOW AS APPROVED BY THE TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION) FOR OPEN CUT INSTALLATION OF PROPOSED WATER LINE ACROSS STREAMS AS SHOWN ON THE PROJECT PLANS. PERFORM ONE-HALF OF CREEK CROSSING, BACKFILL, THEN RE-LOCATE SAND BAG BERM TO OPPOSITE SIDE OF CREEK AND REPEAT
4. TRENCH BACKFILL SHALL BE CLEAN #57 OR #67 CRUSHED STONE UP TO WITHIN EIGHTEEN (18") INCHES OF CREEK BOTTOM. THE TOP EIGHTEEN (18") INCHES SHALL BE 6-12 INCH NOMINAL SIZE RIP-RAP OR RIVER ROCK.
5. ANY EXCAVATION OF THE STREAM CHANNEL AREA SHALL BE SEPARATED FROM FLOWING WATER, AND ACCOMPLISHED DURING LOW FLOW CONDITIONS. THIS SHALL BE ACCOMPLISHED BY THE USE OF FLUMES, LINED DIVERSION CHANNEL WITH SAND BAG BERM, DIVERSION PIPE INLET, OR IN SOME CASES, COFFER DAMS. COST TO BE INCLUDED IN OTHER ITEMS OF CONSTRUCTION.
6. ALL RIP-RAP SHALL BE HAND PLACED IN A MANNER TO MINIMIZE VOIDS.
7. TWO IN-LINE GATE VALVES (ONE ON EACH SIDE OF THE STREAM) SHALL BE REQUIRED FOR WATER DISTRIBUTION AREAS THAT ARE PART OF A LOOP-FED SYSTEM (COORDINATE WITH WKUD).



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TYPICAL OPEN CUT STREAM CROSSING				Date:	04/22/24
				DRAWING NUMBER:	W7

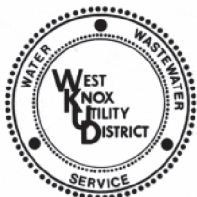
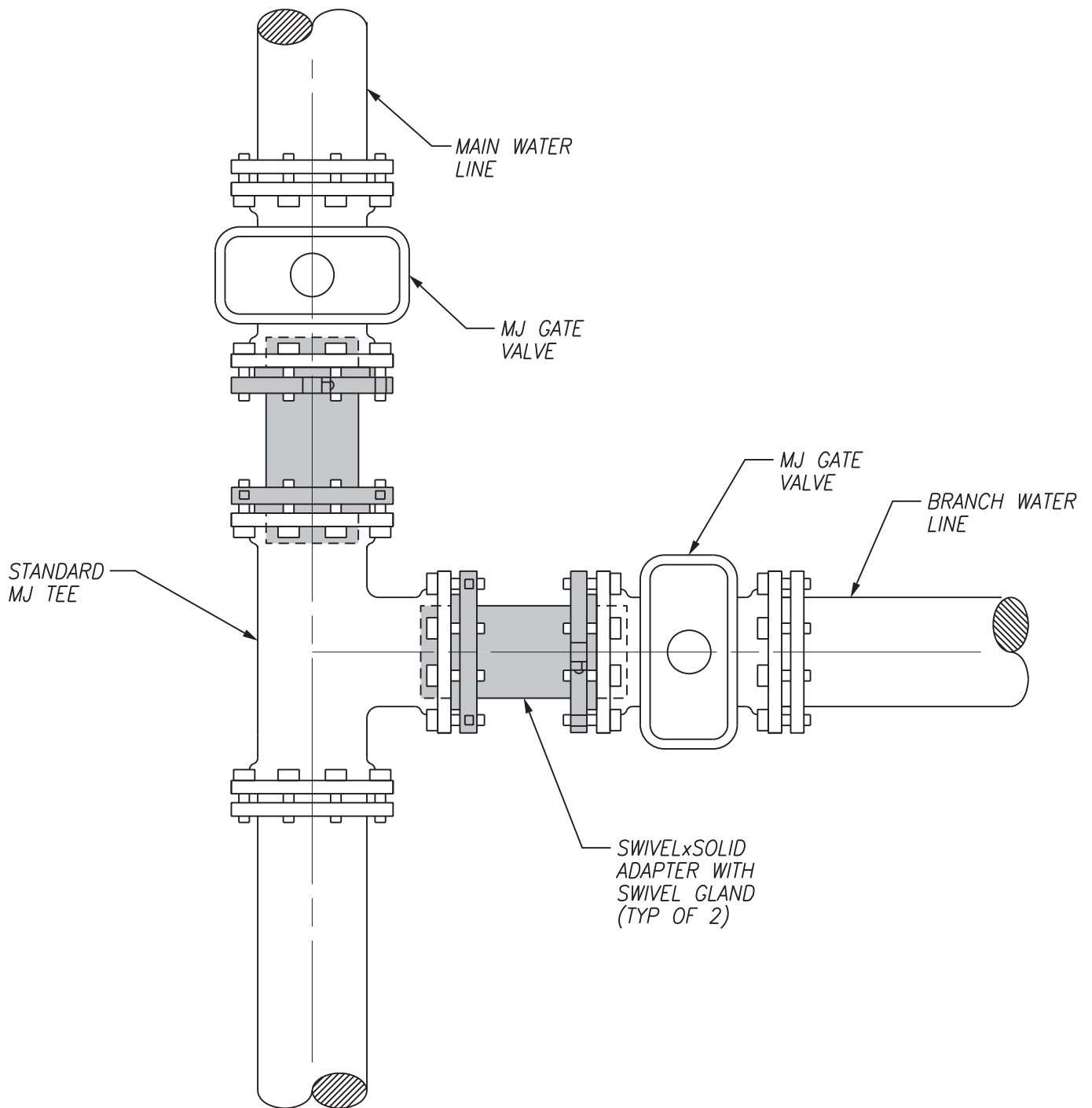


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**SWIVEL X SOLID ADAPTER
 ON MJ TEE
 (1-WAY)**

Date: 05/14/24
DRAWING NUMBER: W8.1



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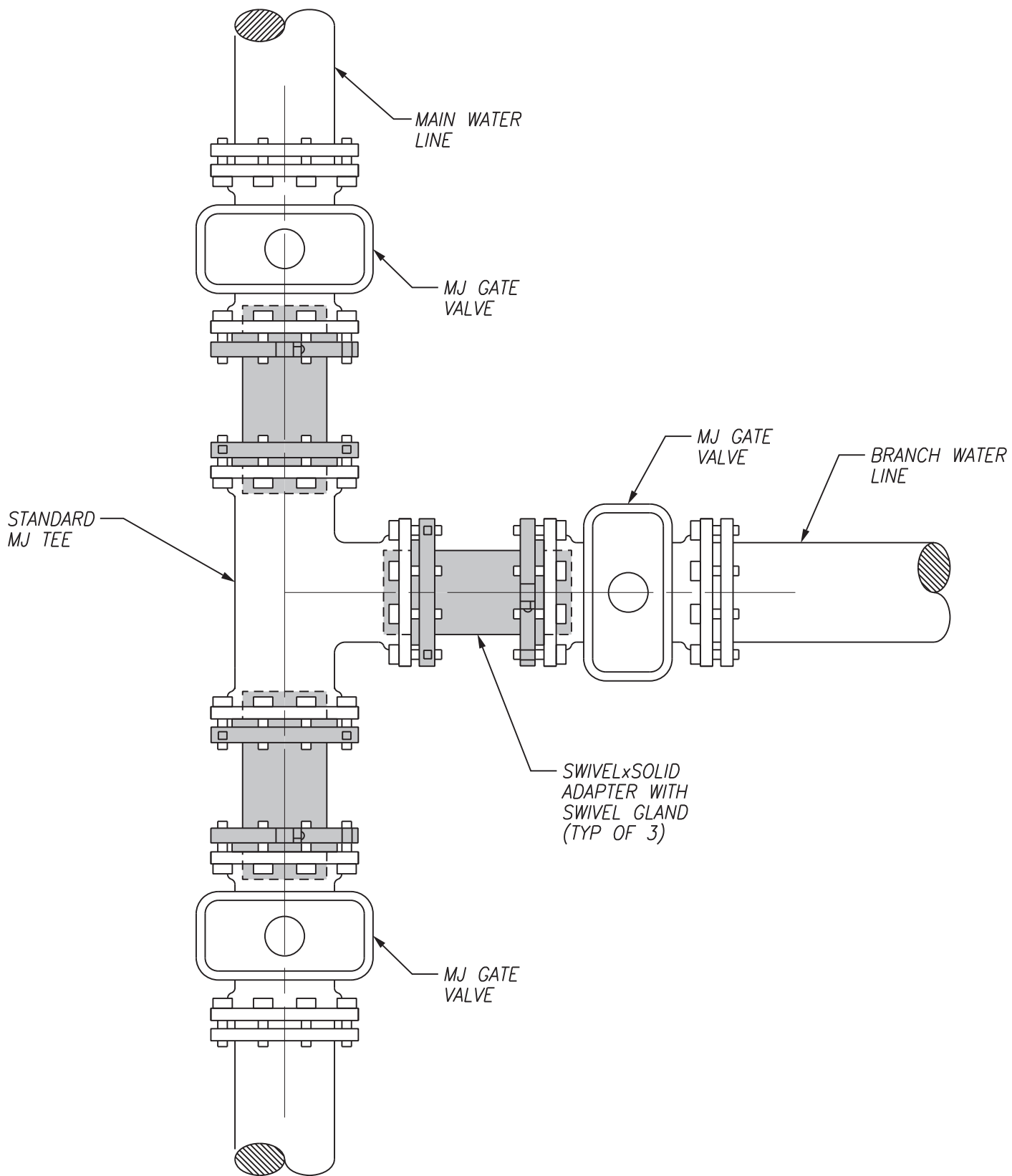
DRAWN BY: ARDURRA

Scale: NTS

**SWIVEL X SOLID ADAPTER
 ON MJ TEE
 (2-WAY)**

Date: 05/14/24

DRAWING NUMBER:
W8.2



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 TELEPHONE 865.690.2521

APPROVED BY: WKUD	DRAWN BY: ARDURRA	Scale: NTS
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SWIVEL X SOLID ADAPTER ON MJ TEE (3-WAY)	Date: 05/14/24
	DRAWING NUMBER: W8.3