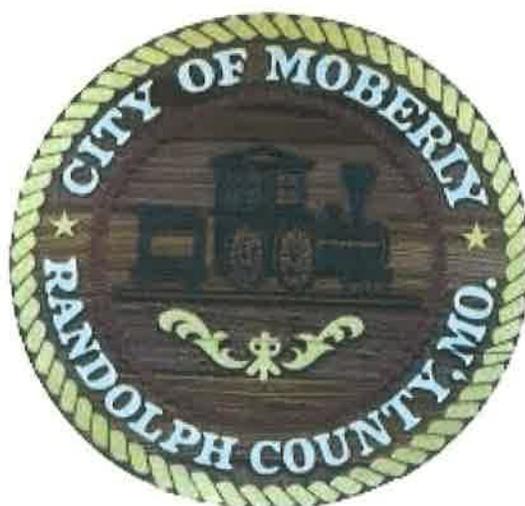


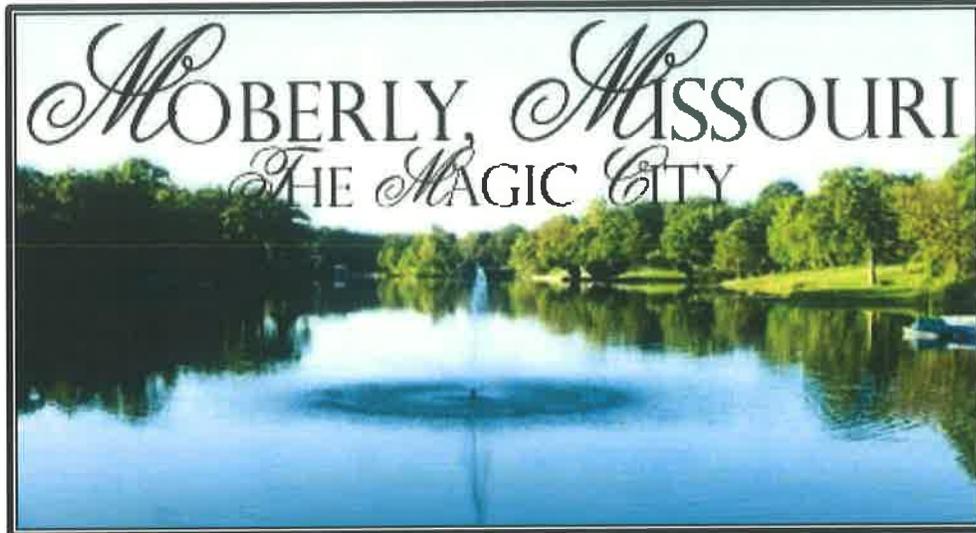
CITY OF MOBERLY, MISSOURI

**STANDARD SPECIFICATIONS
FOR SANITARY SEWER SYSTEMS**



PSBA
Poepping, Stone, Bach & Associates, Inc. *Engineers, Architects, Surveyors, GIS*

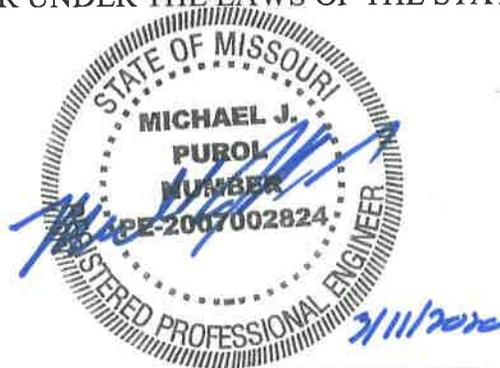
Suite 248, 801 Broadway St., P.O. Box 190, Hannibal, MO 63401 Ph: 573-406-0541



CITY OF MOBERLY, MISSOURI

**STANDARD SPECIFICATIONS
FOR SEWER MAIN CONSTRUCTION**

I HEREBY CERTIFY THAT THESE SPECIFICATIONS AND DETAILS WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI.



MICHAEL J. PUROL, PE
MISSOURI LICENSED PROFESSIONAL ENGINEER NO. PE-2007002824
EXPIRES 12-31-2021

THIS SEAL COVER STANDARD SPECIFICATION SECTIONS 01000 THRU 01006
AND STANDARD DETAIL SHEETS 02001 THRU 02005.



Suite 248, 801 Broadway St., P.O. Box 190, Hannibal, MO 63401 Ph: 573-406-0541

**CITY OF MOBERLY, MISSOURI
STANDARD SPECIFICATIONS FOR SANITARY SEWER SYSTEMS**

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SECTION 01000 APPROVAL AND ACCEPTANCE

PART 1 – GENERAL

1.01 SUMMARY

- A. These specifications are for the construction, replacement, extension, and alteration of sewer systems intended to be maintained under authority of the City of Moberly, Missouri.
- B. The intent of these specifications and details is to specify the type and quality of sanitary sewer system materials, installation, inspection, testing, and final acceptance by the City for all improvements, replacements, and extensions to be included as a part of the City's sanitary sewer system.
- C. All design, permitting, materials, and work shall be in accordance with applicable sections of:
 - 1. City of Moberly Standard Specifications for Sanitary Sewer Systems
 - 2. City of Moberly, Missouri – Code of Ordinances, Chapter 42-Utilities
 - 3. Missouri Department of Natural Resources - Minimum Design Standards.
 - 4. Missouri Standard Specification for Highway Construction, current edition
 - 5. Approved, Project-Specific Special Provisions, Specifications, and Plans
- D. The work shall consist of obtaining all required permits, approvals, and legal easements before beginning work. Work includes furnishing all labor, materials, and equipment for the complete installation of sewer line extension and/or alterations, and appurtenances, in conformance with approved construction documents.
- E. Proposed modifications, alterations, or changes to City of Moberly, Missouri Standard Specifications and Details must be submitted to the City for approval prior to implementing changes.

1.02 DEFINITIONS

- A. City: City of Moberly, Missouri.
- B. Wastewater Department: City Wastewater Department.
- C. Enforcement Officer: City Director of Public Utilities or designated representative.
- D. Engineer: Licensed Professional Engineer in responsible charge for the project and licensed to perform services in the State of Missouri.
- E. Developer: Entity requesting sewer service construction, modifications, extensions, and/or alteration to the city sewer system. The Developer could be a public or private entity, such as the City or private Developer.
- F. Contractor: Entity contracted by Developer to perform work on water main and services. The Contractor is responsible for constructing approved plans.

Standard Specifications For Sanitary Sewer Systems

- G. Owner: Entity who is responsible for long term performance, maintenance, and operation of sanitary sewer systems. The City will typically become the Owner upon final approval and acceptance by City. The Developer will be responsible for the project until final approval and acceptance.
- H. Standard Specifications: City of Moberly, Missouri Standard Specifications for Sanitary Sewer Systems.

1.03 DESIGN - GENERAL

- A. All sewer system extensions or alterations shall be designed, signed, and sealed by an Engineer.
- B. Sanitary Sewer Systems shall be designed to meet City of Moberly, Missouri Specifications and minimum design requirements in accordance with Rules of Missouri Department of Natural Resources, Division 20 – Clean Water Commission, Chapter 8 – Design Guides (MoDNR Design Guides). Gravity Sewer Design shall be in accordance with Title 10 CSR 20-8.120. Sewage pumping station and force main design shall be in accordance with Title 10 CSR 20-8.130.
- C. Design considerations shall include, but are not limited to:
 - 1. Design capacity and flow; flow velocity, flow depth, and solids deposition;
 - 2. Future extensions, service connections and system expansion;
 - 3. Depth of bury; flowline gradient;
 - 4. Topography; subsurface soil, rock, and groundwater conditions; flood plains
 - 5. Construction means and methods; construction and maintenance accessibility;
 - 6. Excavation support systems; Dewatering and water control;
 - 7. Pipe anchorage for steep gradients or installations below groundwater;
 - 8. Excavation depths; external loading; differential ground and pipe movement;
 - 9. Road, highway, and street crossings; pavement repair;
 - 10. Pipe alignment and gradient; location; public and private easements; competing uses;
 - 11. Manhole sizes and locations; flow channel configurations, water tightness; inverted siphons; relationship to waterbodies; aerial crossings; water supply protection;
 - 12. Relative location of utilities, structures; roads, and stream crossings.
- D. Sanitary sewers shall be polyvinyl chloride (PVC), unless otherwise specified in the Standard Specifications. Clay tile sewer mains and taps shall be replaced with SDR26 PVC, or greater.
- E. Service lateral connections shall be at least 6 inches with a minimum gradient of 0.60%.
- F. The minimum diameter pipe for sanitary sewer mains shall be 8-inch. Size shall not decrease with increasing length downstream in direction of flow.
- G. Pavement Structure Crossings: In accordance with authority having jurisdiction with a design vehicle loading no less than AASHTO HS-20.

Standard Specifications For
Sanitary Sewer Systems

H. Sanitary Sewer Alignment Best Practice:

1. Linear pipe with no gradient or angular changes between structures.
2. Consistent and regular gradient changes at structures.
3. Pipe parallel to existing road/street centerlines.
4. Pipe perpendicular to existing road/street centerlines at crossings.
5. Manholes at all gradient and angular changes.
6. Angular changes in direction of flow less than 90 degrees at manholes.
7. Hydraulic grade line below the inside diameter crown of the pipe.
8. Concrete anchorage cradle or collar if gradient is 20% or greater. Conditional approval is required for gradients exceeding 50 %.

I. Sanitary Sewer Location Best Practice:

1. To serve all property conveniently.
2. In unimproved or unpaved areas when possible.
3. In public streets, roads, alleys, rights-of-way, or City sewer easements.
4. To avoid crossing private property.
5. To avoid interference between house, foul water, sanitary sewer, and storm sewer connections.
6. At a sufficient distance from existing/proposed structures, foundations, and underground utilities to limit encroachment and potential instabilities during construction.
7. To avoid karst features, water bodies, and storm water overflow; no sanitary lateral cleanouts or sewer vents shall be placed within an overflow path of stormwater.

J. Sanitary Sewer Manholes Best Practice:

1. Provide access to sewers for inspection, maintenance, and repair. New manholes shall not have steps.
2. Provide junction structures for connecting lines and alignment changes.
3. Distance between manholes shall not exceed 400 feet for pipe sizes less than 15 inches
4. Distance between manholes shall not exceed 500 feet for pipe sizes greater than 15 inches. Conditional approval may be given for increased spacing on a project specific basis
5. Minimum inside diameter for manholes is 48 inches.
6. Manholes with sewer pipe diameters greater than 36 inches are considered special structures and shall be designed by an engineer licensed in Missouri and approved by the City.

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Sanitary Sewer Systems

7. Manholes shall be installed on each side of a stream, creek, or water body crossing and installed at least 10 feet laterally behind top of bank.
8. Manholes within FEMA mapped 100-year flood limits, within storm water overflow paths, or other areas subject to flooding shall be water-tight and include a lock-type water-tight manhole cover.

K. Sanitary Sewer Design Flow Best Practice:

1. Hydraulic calculations shall be included in submittal packages to be reviewed by the City.
2. Sewer flows shall be based on the design peak hourly flow in accordance with MoDNR Design Guides 10 CSR 20-8-110 and shall be designed to prevent sanitary sewer overflows. If actual flow data is available, it may be used in lieu of the design average daily wastewater flow. In no case shall the ratio of peak hourly flow to design average flow be less than 4.
3. Population factors shall be determined from the most recent United States Census Tracts. In lieu of census data, 3.7 persons per household may be used for residential applications.
4. Project-specific flow design for non-residential, unconventional, or other applications may be considered in lieu 10 CSR 20-8-110, Table 1, on a project-specific basis and subject to review and approval by the City and MoDNR.

L. Sanitary Sewer Gradient Best Practice:

1. The following minimum pipe and flowline gradients shall be used. These values assume a minimum velocity of 2.0 feet per second, flowing full, and are based on a Manning "n": value of 0.013.

Nominal Pipe Size (inches)	Percent Slope
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.08
27	0.067
30	0.058
36	0.046

2. Field verification of as-built pipe gradient is required. Submittal of revised hydraulic calculations for lines with as-built gradients less than the approved design gradient by more than 0.1% is required. Removal and replacement of sewer lines and structures will be required if sufficient hydraulic capacity and cleansing velocity of the system is not met.

Standard Specifications For
Sanitary Sewer Systems

M. Sanitary Sewer Minimum Depth and Cover Best Practice:

1. 9 feet below finish grade to flowline for new sewers with reasonable expectation of future expansion or extension. The City will review this requirement on a project-specific basis. In some cases, upstream topography may indicate shallower burial is more economical.
2. 3 feet to top of pipe for sewer mains.
3. 2.5 feet to top of pipe for service lateral connections. Service laterals shall be at least 2.5 feet below low-floor or basement-floor elevations. This elevation shall determine recommended depth of new sewer mains.
4. At stream and channel crossings, streambanks shall be protected with a grouted rock blanket in accordance with MoDNR Design Guides 10 CSR 20-8.120 (8) "Sewers in Relation to Streams".
5. Deviations from Best Practices will be reviewed by the City on a project-specific basis.

N. Sanitary Sewer Manhole and Sewer Line Connections Best Practice:

1. All connections to manholes are subject to City review and approval. Connections to existing structures may require rehabilitation or reconstruction. Rehabilitation or reconstruction shall be included in the scope of a proposed project, where appropriate.
2. Service connections shall be made to sewer lines with a factory tee, Inserta Tee or approved equal. All service connections shall be made to sewer lines. Service connections to manholes will be reviewed by the City on a project-specific basis.
3. Drop type manhole connections shall be provided for a sewer line entering a manhole 24 inches or more above the invert.
 - a. Drop Pipe size shall be 12 inches or less.
 - b. Outside drops shall be fully encased in concrete.
 - c. Inside drops connections are allowed if manhole inside diameter is at least 48 inches and the incoming sewer gradient is less than 1%. Only one inside drop is allowed in a manhole.
 - d. Drop connections shall not be made through manhole joints or the transition conical section.
 - e. Manhole inverts shall be shaped to provide proper flow through the manhole
4. Force main connections to manholes shall be made within 12 inches of the manhole flowline and the invert shall be shaped to allow proper flow through the structure.
5. Pipes entering and exiting manholes at the flowline should project through the center of the structure and the manhole invert shall be shaped to ensure proper flow through the structure.
6. The number of lines entering a manhole, either new or existing, shall be kept to a minimum.

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Sanitary Sewer Systems

7. All replaced or repaired sewer mains shall be re-connected with a Shear Guard type fitting, or approved equal, to mitigate effects of differential pipe movement at joint and connections to dissimilar pipe materials.

O. Adjusting Manholes to Grade

1. If a proposed project requires manhole adjustment to grade, the proposed grade and method of adjustment shall be included in the project plans and is subject to City approval.

1.04 DESIGN - SEPARATION REQUIREMENTS

A. Public health is paramount. To protect the public health, the following separation requirements shall be met for water lines near sanitary and storm sewer lines. These requirements apply to both conventional trench-type construction methods and trenchless construction methods including but not limited to directional drilling and utility jacking and boring. These requirements shall be considered minimum requirements. Additional requirements may be required as conditions of required permits.

B. The following factors should be design considerations for separation requirements:

1. Materials and type of joints for water and non-potable fluid pipes.
2. Soil conditions.
3. Service and branch connections into the water main and non-potable fluid.
4. Compensating variations in the horizontal and vertical separations.
5. Space for repair and alterations of water and non-potable fluid pipes.
6. Routing water mains around manholes.

C. Horizontal Separation Requirements

1. See Standard Details.
2. Water lines shall be located at least ten (10) feet horizontally from any existing or proposed line carrying non-potable fluids such as, but not limited to, drains, storm sewers, sanitary sewers, combined sewers, sewer service connections, inlets, manholes, and process waste or product lines. The distance shall be measured edge to edge.
3. Water mains may be located closer than ten (10) feet when:
 - a. Local conditions prevent lateral separation.
 - b. The water main invert is at least 18 inches above the crown of non-potable fluid lines.
 - c. The water main is either in a separate trench or in an adjacent trench on an undisturbed earth shelf located on one side of the non-potable fluid line.
4. If separation requirements listed above cannot be met, the water line shall be placed in casing suitable for potable water in accordance with City Standard Specifications or the non-potable fluid line shall be re-constructed using pipe suitable for potable water use in accordance with Section 01001 – Standard Specification for Water Mains.

D. Vertical Separation Requirements

1. See Standard Details. The minimum vertical separation from water lines and non-potable fluid lines shall be 18 inches.
 - a. If the 18-inch vertical separation cannot be met for water lines above non-potable fluid lines, the water line shall be placed in casing suitable for potable water in accordance with City Standard Specifications and Details. Casing pipe shall be placed no closer than 4 inches above non-potable fluid pipe.
 - b. For water lines placed 18 inches or more below a non-potable fluid line, the water line shall be placed in casing suitable for potable water in accordance with City Standard Specifications and Details. Adequate support shall be provided to prevent damage to utilities located above the water line.
 - c. Where required, protective casing shall extend a minimum of 10 feet from non-potable fluid line measured perpendicular to the non-potable fluid line. Casing shall be sealed at each end according to City Standard Specifications.

1.05 PRE – CONSTRUCTION SUBMITTALS

- A. **Preliminary Submittal:** Project-specific special provisions, specifications, and plans shall be submitted to the City for review and approval of any public sewer main alteration or extension. The submittal shall be prepared by an Engineer. Submittal shall include but may not be limited to:
1. A completed MoDNR Application for Construction Permit – Sewer Extension, Form MO 780-1632.
 2. Proposed alignment, grade and locations of new structures and connections to existing sewer systems.
 3. Materials list and manufacturer data sheets, catalog data, and illustrations for all proposed materials to be used for the project. Material test certificates and affidavits of compliance with applicable standards.
 4. A work plan describing construction means, methods, sequencing, and scheduling.
 5. Plan showing all existing utilities and identifying potential conflicts with proposed work. If utility relocation is required, the Developer and their Engineer, in conjunction with respective utility owners, shall provide a proposed utility relocation plan for approval. The relocation of existing utilities shall be incorporated into the overall construction project as well as appropriate demolition plan of abandoned utility facilities.
 6. Other submittals detailed in other sections of City Standard Specifications
- B. **Preliminary Submittal Review(s):** Project-specific special provisions, specifications, and plans shall be submitted to the City of Moberly for review and approval of any public sewer main alteration or extension. The submittal shall be prepared by a professional licensed to practice in the State of Missouri. Submittal shall include:
1. At discretion of City, multiple iterations of the preliminary submittal review will be performed until all design and pertinent modifications are complete.

C. Final Submittal:

1. Final submittal to the City shall include Engineer's official seal, current date stamp, and signature on project-specific special provisions, specifications, and plans. Three (3) hard copies and one (1) electronic copy in .pdf format.
2. Submit approved MoDNR Application for Construction Permit – Sewer Extension, Form MO 780-1632. No work may begin until a copy of the approved permit has been provided to City.
3. Submit legally recorded copies of required utility easements, if any. No work may begin within proposed easements without having legally recorded permanent easements.
4. Submit approved Missouri Department of Transportation Highways and Transportation Commission, Permit to Work on Right of Way, if applicable.

1.06 INSPECTION

- A. In general, all work shall be inspected by the Enforcement Officer. Inspection for acceptance of materials will be conducted as soon as practical after materials arrive on the job site. Inspections will be performed as work progresses.
- B. The Enforcement Officer shall always have access for observation and inspection during the work. Access will be coordinated with the Contractor. The Contractor shall furnish all reasonable aid and assistance required by the Enforcement Officer for the proper inspection and examination of work and materials. The Enforcement Officer shall be notified at least two (2) working days in advance of all testing for inspection and observation. Notifications are required in accordance with other Standard Specifications.
- C. The Enforcement Officer reserves the right to reject materials and work not in compliance or accordance with approved plans and specifications.
- D. The Enforcement Officer reserves the right to suspend work.
- E. Under no circumstance shall service connections be made to existing mains without approval. All service connections will be coordinated by Contractor and conducted in the presence of Enforcement Officer.

1.07 POST – CONSTRUCTION FINAL SUBMITTAL

- A. Upon successful completion of construction and obtaining required testing results meeting or exceeding performance requirements, the Developer shall submit:
 1. Copies of all test reports, including failed tests.
 2. Submit two (2) copies of as-built drawings to City showing all changes, deviations, or modifications to original plans. As-built drawings shall include reference swing tie measurements from identifiable landmarks to all service connections. Each service connection shall have at least two (2) reference swing tie measurements.
 3. As-built drawings shall be completed by Engineer, dated and clearly marked with the name and company of the person illustrating the changes.

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1.08 ACCEPTANCE

- A. After Final Submittal and City Approval, the City will conditionally accept the work.
- B. The Owner and Contractor shall warranty all work and materials for a period of one year. The Owner and Contractor will be responsible for repairing and replacing failures or damages resulting from poor workmanship and defective materials.
- C. The Enforcement Officer will inspect the work periodically during the warranty period, document conditions, and notify Developer of repairs required, if any.
- D. Final acceptance will be given when the warranty period ends, and all work and site conditions are to the satisfaction of the City.

END OF SECTION 01000

SECTION 01001 SEWER LINES AND MANHOLES

PART 1 – GENERAL

1.01 SUMMARY

- A. The design and construction of sewer main replacements, extensions, and alterations shall be in conformance with the City of Moberly Standard Specifications and Missouri Department of Natural Resources Minimum Design Standards for Sewer Systems.
- B. The work shall consist of furnishing all labor, materials, and equipment for complete installation of sewer main replacements, extensions, alterations, and appurtenances, in conformance with the lines and grades shown on the plans, as established by the Engineer, or otherwise specified.
- C. The Contractor shall employ skilled, qualified workers and supervision to perform work following generally accepted industry practices. The City reserves the right to suspend work if, in the opinion of the Enforcement Officer, this requirement is not being met.

1.02 DEFINITIONS

- A. City: City of Moberly, Missouri
- B. Sewer Department: City Sewer Department
- C. Enforcement Officer: City Director of Public Utilities or designated representative
- D. Engineer: Licensed Professional Engineer in responsible charge for the project licensed to perform services in the State of Missouri.
- E. Developer: Entity requesting sewer service construction, modifications, extensions, or alterations to the City sewer system. The Developer could be a public or private entity, such as the City of Moberly or a private Developer.
- F. Contractor: Entity contracted by Developer to perform work on sewer main and services. The Contractor is responsible for constructing approved plans.
- G. Owner: Entity who is responsible for long term performance, maintenance, and operation of new sewer mains. The City will typically become the Owner upon final approval and acceptance by City. The Developer will be responsible for the project until final approval and acceptance.

1.03 RELATED WORK

- A. Section 01000 – Approval and Acceptance
- B. Section 01002 - Earthwork
- C. Section 01003 - Directional Drilling
- D. Section 01004 - Utility Jacking and Boring
- E. Section 01005 - Pavement Repair

1.04 NOTIFICATION

- A. The Contractor shall notify the Enforcement Officer at least five (5) business days prior to commencing work.

1.05 SUBMITTALS

- A. See Section 1000 – Approval and Acceptance
- B. Material product data
- C. Work Plan detailing means, methods, equipment, sequencing, schedule, and testing for.
- D. Testing Reports and documentation of repairs

1.06 JOB CONDITIONS

- A. Interrupting Utility Service:
 - 1. Utility services to the City and existing customers shall not be interrupted unless approved by the Enforcement Officer and existing utility provider.
 - 2. If approval for an interruption of service is obtained, the Contractor shall provide an eight-hour notification to the Enforcement Officer and all affected occupants. The City Fire Department shall be notified at least 24-hours in advance.
 - 3. The Contractor shall provide standby service, if required. Outages shall not exceed 6 hours and will be coordinated with the Enforcement Officer.
 - 4. The Water Department is responsible for operation of in-service water valves, including closure as needed. Closure by other entities will not be permitted.
 - 5. The Contractor shall be responsible for preventing contamination of existing lines.
- B. New sewer mains must be fully tested and approved before installing service line connections.
- C. Whenever pipe laying is not actively in progress, open ends of all installed pipe and fittings shall be sealed water tight.

1.07 MATERIAL DELIVERY, STORAGE, AND HANDLING

- A. Means and methods for material shipping, loading, transporting, unloading, storing, and placing shall prevent damage. Damaged and/or defective materials shall not be installed. The City reserves the right to reject all damaged or defective materials.
- B. All materials shall be packaged, labeled, or otherwise marked with adequate, identifiable information to determine suitability for intended project application.
- C. Materials shall be stored at a mutually agreed upon location. Materials shall not be stored directly on the ground or in direct sunlight. They shall be stored in a manner to ensure they are kept clean, dry, and free of foreign debris.
- D. Materials shall be protected in a manner to prevent entrance of contamination or foreign debris.

1.08 BASIS OF PAYMENT

- A. This section applies to projects where the City of Moberly is the responsible Developer/Owner.
- B. Gravity Sewer Systems
 - 1. **Sewer main** will be measured and paid by the lineal foot of pipe along pipe centerline, including all labor, equipment, and materials required for installation. Unless otherwise identified as a bid item, unit cost shall include: excavation, backfill, fittings, joints, tracer wire, warning tape, erosion control, dewatering, pavement repair, seeding, and cleanup.
 - 2. **Manholes** will be counted as a single unit and be paid on a per-each basis, including all labor, equipment, and materials required for installation. Costs for pipe insertion, grouting, sealing; invert forming, frames and lids shall be included in the unit costs.
 - 3. **Service Lines and Connections** will be paid for on a per each basis, including all labor, equipment, and materials required for installation. Unit cost will include connections at sewer main, connections to service lines (new and existing), and cleanout installation where specified.
 - 4. **Separation Casing Pipe** will be measured and paid by the lineal foot along casing centerline. Unit cost shall include insulating spacers and end seals. Casing required for trenchless construction methods will be paid for separately.
 - 5. Estimated quantities for bid items could change. If quantities increase, additional materials and associated work will be paid for at contract unit cost. Purchasing additional materials and performing additional work shall not be done without prior written approval from the Enforcement Officer.
 - 6. Cost associated with all work and materials not specifically identified as a bid item shall be considered as incidental to other pay items.
 - 7. Additional, extra, and/or changes in work must be approved by Enforcement Officer. Payment will be on basis of Contract documents regarding changes in work.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE (PVC) AND FITTINGS

- A. Unless otherwise specified or shown on the plans, the following type of pipe shall be used for gravity sewers:
 - 1. PVC pipe less than 18 inches shall meet requirements of ASTM D3034, with minimum SDR26. PVC pipe 18 inches and greater shall be in accordance with ASTM F679.
 - 2. All pipe shall have a minimum stiffness of 46 psi.
 - 3. Pipe shall be bell and spigot type. Wall thickness in pipe bell shall not be less than pipe barrel.
 - 4. Pipe shall have reference marks on male end indicating proper seating into bell.
- B. Fittings shall be of the same material and strength as sewer pipe. Fittings shall be compatible with pipe manufacturer.

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C. Joints and Gaskets:

1. Finish joints shall be in accordance with ASTM D3212
2. Gaskets shall be in accordance with ASTM F477
3. Wall thickness in pipe bell shall not be less than pipe barrel. Pipe shall have reference marks on male end indicating proper seating into bell.
4. Buried joints shall be push-on type unless restrained or mechanical joints are required, specified, or as shown on the drawings.

D. Adapters and Couplings:

1. All sewer main replaced or repaired shall be re-connected. Connection of dissimilar material or different size materials shall be made with an approved, flexible, pre-formed elastomeric material conforming to ASTM - D3212, mechanical or compression seal type and also be equipped with a Shear Guard type fitting or approved equal. Stainless steel bands shall be used.

2.02 MANHOLES

A. Pre-cast concrete manholes: In accordance with ASTM C478 with provisions for gasketed joints between barrel and conical sections. Special design is required for manholes with incoming pipe diameter greater than 36 inches.

B. Size:

1. Base Section: 6-inch minimum floor thickness with 5-inch minimum thickness for wall and base riser.
2. Riser Sections: 5-inch minimum thickness and 48-inch inside diameter with lengths to provide depth/elevations indicated.
3. Top Section: Concentric cone type; top of cone shall match grade ring size.

C. Drop Type Manhole: Same as above. See standard details.

1. Drop pipe shall be PVC pipe with solvent welded elbow at bottom. Pipe shall be installed below flow line of incoming pipe.
2. Inside Drop: Pipe gradient for inside drops shall be less than 1%. Drop pipe shall be same size as incoming line. Use prefabricated or field-fit drop bowl. Solvent weld 90 degree elbow at bottom to match flowline. Drop pipe shall be attached to the inside face of manhole with at least three "Flared-Leg Brack-it" type D021 or approved equal, with 3-inch x 3/8-inch stainless steel bolt. Bracket shall be fastened to concrete with stainless steel anchor, wedge-type or grouted. A 3/4-inch stainless steel band shall be wrapped around the pipe and attached to the bracket. At least two bracket/band assemblies shall be used with a maximum spacing of 3 feet.
3. Outside drops shall be either pre-cast with the manhole or fully encased in concrete. Maximum pipe size for outside drops is 12 inches.

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D. Gaskets:

1. In accordance with ASTM C923, rubber or mastic sealant. Ram-Nek, E-Z Stik, or approved equal.

E. Grade Rings:

1. Pre-cast concrete, Cretex Pro Ring, or approved equal and compatible with 24-inch manhole frames and covers. Maximum thickness for grade rings and frame shall be 18 inches.

F. Concrete Manhole Collar:

1. Where specified and shown on the drawings install concrete manhole collars for manholes installed within existing pavement structures in accordance with standard details.

G. Steps:

1. No steps shall be installed in manholes, unless otherwise specified or shown on the drawings.

H. Pipe Connections:

1. In accordance with ASTM C923, resilient, of size required for each pipe connecting to manhole. Pipe connections shall be A-Loc, Z-Loc, or approved equal.

I. Frames and Covers:

1. In accordance with either ASTM A48 - Standard Specification for Gray Iron Castings or ASTM A536 Standard Specification for Ductile Castings manufactured by Neenah Foundry Company or approved equal with machined bearing surface and self-sealing gasket.
2. Frames shall be secured to the manhole with at least four connections. Connections may be wedge anchor or grout type with at least 1/2-inch x 4-inch bolts.
3. 22-inch minimum inside diameter
4. 7-inch to 9-inch riser with 4-inch minimum flange width
5. 24-inch diameter cover, checkered or knobbed surface finish with "SANITARY SEWER" cast into cover
6. The frame shall be compatible with chimney seal installations.
7. Watertight manhole frames and covers shall be provided where indicated on the plans, manufactured by Neenah Foundry Company or approved equal and installed according to manufacturer recommendations. Covers shall have concealed pickholes.

J. Chimney Seals:

1. Where indicated on the plans, an external or internal chimney seal shall be installed between the manhole frame and masonry chimney in accordance with manufacturer's recommendations and specifications. Seals shall be Cretex or approved equal.

K. External Joint Sealing Bands:

1. External joint seals shall be installed on each manhole section joint. Seals shall be CretexWrap or approved equal meeting requirements of ASTM C877, Type II, and installed according to manufacturer's recommendations and specifications.

L. Protective Coatings:

1. Surfaces shall be clean, dry, and contaminant free. Remove surface protrusions and fill air pockets, lifting lug holes, and other surface imperfections with hydraulic cement grout or other approved filler compatible with coating application. Supply written confirmation of material compatibility with selected coating.
2. All exterior manhole surfaces shall have a waterproof protective coating either factory or field applied.
 - a. 1 or 2 coat asphalt waterproofing conforming to ASTM D449, Type C, 15-mil thickness unless otherwise specified or shown on the drawings.
3. Provide protective interior surface coatings where specified or indicated on the plans. Protective coating shall be applied according to manufacturer's recommendations and specifications.
 - a. SewerGard polymer lining, or approved equal
 - b. Tnemec Series 66 Epoxoline barrier coat and Tnemec Series 46H-413 finish coat, or approved equal
 - c. The material shall be an impermeable, high strength, corrosion-resistant, fiber-filled or aggregate-filled epoxy material specifically designed to protect concrete surfaces of municipal wastewater treatment structures and collection systems.
 - d. The material shall prohibit water infiltration and shall have proven resistance to corrosive chemicals, including sulfuric acid as well as other chemicals typically found in sanitary sewers.
 - e. The material shall be suitable for application over damp or dry concrete surfaces without the use of a primer.
 - f. The material shall have a non-sagging consistency to permit application on vertical and overhead surfaces.

2.03 CONCRETE

- A. Cast-in-place according to ACI 318, ACI 350R
- B. Cement: ASTM C150, Type I or II
- C. Fine Aggregate: ASTM C33 Sand
- D. Coarse Aggregate: ASTM C33, Crushed Grave, 1-inch maximum particle size
- E. Water: Potable
- F. Reinforcement: ASTM A185, steel, welded wire fabric, plain

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- G. Reinforcement: ASTM A615, Grade 60, deformed steel
- H. Water Cement Ratio: 0.45 maximum
- I. Unconfined Compression Strength: 4,000 psi minimum
- J. Air Entrainment: 3% to 6%

2.04 GROUT

- A. ASTM C1107 Standard Specification for Packaged Dry, Hydraulic Cement Grout (Non-shrink)
- B. Quikrete commercial grade non-shrink precision grout or approved equal.

2.05 SEPARATION CASING PIPE

- A. This section applies when casing is required around water mains to comply with sanitary and storm sewer separation requirements. Casing materials, including joints, shall be suitable for potable water. Casing size shall be large enough to allow unrestricted installation of product pipe, including casing spacers, pipe fittings, and joints.
- B. Casing materials may be PVC, Steel, or High-Density Polyethylene (HDPE)
 - 1. PVC casing shall be in accordance with this section.
 - 2. Steel casing shall conform to AWWA C200 and AWWA M11, joined by fully welding in accordance with AWWA C206. Casing shall have a minimum wall thickness of 0.25-inch for casing up to 24 inches.
 - 3. HDPE casing shall be in accordance with Section 01003 – Directional Drilling.
- C. Projection type, non-metallic insulating spacers shall be used to support sewer main inside casing. Insulating spacers shall be RACI, Advance Products & Systems, or approved equal. Refer to manufacturer's product data for spacer type and size.
- D. Synthetic rubber end seals shall be installed on each end of the casing pipe. End seals shall be Advanced Model Products – Model AC pull-on or approved equal fastened tightly with stainless steel bands.
- E. See Standard Details.

2.06 TRACER WIRE

- A. Tracer wire shall be green HDPE insulated single strand #12 AWG continuous copper clad steel tracer wire. Tracer wire shall be manufactured by Copperhead Industries LLC or approved equal.

2.07 WARNING TAPE

- A. Warning tape shall be "green" non-metallic, 3-inches wide and at least 5 mil thick. Warning tape shall have "Caution Buried Sewer Line" or similar warning printed on the tape. Tape shall be buried at least 2 feet above top of pipe.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify the actual locations (horizontal and vertical) of all utilities prior to beginning work. Protect all utilities from damage during construction. Notify utility providers at least 3 business days prior to performing work adjacent to existing utilities. Damage to existing utilities shall be repaired to the satisfaction of the utility provider at Contractor's expense.
- B. Coordinate Utility interruptions with service provider. For city-owned utilities, a written approval and two day notification is required before interrupting service.
- C. Document existing conditions including distress to existing features within project limits and footprint of construction. Document conditions at adjoining properties.
- D. When connecting to existing sewer lines, verify invert elevation of existing sewer prior to constructing new sewer.
- E. Establish survey control and verify governing dimensions and elevations. Locate existing structures and piping scheduled for abandonment and/or decommissioning.
- F. Prior to laying pipe, prepare trench subgrade and bedding in accordance with Section 01002 – Earthwork.
- G. Trench excavations shall be protected in accordance with applicable Federal, State, and local regulations, Laws, and rules in accordance with OSHA 29 CFR part 1926. Trench and excavation stability shall be the responsibility of the Contractor.
- H. If surface or ground contamination is suspected or encountered, notify the City immediately. The Developer and Contractor, in communication with the City, shall assess conditions and develop a plan for continued work including but not limited to: removal and disposal of contamination, specifying different sewer line materials and/or sewer line realignment.
- I. All pipe, fittings, and joints shall be clean, and free of foreign debris.
- J. Exclude entrance of foreign material if work is suspended or stopped.
 - 1. Close ends of pipe with snug-fitting closures such as end caps.
 - 2. Do not let water fill the trench. Include provisions to prevent flotation if water control measures are inadequate.
 - 3. Remove water, sand, mud, and other undesirable material from trench before removal of end cap.

3.02 WATER CONTROL

- A. Develop and implement an approved stormwater pollution prevention plan including erosion control measures. Prevent surface water and subsurface or ground water from entering excavations.
- B. If required, dewater to lower groundwater elevation a sufficient depth below pipe and structures to allow specified subgrade preparation, pipe laying, backfilling, and testing.

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1. If dewatering is required, the contractor shall submit a project-specific dewatering plan prepared by an Engineer with at least 10 years' experience designing dewatering systems. Develop and implement site specific studies as needed to assist with the design.
- C. Water from surface runoff, downspouts, and subsurface drains shall be managed and controlled by the Contractor through an approved site drainage system. Equipment and materials required to remove water from excavations shall be on-site and available for uses throughout construction.
- D. Water disposal shall be the responsibility of the Contractor and completed in accordance with applicable federal, state, and local regulations.

3.03 INSTALLATION

A. Pipe Laying

1. In accordance with ASTM D2321 – Standard Practice for Underground Installation of thermoplastic pipe sewers and other gravity flow applications.
2. Perform only when weather and trench conditions are suitable. Do not lay in water.
3. Remove trash, debris, vegetation, snow, ice, water or other unsatisfactory materials from excavations.
4. All materials shall be carefully lowered into the trench using means and methods to prevent damage and entrance of foreign debris. Rolling or dropping materials will not be permitted. End hooks will not be permitted.
5. Commence laying at the downstream end of line and install pipe with spigot ends in the direction of flow. Bells shall be in the direction of the laying operations.
6. Open ends of sewer lines shall be adequately sealed to prevent intrusion of foreign debris during all work stoppages.
7. Clean piping and structures; remove all foreign debris. Maintain drag or swab line and pull past each joint as it is completed.
8. Install concrete cradles, encasement, and anchors in accordance with approved plans. Provide temporary support as required to position or anchor the pipe. Concrete shall be worked beneath pipe to eliminate all voids. Place concrete evenly on both sides of pipe.

B. Manhole Installation:

1. In accordance with ASTM C891 – Standard Practice for Installation of Underground Concrete Utility Structures.
2. Install manholes at locations and orientation and of type as shown on the plans and Standard Details.
3. Seal joints between manhole sections, conical sections, grade rings and frames. Provide water tight manhole covers where specified or shown on the plans.
4. Install and seal pipe connections as specified.
5. Place concrete inverts and benches. Inverts shall be shaped to the incoming and outgoing pipes and smoothly shaped from pipe to pipe to the top of invert at springline. Form smooth, curved channels. Slope benches from manhole wall down to channel at 1 in/ft.

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6. Set top of frames and covers at specified elevations. In general, flush with surface in pavement structures and 1 inch above finished surface in all other area, unless otherwise specified.
7. Fill all voids, holes, and defects with hydraulic cement non-shrink grout. If interior protective coatings are specified, ensure compatibility of filler and coating materials.
8. If field applied, apply waterproof protective coating to exterior surfaces. If factory installed, repair damaged coatings.
9. Apply interior protective coating where specified and shown on the plans.
10. Install external joint sealing bands according to manufacturer's recommendations and specifications.
11. Where indicated, install chimney seals as specified and shown on the plans.

C. Service Connections

1. See Standard Details
2. Provide wye or tee type fitting on sewer main at service connections as shown on Standard Details. Inserta Tee type fittings require City approval.
3. No connections shall have bends greater than 45 degrees.
4. Where indicated, install service line cleanouts according to Standard Details.
5. Re-connect services in accordance with these specifications.
6. If existing service lines will be disconnected and abandoned, the service line shall be plugged with a water-tight seal.
7. Document connection locations relative to manhole locations. Document offset location to existing service line and clean out location. Provide documentation to City.

D. Joining

1. Join pipe in accordance with manufacturer's recommendations
 - a. Clean and lubricate all joint and gasketed surfaces.
 - b. Employ means and methods to prevent damage during jointing.
 - c. Inspect joint openings and deflection for compliance with specifications.
2. Install gaskets, seals, sleeves, couplings, and other fittings according to manufacturer recommendations.
3. Pipe expansion and contraction due to changes in temperature shall be monitored during construction. Previously joined pipe shall be inspected to ensure joints have not separated due to expansion and contraction.

E. Cutting Pipe

1. Cut neatly without damage to pipe. Surfaces shall be perpendicular to pipe centerline.

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2. Remove burrs and sharp edges and smooth the pipe end by grinding.

F. Casing Pipe

1. Where required, install casing to satisfy separation requirements.
2. When typical trench-type construction techniques are used, subgrade preparation, bedding, initial backfill, and final backfill shall be in accordance with Standard Specification Section 01002 – Earthwork
3. When trenchless construction techniques are used, installation shall be in accordance with Standard Specifications Section 01003 – Directional Drilling and Section 01004 – Utility Jacking and Boring

G. Furnish and install plugs where necessary to properly complete required testing.

H. Tracer Wire

1. Attach continuous tracer wire to top of sewer line or force main, either taped, banded, or strapped at 5 feet to 7 feet intervals. Install according to manufacturer's recommendations.
2. Tracer wire shall be looped to the surface at all Manholes and service line cleanouts, and locations specified or as shown on the plans.
3. All sewer service lines shall have a tracer wire from the sewer main tap to the cleanout at Right-Of-Way.
4. Prior to acceptance, Contractor shall perform conductivity testing for all tracer wire. Full continuity must be established prior to final acceptance.

I. Warning Tape:

1. Install continuous warning tape at least 2 feet directly above all sewer lines.

J. Backfilling and Pavement Repair:

1. Backfill and finish surface in accordance with Standard Specification Section 01002 – Earthwork, and Standard Specification Section 01005 – Pavement Structure Repair.

K. Connections to Existing Manholes:

1. Where specified and shown on the drawings, connect new sewer main to existing manholes. Provide inside or outside drop type in accordance with drawings and specifications.
2. Cut holes in manhole wall to permit pipe insertion, alignment and gradient establishment and a minimum 2-inch annular space between pipe and wall across full circumference. Remove all debris prior to bedding pipe and placing grout. For smaller pipe (four (4) inch to six (6) inch), the manhole shall be core drilled and a link seal installed. This work is subject to approval of the City of Moberly
3. Coat surface of hole with grout prior to setting pipe. Place grout bedding prior to inserting pipe. Place pipe in grout bedding and allow to set.

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4. After setting, completely fill annular space with grout and provide smooth surface flush with manhole wall.
5. Construct new inverts between new and existing flowlines in accordance with manhole installation section of this specification.
6. The Enforcement Officer shall observe all connections to existing manholes. If, in the opinion of the City, manhole repair and replacement is required, subsequent mitigation work will be the responsibility of the Contractor.

3.04 QUALITY CONTROL

A. General

1. All work shall be inspected and approved by the Enforcement Officer prior to backfilling. Contractor shall notify the Enforcement Officer and arrange for inspection and observation of all testing prior to commencing.
2. Contractor shall obtain approval from Enforcement Officer prior to making any connections to existing manholes. The Enforcement Officer or representative must be present during any connection activities.
3. The Contractor shall furnish all equipment, labor and other materials and services necessary to perform pressure testing, deflection testing, and pipe gradient verification.
4. All pipe being tested shall have backfill placed in accordance with specifications, except in pavement structure areas. Placement of pavement structure base and surface courses shall be completed after all pressure, leak, deflection, and distortion testing requirements are met. Prior to backfill, verify pipe is to grade and alignment along entire length. Care should be taken during backfill to avoid moving the pipe.
5. Manhole water tightness testing shall be performed prior to backfilling.
6. Submit results of each test to Enforcement Officer.
7. Test failures require repair of failed portions of system until satisfactory test results are achieved.

B. Deflection/Distortion Testing

1. Deflection/Distortion testing shall be performed on all pipe at least 30 days after backfilling.
2. A go/no-go mandrel shall be used. The diameter of the mandrel shall be at least 95% (i.e. 5% Deflection Mandrel) of the pipe base inside diameter determined in accordance with ASTM D3034 or ASTM F679. Base inside diameter is established by subtracting a statistically derived tolerance package from the PVC sewer pipe in accordance with ASTM standard the pipe was manufactured.
3. The device shall be manually pulled through the pipe section being tested. Where possible, begin testing at downstream end of pipe. Mechanical pulling devices are not allowed.
4. Failure to advance the mandrel through the pipe constitutes a failed test.

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C. Low Pressure Air Test for Pipe Sections

1. Perform test in accordance with ASTM F1417 - Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air. During joining, ASTM F3058 – Standard Practice for Preliminary Field Testing of Thermoplastic Pipe Joints for Gravity Flow (Non-Pressure) Sewer Lines may be used to test individual joints. Final testing for acceptance will be in accordance with ASTM F1417 methods.
2. Seal ends of pipe and openings air and watertight.
3. Minimum test pressure shall be 5 psig above average groundwater pressure, if any, at pipe springline.
4. Pressurize pipe and allow pressure to stabilize at least 4 minutes. Adjust pressure to 5 psig and begin recording time. Measure the amount of elapsed time it takes for the pressure to drop 1 psi. in minutes and seconds.
5. Reference Table 1 in ASTM F1417 Minimum Time for a 1 psig Pressure Drop for Size and Length of Pipe for $Q = 0.0015 \text{ ft}^3/\text{min}/\text{ft}^2$ of Internal Surface. Measured time greater than those listed in the table for a particular pipe size and length constitute a passing test.

D. Manhole Water Tightness

1. Vacuum testing and acceptance shall be in accordance with ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill. These testing requirements do not apply to existing manholes, unless otherwise specified or shown on project drawings.
2. Seal manhole. Apply 10 in/Hg vacuum. This creates a pressure differential of approximately 5 psi from outside to inside when test is conducted under normal atmospheric pressure conditions. Maintain vacuum for at least 5 minutes.
 - a. De-water as necessary to remove additional hydrostatic pressure. Vacuum testing a manhole system subject to hydrostatic pressure may induce a pressure differential in excess of design limits of critical flexible connectors.
3. Begin recording time. Measure the amount of elapsed time it takes for the pressure to drop 1 in/HG in minutes and seconds.
4. Reference Table 1 in ASTM C1244 for minimum elapsed time for a drop in vacuum of 1 in/Hg. Measured time greater than those listed in the table for a particular manhole size and depth constitute a passing test.

END OF SECTION 01001

SECTION 01002 EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes specifications for earthwork, trenching, backfilling and compacting. The work shall consist of all labor, materials, and equipment required to install sewer main and appurtenances in accordance with contract documents, drawings, and specifications.
- B. The Contractor shall employ skilled, qualified workers and supervision to perform work following generally accepted industry practices. The City reserves the right to suspend work if, in the opinion of the Enforcement Officer, this requirement is not being met.

1.02 DEFINITIONS

- A. City: City of Moberly, Missouri
- B. Sewer Department: City Sewer Department
- C. Enforcement Officer: City Director of Public Utilities or designated representative.
- D. Engineer: Licensed Professional Engineer in responsible charge for the project licensed to perform services in the State of Missouri.
- E. Developer: Entity requesting sewer service construction, modifications, extensions, or alterations to the City sewer system. The Developer could be a public or private entity, such as the City of Moberly or a private Developer.
- F. Contractor: Entity contracted by Developer to perform work on sewer main and services. The Contractor is responsible for constructing approved plans.
- G. Owner: Entity who is responsible for long term performance, maintenance, and operation of new sewer mains. The City will typically become the Owner upon final approval and acceptance by City. The Developer will be responsible for the project until final approval and acceptance.
- H. ASTM: American Society for Testing and Materials

1.03 RELATED WORK

- A. Section 01000 – Approval and Acceptance
- B. Section 01005 - Pavement Repair
- C. Section 01006 - Seeding

1.04 REFERENCE STANDARDS

- A. ASTM D698 - Moisture-Density Relations of Soils and Soil Aggregate Mixtures, Using 5.5 lb. Rammer and 12-inch Drop.
- B. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (shallow depth).

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- C. Missouri Standard Specification for Highway Construction.

1.05 NOTIFICATION

- A. The Contractor shall notify the Enforcement Officer at least five (5) business days prior to commencing work.

1.06 SUBMITTALS

- A. See Section 1000 – Approval and Acceptance.
- B. Work Plan detailing means, methods, equipment, sequencing, and schedule for Earthwork.
- C. Traffic control plan and required permits from jurisdictions having authority.

1.07 BASIS OF PAYMENT

- A. This section applies to projects where the City of Moberly is the responsible Developer/Owner.
- B. Trenching, backfilling, and compacting shall be included in the Contract unit cost of sewer main pipe.
- C. Additional, extra, and/or changes in work must be approved by Enforcement Officer. Payment will be on basis of Contract documents regarding changes in work.

PART 2 - PRODUCTS

- 2.01** Materials shall be in accordance with Contract Documents, plans, specifications, and approved submittals.

2.02 BEDDING AND INITIAL BACKFILL

- A. Granular bedding containing no clods, muck, sod, frozen material, roots or other deleterious material with a plasticity index not greater than 6 and meeting the following gradation requirements.

Sieve Size	Percent Passing
1.5 inch	100
#4	20-60
#200	0-6

2.03 FINAL BACKFILL

- A. **Excavation Spoils:** suitable silt, sand, gravel, lean clay or combinations thereof containing no clods, muck, organics, frozen material, or other deleterious material from excavations. Maximum particle size shall be 3 inches.
 - 1. If sufficient quantity of suitable materials is not available from excavation spoils, the Contractor shall identify and import suitable materials for backfill. Contractor shall dispose of all unsuitable material.

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- B. **Select Granular Backfill**, Section 1010, Missouri Standard Specification for Highway Construction. Material shall meet the following gradation:

Sieve Size	Percent Passing
3 inches	100
#40	20-60
#200	0-6

2.04 AGGREGATE BASE AND SURFACE

- A. **Aggregate Base:** Type 5, Section 1007, Missouri Standard for Highway Construction.
- B. **Aggregate Surface:** Grade A or B, Section 1006, Missouri Standards for Highway Construction.

2.05 CONTROLLED LOW-STRENGTH MATERIAL (FLOWABLE FILL)

- A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:
1. Portland Cement: ASTM C150/C150M, Type I or Type II.
 2. Fly Ash: ASTM C618, Class C or F.
 3. Normal-Weight Aggregate: ASTM C33/C33M, 3/4-inch nominal maximum aggregate size.
 4. Water: ASTM C94/C94M.
 5. Air-Entraining Admixture: ASTM C260/C260M.
- B. Produce conventional-weight, controlled low-strength material with 100-psi compressive strength when tested according to ASTM C495/C495M and placed in the field with a slump between 9 and 11 inches tested in accordance with ASTM C143..

PART 3 - EXECUTION

3.01 GENERAL

- A. Verify the actual locations (horizontal and vertical) of all utilities prior to beginning work. Protect all utilities from damage during construction. Damage to existing utilities shall be repaired to the satisfaction of the utility provider at Contractor's expense.
- B. Establish line and grade to maintain minimum burial and separation requirements in coordination with Enforcement Officer and Engineer. Notify Enforcement Officer and Engineer if conflicts with existing utilities or structures exist.
- C. Trench excavations shall be protected in accordance with applicable Federal, State, and local regulations, Laws, and rules in accordance with OSHA 29 CFR part 1926. Trench and excavation stability shall be the responsibility of the Contractor.
- D. Implement and maintain traffic control plan

3.02 WATER CONTROL

- A. Develop and implement stormwater pollution prevention plan including erosion control measures. Prevent surface water and subsurface or ground water from entering excavations. Dewater to remove all water a sufficient depth below pipe and structures to allow specified subgrade preparation, pipe laying, and backfilling. The plan shall address water disposal if dewatering is required.

- B. Water from surface runoff, downspouts, and subsurface drains shall be managed and controlled by the Contractor through an approved site drainage system. Equipment and materials required to remove water from excavations shall be on-site and available for uses throughout construction.
- C. Water disposal shall be the responsibility of the Contractor and completed in accordance with applicable federal, state, and local regulations.

3.03 PREPARATION

- A. Clear and grub areas of excavation.
- B. Backfilling and compaction shall not occur until the following conditions are satisfied:
 - 1. Subgrade proof-compacting, required inspection, testing and acceptance by Enforcement Officer.
 - 2. Soft, rutting, pumping, frozen or otherwise unsuitable soils in base of excavations shall be removed at direction of Enforcement Officer. Notify Enforcement Officer once subgrade elevations are reached. Excavate unsuitable soils within directed limits and replace with suitable materials approved by Enforcement Officer. Suitable materials could include but are not limited to bedding, initial backfill, and final backfill.
 - 3. All trash, debris, vegetation, snow, ice, water or other unsatisfactory materials shall be removed from excavations.

3.04 EXCAVATION

- A. Excavate trenches to approved subgrade elevations. Unless otherwise specified, the minimum trench width shall be at least one (1) foot greater than the outside diameter of the pipe.
- B. If rock is encountered, it shall be excavated at least 12 inches wider than the outside diameter of the pipe and at least 6 inches deeper than planned subgrade elevation. Alternatively, pipe alignment and grade could be adjusted to avoid rock excavation if separation, burial, and joint restraint requirements are satisfied. If additional excavation is required, bedding material shall be used as backfill.
 - 1. For City projects, notify Enforcement Officer and Engineer immediately if rock is encountered within excavation limits, and earthwork progress significantly slows or stops. Excavation in rock shall not progress unless approved by Enforcement Officer. The Enforcement Officer will provide guidance and specifications for rock excavation and backfilling on a case by case basis.
 - 2. For City projects, unless identified as a bid item, additional cost for rock excavation will be paid for as additional work in accordance with Contract Documents regarding changes.
 - 3. For City projects, unless identified as a bid item or otherwise addressed on a project specific basis, if surface or ground contamination is suspected or encountered, notify the City immediately. The Contractor, in communication with the City, shall assess conditions and develop a plan for continued work including but not limited to: removal and disposal of contamination, specifying different sewer line materials, and sewer line realignment. Additional work, will be paid for as additional work in accordance with Contract Documents.
- C. Stockpile materials acceptable for use as backfill and topsoil. Stockpile locations relative to excavations shall be incorporated into Contractor's responsibility for excavation stability. Place,

grade, and shape stockpiles to promote positive drainage with adequate erosion control. Dispose unsuitable materials.

3.05 BACKFILLING

- A. Proof-compact subgrade prior to placing bedding or laying pipe. Proof-compacting shall be performed in the presence of Enforcement Officer; approval is required before placing bedding to receive pipe.
- B. Shape and compact bedding to provide uniform bearing of the pipe. Excavate bell holes to allow for unobstructed assembly of the joint. Make bell hole as small as practical. After the joint has been made, carefully fill bell hole with bedding material and compact.
- C. After pipe laying, joining and aligning, place and compact bedding and initial backfill as shown on the plans. Ensure material is worked under the haunch of the pipe to provide adequate side support. Take precautions to prevent movement of the pipe during placement and compaction of haunching material.
- D. Place and compact initial backfill to provide cover over the pipe. Use methods to prevent pipe damage or displacement.
- E. In unpaved areas, place final backfill using methods to prevent pipe damage or displacement. Place final backfill in 6-inch loose lifts and compact. Leave material neatly mounded over the trench. Maintain trench and fill settled areas as they occur. Finish grade to eliminate uneven areas. Seed areas where required.
- F. In paved areas, place and compact base and surface repairs in accordance with details and project specification Section 01005 - Pavement Repair. Place final backfill using methods to prevent pipe damage or displacement.
- G. Jetting or water-settling backfill is prohibited, unless permitted by Enforcement Officer and Engineer.

3.06 COMPACTION

- A. Compact materials in accordance with ASTM D698 and ASTM 6938 and according to the following table:

Material	Minimum Compaction	Maximum Loose Lift Thickness
Bedding and Initial Backfill	90%	4 inches
Suitable Excavation Spoils	90%	6 inches
Select Granular Backfill	95%	6 inches
Aggregate Base	95%	6 inches
Aggregate Surface	95%	6 inches
Bituminous Surface	98%	3 inches

- B. Moisture condition (wetting or drying) fill as needed to achieve optimum moisture contents and required compaction.
- C. Use compaction equipment capable of achieving required densities and avoid damage to pipe, adjacent utilities, and adjacent structures. Self-propelled, "heavy" roller or pad type vibratory rollers shall not be operated within 2 feet from top of pipe.

3.07 QUALITY CONTROL

- A. Compaction quality control shall be provided by Contractor and will be incidental to Contract Unit costs. Quality control technicians and testing organizations shall be trained and certified to perform required testing in accordance with ASTM standards and specifications.
- B. Quality control density testing frequency shall be in accordance with the following table:

Material	Testing Frequency per lift
Bedding and Initial Backfill	One test every 300 linear feet of trench
Suitable Excavation Spoils	One test every 300 linear feet of trench
Select Granular Backfill	One test at each pavement structure crossing
Aggregate Base	One test at each pavement structure crossing
Aggregate Surface	One test at each pavement structure crossing
Bituminous Surface	One test at each pavement structure crossing

- C. Areas where testing indicates insufficient compaction shall be re-compacted, re-conditioned, re-worked, and/or moisture conditioned until requirements are met and to satisfaction of Owner and Engineer.
- D. Controlled low strength material shall be tested in the field for slump and samples collected for comprehensive strength testing. Slump and comprehensive testing shall be in accordance with ASTM C143 and ASTM C495, respectively. Testing frequency shall be 1 set of tests per 100 cubic yards of material used. Slump shall be between 9 and 11 inches. Minimum compressive strength is 100 psi.

3.08 MAINTENANCE

- A. The Contractor will demobilize equipment and restore the work site to the original condition. All excavations will be backfilled, and surfaces restored according to specifications and project drawings.
- B. Remove all leftover materials, including unsuitable excavation spoils, trash, debris, and other construction waste in accordance with applicable federal and state laws and regulations.
- C. Protect newly graded areas from traffic (except pavement crossings) and erosion. Keep free of trash and debris See Section 01005- Pavement Repair for pavement area maintenance.
- D. Repair and re-establish grades in settled, eroded and rutted areas to specified tolerances during warranty period and to satisfaction of Enforcement Officer.
- E. Where differential movement is measurable or observable along excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add appropriate backfill material, compact, and replace surface treatment according to project specifications and plans. Restore appearance, quality, and condition of surface or finish to match adjacent work to satisfaction of Enforcement Officer.

END OF SECTION 01002

SECTION 01003 DIRECTIONAL DRILLING

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes specifications for directional drilling installation methods for High Density Polyethylene (HDPE) pipe casing or steel pipe casing beneath traveled ways or at locations shown on the drawings. The Contractor shall provide all labor, materials, and equipment required to install casing in accordance with these specifications.

1.02 SUBMITTALS

- A. Submit work plans, shop drawings, and product data for approval. Submittals shall include:
1. Detailed work plan and sequencing including procedures and schedule;
 2. Proposed line and grade of casing pipe to maintain minimum burial depth, minimum separation requirements from existing utilities, and radius of curvature;
 3. Proposed equipment including but not limited to: drilling rig, rotary torque capacity, thrust/pullback pressures, tensile load limit calculations, drill bits, mud system including pump and motor size, down-hole tools, guidance system with stated accuracy, and safety systems;
 4. Pit locations;
 5. Design, means, methods and materials for pit excavation support;
 6. Pit dimensions showing relative location to traveled ways;
 7. Dewatering methods;
 8. Spoil removal methods;
 9. Drilling fluids including water source;
 10. Methods for monitoring drill fluid volumes and losses;
 11. Product data;
 12. Casing pipe material and size;
 13. Casing pipe segment joining methods and procedures;
 14. Product pipe spacers and casing pipe end seal materials;
 15. Erosion control and stormwater pollution prevention plan;
 16. Adverse conditions plan:
 - a. Plan shall address means and methods of work, especially HDPE fusion welding, in adverse conditions such as freezing temperatures, precipitation, and wind and mitigation measures to eliminate resulting effect on pipe fusion and installation;
 17. Remediation plan:
 - a. Identify means and methods to remove obstructions at the boring face;
 - b. Identify remedial measures for mitigating damage to existing facilities, and impacts to traveled ways, including ground subsidence and heaving;
 - c. Identify remedial measures for excessive drill fluid loss;
 18. Experience:
 - a. Submit a list of at least five (5) successfully completed directional drilling projects using HDPE pipe sizes of at least 18 inches and lengths greater than 150 feet within the last five (5) years. Include project owner contact information references substantiating Contractor's experience; and,
 19. As-Built Drawings showing horizontal and vertical alignment of completed casing installation. This submittal shall also include pullback pressure logs, volume of drilling fluid, and fluid losses, if any.

1.03 NOTIFICATION

- A. The Contractor shall notify the Enforcement Officer at least two (2) business days prior to commencing work. All work shall be performed in the presence of the Enforcement Officer.

1.04 BASIS OF PAYMENT

- A. Directional drilling shall be paid for by the lineal footage of casing installed along casing centerline. The unit price shall include:
 - 1. Excavation, use, and backfilling of all pits;
 - 2. Removal and disposal of spoils and drilling fluid;
 - 3. Traffic control;
 - 4. Verifying location and depth of all utilities within impacted area;
 - 5. Casing pipe installation; and,
 - 6. All labor, equipment, and materials required to complete the work.
- B. The unit cost shall be for casing pipe and shall not include product pipe and installation.
- C. Cost associated with all work and materials not specifically identified as a bid item shall be considered as incidental to other pay items.
- D. Additional, extra, and/or changes in work must be approved by Enforcement Officer. Payment will be on basis of Contract documents regarding changes in work.

PART 2 – PRODUCTS

2.01 HIGH DENSITY POLYETHYLENE PIPE CASING

- A. Materials shall be in accordance with Contract Documents, plans, specifications, and approved submittals.
- B. All HDPE shall be manufactured from PE 4710 resin listed as TR-4 by the Plastic Pipe Institute (PPI). The resin shall meet ASTM D3350 with a minimum 445474C cell classification. The manufacturer shall certify the specified cell classification.
- C. HDPE casing shall conform to ASTM F 714, ANSI and AWWA C906, and have an NSF-61 listing.
- D. All pipe, fittings, and fusion equipment shall be provided by one supplier. Fusion equipment must be in satisfactory working order. All fusion equipment operators shall be qualified to perform heat fusing procedures.

2.02 STEEL PIPE CASING

- A. Materials shall be in accordance with approved submittals.

- B. Steel casing pipe shall meet or exceed ASTM A-139, Grade B with a minimum wall thickness of 0.25 inches and minimum yield strength of 35,000 psi. Steel casing shall be joined by fully welding around the entire circumference of the pipe. Welding shall conform to AWWA Standard C206.

2.03 CASING END SEALS

- A. Synthetic rubber end seals shall be installed on each end of the casing pipe. End seals shall be Advanced Model Products – Model AC Pull-on or approved equal and fastened tightly with stainless steel bands.

2.04 INSULATING SPACERS

- A. Projection type, non-metallic spacers shall be RACI, Advance Products & Systems, or approved equal. Refer to manufacturer's product data for spacer type and size.

2.05 DIRECTIONAL DRILLING EQUIPMENT

- A. Directional drilling equipment shall consist of a hydraulically-powered directional drilling rig of sufficient capacity to perform the bore and pullback the casing pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the crossing, a drilling fluid recycling system to remove solids from the drilling fluid, a guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle drilling fluid volume, and qualified 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 this project.
- B. The directional drilling rig shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while recirculating pressurized drilling fluid mixture to a guidable drill head. The rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations. The rig shall be electrically grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm that automatically sounds when an electrical current is detected.
- C. Drilling fluid shall be composed of clean water and appropriate bentonite clay additives in accordance with approved submittals. Water shall be from source approved by Enforcement Officer and be contaminant free. Drilling fluids shall be thoroughly mixed and free of clumps or clods.

PART 3 - EXECUTION

3.01 GENERAL

- A. Verify the actual locations (horizontal and vertical) of all utilities prior to beginning work. Protect all utilities from damage during construction. Damage to existing utilities shall be repaired to the satisfaction of the utility provider at Contractor's expense.
- B. Construction means, methods, and materials shall be in accordance with approved submittals.
- C. Entry and exit pit excavations shall be constructed in accordance with approved submittals. Excavations should be protected in accordance with applicable Federal, State, and Local regulations, laws, and rules. Excavation protection shall not be less than the standards and regulations established by OSHA 29 CFR Part 1926. Trench safety and stability shall be the responsibility of the Contractor, including placement of excavation spoils and control of water intrusion.

3.02 HANDLING OF MATERIAL

- A. Handle pipes, conduits, casing, and ancillary items in such a manner as not to damage the material. Pipe rollers or other approved means shall be used during pullback operations to avoid damage to casing pipe and product pipe.
- B. Damage to material shall be repaired to the satisfaction of the Enforcement Officer and, if required, replaced.
- C. The Enforcement Officer maintains the authority to reject materials damaged or otherwise unsuitable for project use.

3.03 DRILLING FLUID

- A. Disposal of drilling fluid and spoils will be the responsibility of the Contractor and shall be done in compliance with all Federal, State, and local regulations.
- B. All drilling fluids and loose cuttings shall be contained in access pits or holding tanks for recycling and disposal. Drilling fluid returns into or on other areas shall be cleaned up and disposed of immediately. The Contractor shall notify the Enforcement Officer immediately if drilling fluid returns occur or are spilled in areas other than approved holding structures.
- C. The Contractor shall provide adequate means and equipment for removing drilling fluid and spoils from access pits to mitigate potential overflows and provide for final disposal. Disposal equipment shall be present during all directional drilling operations.

3.04 DIRECTIONAL DRILLING

- A. Perform directional drilling operations in accordance with approved submittals. The Contractor shall provide all material, equipment, and facilities required to perform directional drilling.
- B. The drill path shall be accurately staked with alignment and entry/exit pits.
- C. Pipe, conduit, and casing installation under traveled ways shall progress on a continuous basis without stoppage, except for adding sections, until the leading edge has reached the receiving pit. Engineering approval is required for variations from this specification.
- D. Stop operations if ground movement is detected and implement the remediation plan in accordance with approved submittals. Immediately report movement to the Enforcement Officer. Repair any damages to traveled ways, including displacement (up or down) resulting from construction operations. Corrective actions shall be approved by the responsible authority. Mitigating repairs and associated costs will be the responsibility of the Contractor.

3.05 PILOT HOLE BORING

- A. The entry angle, pilot hole, and boring process shall maintain a curvature that does not exceed allowable bending radius of casing or product pipe and in accordance with approved submittals.
- B. The pilot hole shall be drilled along the Contractor submitted, and approved line, grade, and radius of curvature. No curves will be accepted with a radius more than approved curvature.
- C. Drilling fluid pressures shall be monitored at all times during operations. Pressures shall be controlled to avoid hydraulic fracturing of subsurface materials and prevent structure and ground surface heaving.

Standard Specifications for
Water Main Construction

- D. Drilling fluid and cutting return shall be monitored at all times during operations. The volume of drilling fluids and spoil return anticipated shall be estimated based on subsurface conditions encountered. Excessive drilling fluid loss or excess spoil return shall be reported immediately to the Enforcement Officer. The Enforcement Officer will, in consultation with the Contractor, determine if corrective actions are required.
- E. Contractor shall provide adequate containment, drilling fluid and spoil removal equipment and other means required to contain all fluid and spoils and/or remove it from site. No additional compensation will be allowed for containment or cleanup resulting from spillage, hydraulic fracturing, or other means leading to release of drilling fluids.
- F. Alignment Adjustments and Restarts
 - 1. The Contractor shall follow the approved alignment within specifications. If adjustments or restarts are required, the Contractor shall notify the Enforcement Officer for approval prior to adjusting.

3.06 CASING PIPE INSTALLATION

- A. After the pilot hole is completed and approved, the enlarging phase of installation shall begin. The borehole diameter shall be increased to accommodate the pullback operations for the specified casing pipe size. The type of reamer shall be determined by subsurface soil conditions encountered during pilot hole drilling. The reamer type shall be selected by the Contractor and must be equipped with a swivel.
- B. The maximum hole diameter shall be 1.25 times the casing pipe outside diameter. The Contractor may elect to perform multiple reaming passes. Multiple reaming passes will be completed at Contractor's expense.
- C. Borehole stability shall be the responsibility of the Contractor. Open boreholes shall be stabilized using appropriate means to prevent collapse while still maintaining ability to perform work.
- D. Once pullback operations have commenced, operations must continue without interruption until pipe is completely pulled into borehole. During pullback operations, Contractor will not apply more than the maximum safe pipe pull pressure at any time. If casing pipe becomes stuck, Contractor will cease pulling operations and allow any potential "suction lock" to subside and resume pulling operations. If pipe remains stuck, Contractor will notify Engineer. Engineer and Contractor will review available options and proceed accordingly.
- E. Drilling fluid pressures shall be monitored at all times during operations. Pressures shall be controlled to avoid hydraulic fracturing of subsurface materials and avoid structure and ground surface heaving. Contractor shall provide adequate containment, drilling fluid and spoil removal equipment and other means required to contain all fluid and spoils and/or remove it from site. No additional compensation will be allowed for containment or cleanup resulting from spillage, hydraulic fracturing, or other means leading to release of drilling fluids.
- F. Drilling fluid and cutting return shall be monitored at all times during operations. The volume of drilling fluids and spoil return anticipated shall be estimated based on subsurface conditions encountered. Excessive drilling fluid loss or excess spoil return shall be reported immediately to the Enforcement Officer. The Enforcement Officer will, in consultation with the Contractor, determine if corrective actions are required.
- G. The casing pipe shall be protected and supported during pullback operations using rollers or other approved means to minimize damage.

3.07 OBSTRUCTIONS

- A. The Enforcement Officer must be notified immediately if any obstruction is encountered that stops progress of operations. The Contactor shall review the situation with the Enforcement Officer and determine the feasibility of continuing drilling operations, switching to alternative methods, and/or modifying alignment/location of the jack and bore.
- B. If continuing is deemed unfeasible or impractical, the obstructed pilot hole or casing shall be abandoned in place and filled completely with grout or other approved materials.
- C. For City projects, substantiated cost of abandoned work resulting from unforeseen obstructions encountered will be paid for as additional work in accordance with Contract documents.

3.08 ALIGNMENT

- A. The Contractor shall provide an accurate means to monitor horizontal and vertical positions of the casing during construction operations. The Enforcement Officer shall always have access to this information during the directional drilling process. If a magnetic guidance system is used, the Contractor shall identify any surface geo-magnetic anomalies and take appropriate corrective measures to ensure accurate spatial tracking of the drill stem.
- B. The casing shall be installed within a tolerance of 6 inches from approved, line and grade over 100 feet. The tolerance will be adjusted proportionally for shorter or longer casing lengths; however, the maximum deviation for casing lengths longer than 150 feet shall be no more than 1 foot.
- C. The alignment of casing shall be established to allow unrestricted insertion of the product pipe, including spacers, pipe bells, and restrained joints. If product pipe cannot be installed, the casing shall be abandoned and filled with grout or other approved materials. The Contractor shall establish another casing at a location approved by Enforcement Officer.

3.09 PRODUCT PIPE INSTALLATION

- A. The product pipe shall be the size and type as specified or shown on the plans.
- B. The end of product pipe shall be protected from damage during installation into the casing.
- C. Product pipe shall have restrained joints within the casing.
- D. The product pipe shall be supported in the casing pipe using projection-type non-metallic casing spacers.
 - 1. The minimum number of spacer projections around the product pipe circumference shall equal the pipe diameter (i.e. a nominal 10-inch pipe shall have minimum of 10 projections). Refer to manufacturer's product data for spacer type and size.
 - 2. Casing spacers shall fasten tightly onto the product pipe to prevent movement during installation.
 - 3. The insulator spacing shall be installed to support the weight of the product pipe and contents. Spacers shall be placed a maximum of 2 feet from each side of a joint and evenly spaced along the product pipe at intervals not to exceed manufacturer's recommendations or 6 feet, whichever is less.
 - 4. Double spacers shall be installed one foot from each end of the casing.
 - 5. Projection type spacers shall be RACI, Advance Products & Systems, or approved equal.

Standard Specifications for
Water Main Construction

3.10 SITE RESTORATION

- A. The Contractor will demobilize equipment and restore the work site to the original condition. All excavations will be backfilled according to specifications and project drawings. Surface restoration shall be completed in accordance with Section 01005 – Pavement Repair and Section 01006 - Seeding.
- B. Remove all excess spoils and dispose of in accordance with all federal, state, and local regulations.

END OF SECTION 01003

SECTION 01004 UTILITY JACKING AND BORING

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes specifications for jack and bore installation of steel casing. The Contractor shall provide all labor, materials, and equipment required to install casing in accordance with these specifications. This work shall consist of pushing/jacking a steel casing pipe with a boring auger rotating within the pipe to remove spoils as casing is advanced.

1.02 SUBMITTALS

- A. This section applies to projects where the City of Moberly is the responsible Developer/Owner.
- B. Submit work plans, shop drawings, and product data for Engineer approval. Submittals shall include:
1. Work plan and sequencing;
 2. Proposed line and grade of casing pipe to maintain minimum burial depth and separation requirements from existing utilities;
 3. Equipment and site configuration;
 4. Jacking and receiving pit locations;
 5. Design, means, methods and materials for pit excavation support;
 6. Pit dimensions showing relative location to traveled ways;
 7. Dewatering methods;
 8. Differential movement monitoring methods;
 9. Excavation face loss prevention methods;
 10. Spoil removal methods;
 11. Drilling fluids;
 12. Product data;
 13. Casing pipe material and size;
 14. Casing pipe segment joining methods and procedures;
 15. Product pipe spacers and casing pipe end seal materials;
 16. Erosion control and stormwater pollution prevention plan;
 17. Remediation plan:
 - a. Identify means and methods to remove obstructions at the boring face;
 - b. Identify remedial measures for mitigating damage to existing facilities, and impacts to traveled ways, including ground subsidence and heaving;
 18. Experience:
 - a. Submit a list of at least five (5) successfully completed jack and bore projects greater than 50 feet within the last five (5) years including project owner contact information references substantiating jack and bore installer's experience; and,
 19. As-Built Drawings showing horizontal and vertical alignment of completed jack and bore.

1.03 NOTIFICATION

- A. The Contractor shall notify the Enforcement Officer at least two (2) business days prior to commencing work. All work shall be performed in the presence of the Enforcement Officer.

Standard Specifications for
Sanitary Sewer System

1.04 BASIS OF PAYMENT

- A. This section applies to projects where the City of Moberly is the responsible Developer/Owner.
- B. Jack and Bore shall be paid for by the lineal footage of casing measured along casing centerline. The unit price shall include:
 - 1. Excavation, use, and backfilling of all pits;
 - 2. Removal and disposal of spoils and drilling fluid;
 - 3. Traffic control;
 - 4. Verifying location and depth of all utilities within impacted area;
 - 5. Casing pipe installation; and,
 - 6. All labor, equipment, and materials required to complete the work.
- C. The unit cost shall not include sewer pipe and installation.
- D. Cost associated with all work and materials not specifically identified as a bid item shall be considered as incidental to other pay items.
- E. Additional, extra, and/or changes in work must be approved by Enforcement Officer. Payment will be on basis of Contract documents regarding changes in work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials shall be in accordance with Contract Documents, plans, specifications, and approved submittals.
- B. Steel casing pipe shall meet or exceed ASTM A-139, Grade B with a minimum wall thickness of 0.25 inches and minimum yield strength of 35,000 psi. Steel casing shall be joined by fully welding around the entire circumference of the pipe. Welding shall conform to AWS requirements for the specific applications.
- C. Synthetic rubber end seals shall be installed on each end of the casing pipe. End seals shall be Advanced Model Products – Model AC Pull-on or approved equal fastened tightly with stainless steel bands.
- D. Projection type spacers shall be RACI, Advance Products & Systems, or approved equal. Refer to manufacturer's product data for spacer type and size.

PART 3 - EXECUTION

3.01 GENERAL

- A. Verify the actual locations (horizontal and vertical) of all utilities prior to beginning work. Protect all utilities from damage during construction. Damage to existing utilities shall be repaired to the satisfaction of the utility provider at Contractor's expense.
- B. Construction means, methods, and materials shall be in accordance with approved submittals.

Standard Specifications for
Sanitary Sewer System

- C. Excavations shall be constructed in accordance with approved submittals. Excavations should be protected in accordance with applicable Federal, State, and local regulations. Excavations must meet or exceed regulations established by OSHA 29 CFR Part 1926. Trench safety and stability shall be the responsibility of the Contractor.
- D. Disposal of excess spoils removed from the casing pipe shall be the responsibility of the Contractor and shall be done in compliance with all Federal, State, and local regulations.

3.02 HANDLING OF MATERIAL

- A. Handle pipes, conduits, casing, and ancillary items in such a manner as not to damage the material.
- B. Damage to material shall be repaired to the satisfaction of the Engineer or replaced at Contractor's expense.
- C. The Enforcement Officer maintains the authority to reject materials damaged or otherwise unsuitable for project use.

3.03 JACK AND BORE

- A. Perform jack and bore operations in accordance with approved submittals and the following requirements:
 - 1. Unsupported excavation (open-hole) ahead of the casing will not be permitted. Mechanical arrangements or other devices shall be provided at the leading end of the carrier to prevent drilling ahead of the casing.
 - 2. The use of water or slurry under pressure (jetting) or puddling shall not be permitted to facilitate boring, pushing, or jacking operations. Non-pressurized water or slurry is acceptable for use as a lubricant behind the cutter head.
 - 3. Pipe, conduit, and casing installation shall progress on a continuous basis without stoppage, except for adding sections, until the leading edge has reached the receiving pit. Engineering approval is required for variations from this specification.
- B. Employ methods to prevent loss of the excavation face in accordance with approved submittals.
- C. Stop operations if ground displacement is detected and implement the remediation plan in accordance with approved submittals. Repair any damages to traveled ways, including displacement (up or down) resulting from construction operations. Corrective actions shall be approved by the Engineer. Mitigating repairs and associated costs will be the responsibility of the Contractor.

3.04 OBSTRUCTIONS

- A. The Enforcement Officer must be notified immediately if any obstruction is encountered that stops progress of operations. The Contractor shall review the situation with the Enforcement Officer and determine the feasibility of continuing operations, switching to alternative methods, and/or modifying alignment/location of the jack and bore.
- B. If continuing is deemed unfeasible or impractical, the obstructed pilot hole or casing shall be abandoned in place and filled completely with grout or other approved materials.
- C. For City projects, substantiated cost of abandoned work resulting from unforeseen obstructions encountered will be paid for as additional work in accordance with Contract documents

3.05 ALIGNMENT

- A. The Contractor shall provide an accurate means to monitor horizontal and vertical positions of the casing during construction operations. The Enforcement Officer shall always have access to this information during the jack and bore process. If a magnetic guidance system is used, the Contractor shall identify any surface geo-magnetic anomalies and take appropriate corrective measures to ensure accurate spatial tracking of casing.
- B. Extreme care shall be exercised by the Contractor to maintain line and grade during jacking operations and casing installation. Modifications to means and methods may be required to maintain correct gradient and alignment or correct deviations when deemed necessary by the Enforcement Officer.
- C. The casing shall be installed within a tolerance that allows unrestricted sewer pipe installation at design gradient and alignment.
- D. The alignment of casing shall be established to allow unrestricted insertion of the sewer pipe, including spacers, pipe bells, and restrained joints.

3.06 SEWER PIPE INSTALLATION

- A. The sewer pipe shall be the size and type as specified or shown on the plans.
- B. The end of sewer pipe shall be protected from damage during installation into the casing.
- C. Sewer pipe shall have restrained joints within the casing.
- D. The carrier pipe shall be supported in the casing pipe using projection-type non-metallic casing spacers.
 - 1. The minimum number of spacer projections around the sewer pipe circumference shall equal the pipe diameter (i.e. a nominal 10-inch pipe shall have minimum of 10 projections). Refer to the manufacturer's product data for spacer type and size.
 - 2. Casing spacers shall fasten tightly onto the sewer pipe to prevent movement during installation.
 - 3. The insulator spacing shall be installed to support the weight of the sewer pipe and contents. Spacers shall be placed a maximum of 2 feet from each side of a joint and evenly spaced along the sewer pipe at intervals not to exceed manufacturer's recommendations or 6 feet, whichever is less.
 - 4. Double spacers shall be installed one foot from each end of the casing.
 - 5. Projection type spacers shall be RACI, Advance Products & Systems, or approved equal. Refer to manufacturer's product data for spacer type and size.
- E. Adjust pipe grade as needed by changing the thickness of spacers to compensate for gradient or alignment variations of the casing.

3.07 SITE RESTORATION

- A. The Contractor will demobilize equipment and restore the work site to the original condition. All excavations will be backfilled according to specifications and project drawings.

Standard Specifications for
Sanitary Sewer System

- B. Surface restoration shall be completed in accordance with contract requirements, Section 01005 – Pavement Repair, and Section 01006 – Seeding.
- C. All excess spoils and materials shall be removed and disposed of in accordance with applicable federal, state, and local regulations.

END OF SECTION 01004

SECTION 01005 PAVEMENT STRUCTURE REPAIR

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes specifications for repairing and restoring aggregate, concrete, and asphalt concrete pavement structures in areas where trenches cross these features. The Contractor shall provide all labor, materials, and equipment required to perform work in accordance with these specifications.

1.02 RELATED WORK

- A. Section 01002 – Earthwork
- B. Section 01003 – Directional Drilling
- C. Section 01004 – Utility Jacking and Boring

1.03 REFERENCE STANDARDS

- A. ASTM D698 - Moisture-Density Relations of Soils and Soil Aggregate Mixture, using 5.5 lb Rammer and 12 in Drop.
- B. Missouri State Highway and Transportation Commission: Missouri Standard Specifications for Highway Construction, current edition, including Section 613 Pavement Repair

1.04 BASIS OF PAYMENT

- A. This section applies to projects where the City of Moberly is the responsible Developer/Owner.
- B. Pavement Structure Repair shall be paid for by the lineal foot at Contract unit cost for surfaces listed on bid form and plan quantities table. Culvert, mailbox, or other surface features required to be removed as a result of construction shall be included in Contract unit cost.
- C. Cost associated with all work and materials not specifically identified as a bid item shall be considered as incidental to other pay items.
- D. Additional, extra, and/or changes in work must be approved by Enforcement Officer. Payment will be on basis of Contract documents regarding changes in work.

PART 2 - MATERIALS

2.01 AGGREGATE BASE AND SURFACE COURSE MATERIALS

- A. Aggregate Base: Type 5, Section 1007, Missouri Standard Specifications for Highway Construction.
- B. Aggregate Surface: Grade A or B, Section 1006, Missouri Standard Specifications for Highway Construction.

2.02 BITUMINOUS SURFACE COURSE AND PATCHING MATERIALS

- A. Prime Coat: Liquid Asphalt RC-MC Grade 30, Section 1015, Missouri Standard Specifications for Highway Construction.
- B. Base Mix: MoDOT Base, Section 401, Missouri Standard Specifications for Highway Construction.
- C. Tack Coat: SS-1 or SS-1H, Section 1015 Missouri Standard Specifications for Highway Construction.
- D. Surface Mix: Type BP-1, Section 401, Missouri Standard Specifications for Highway Construction.

2.03 PORTLAND CEMENT CONCRETE

- A. Portland Cement: Type I or Type II
- B. Concrete Mix: Portland Cement Concrete Base and Pavement, class B-1, non-air entrained with material conforming to Section 502 and 1000, Missouri Standard Specifications for Highway Construction with a slump between 3 and 6 inches.
- C. Water: potable
- D. Reinforcement: #4 rebar placed 12 inches on center each way. Concrete shall be dowelled into existing with drilled and epoxy set #4 rebar dowels placed 18 inches on center, 24 inches long.

PART 3 - EXECUTION

3.01 REPAIR

- A. All trenches in traveled ways shall be repaired with either Bituminous Surface Course and Patching Materials or Concrete Material according to standard details.
- B. All trenches in concrete sidewalk, driveways and roadways shall be repaired/replaced with concrete material according to standard details.
- C. All trenches in aggregate surfaced pavement structures shall be replaced with Aggregate Base and Surface Course according to standard details.
- D. Pavement replaced shall adhere to the following procedures:
 - 1. Place granular backfill to provide temporary surface over trenches across traveled ways. Open to traffic for at least one week. Repair all potholes and level surface daily, adding additional material as needed. Base under the pavement shall be 8 inches thick.
 - 2. After pavement has been open to traffic for one week, saw cut and remove existing pavement on both sides of trench, remove sufficient base course material, level, compact, and construct pavement patch per the project details.

3.02 COMPACTION

- A. In accordance with Section 01002 Earthwork.

Standard Specifications for
Sanitary Sewer Systems

3.03 MAINTENANCE

- A. Maintain surface repairs until final acceptance. Replace and repair areas where excessive displacement, rutting, raveling, or other unacceptable damages occur as a result of construction.
- B. Repaired areas will be accepted at end of maintenance period and all pavement repairs are performing well without further damages.

END SECTION 01005

SECTION 01006 SEEDING

PART 1 – GENERAL

1.01 RELATED WORK

- A. Section 01002 - Earthwork
- B. Section 01003 – Directional Drilling
- C. Section 01004 – Utility Jacking and Boring

1.02 REFERENCE STANDARDS

- A. Missouri Standard Specification for Highway Construction, current edition.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, and location of packaging. Damaged packages are not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.04 BASIS OF PAYMENT

- A. This section applies to projects where the City of Moberly is the responsible Developer/Owner.
- B. Seeding cost shall be included in Contract unit cost for sewer pipe.

PART 2 - MATERIALS

2.01 SEED

- A. Seed shall meet the following minimum percentages for purity and germination, and maximum percentage for weed seed. Vendor certification for each lot number of numbers with testing statement. Seed that has not been tested and certified within the last 1 year will be rejected

Type	Purity	Germination	Weed
Kentucky Blue Grass	85	80	<1.0
Perennial Rye	98	85	<1.0
Red Fescue	97	85	<1.0

2.02 FERTILIZER

- A. Standard commercial fertilizer supplied separately or in mixtures and furnished in water tight containers. Each container shall be marked with weight and manufacturer's guaranteed analysis showing ingredient percentages.
- B. Furnish a mixture of chemical ingredients providing total nitrogen, phosphoric acid, and potassium required based on soil analysis or as otherwise specified. Chemical ingredient tolerances shall be within 2 percent.

Standard Specifications for
Sewer Main Construction

2.03 MULCH

- A. Fresh wheat, rye, or oat straw, air dried. Non-toxic to vegetation and to the germination of seed, free from noxious seeds and weed seeds.

2.04 APPLICATION RATES

- A. **Fertilizer:** provide total nitrogen, phosphoric acid, and potassium required based on soil analysis or as otherwise specified.

B. **Seed**

- | | | |
|----|----------------------|------------------------|
| 1. | Kentucky Blue Grass: | 1.10 lbs/1,000 sq. ft. |
| 2. | Perennial Rye: | 0.60 lbs/1,000 sq. ft. |
| 3. | Redtop: Red Fescue: | 0.40 lbs/1,000 sq. ft. |

PART 3 - EXECUTION

3.02 PREPARATION

- A. When soil is in a tillable condition, cultivate to a depth of 4 inches, reducing soil particles to a size not larger than 2 inches. Moisture condition surface to receive seed.
- B. Assure seed bed is level, smooth, and free of weeds, clods, stones, roots, and sticks. Moisture condition as needed.
- C. Apply fertilizer and mix into the top 2 inches of soil. Apply within 48 hours prior to seeding.

3.03 SEEDING AND MULCHING

- A. Uniformly sow seeds in two operations at right angles to each other. Within 12 hours after seeding roll areas at right angles to runoff with a lawn type roller. Do not over compact.
- B. Within 24 hours of seeding apply mulch at 2 1/2 tons per acre. Stabilize vegetative mulch by embedding in soil to prevent mulch loss by wind or water erosion.

3.04 MAINTENANCE

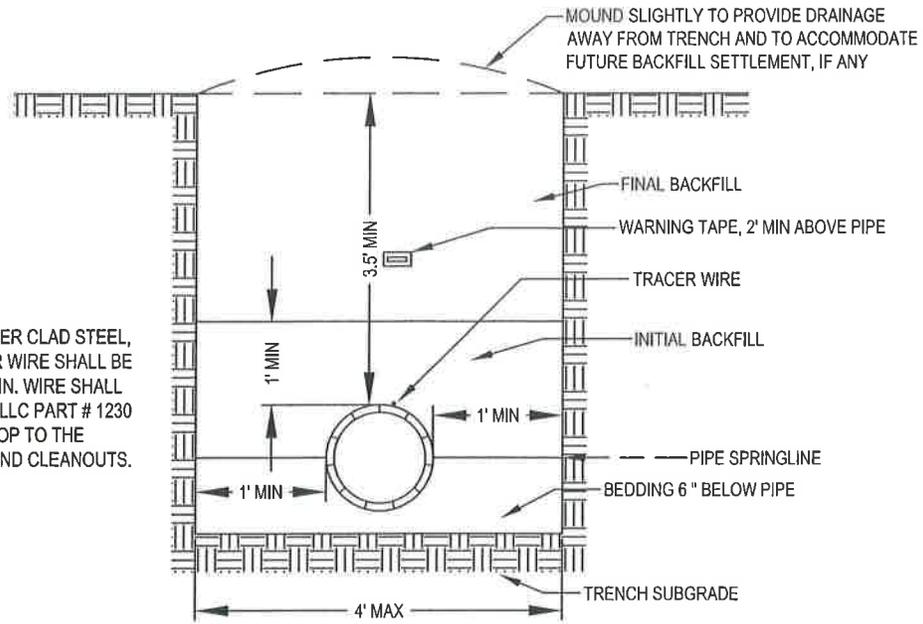
- A. Maintain surfaces until final acceptance and supply additional topsoil, seed, and fertilizer where necessary, including areas affected by erosion.
- B. Replant damaged grass areas showing root growth failure, deterioration, bare or thin spots, and eroded areas.
- C. Seeded areas will be accepted at end of maintenance period when seeded areas are properly established and otherwise acceptable.

END OF SECTION 01006

**CITY OF MOBERLY, MISSOURI
STANDARD SPECIFICATIONS FOR SANITARY SEWER SYSTEMS**

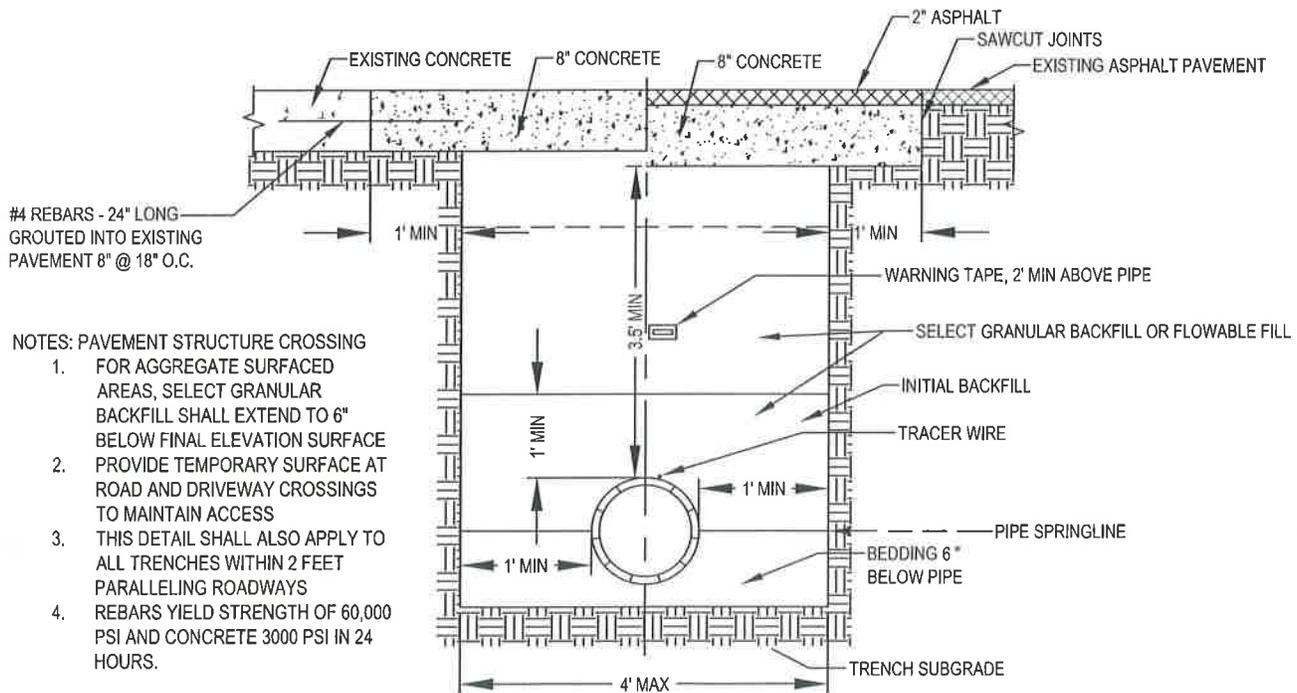
SECTION 2 – STANDARD DETAILS FOR SANITARY SEWER SYSTEMS

02001	Typical Sewer Trench Installations
02002	Typical Sanitary Sewer Manhole
02003	Typical Service Connection and Cleanout
02004	Typical Sewer Main in Casing
02005	Typical Water/Sewer Main Separation Requirements



TRACER WIRE SHALL BE COPPER CLAD STEEL, CCS, (12 GAUGE AWG) TRACER WIRE SHALL BE ATTACHED TO THE SEWER MAIN. WIRE SHALL BE COPPERHEAD INDUSTRIES LLC PART # 1230 HS OR EQUAL, WIRE SHALL LOOP TO THE SURFACE AT ALL MANHOLES AND CLEANOUTS.

TYPICAL TRENCH INSTALLATION DETAIL-UNPAVED AREAS



#4 REBARS - 24" LONG
GROUTED INTO EXISTING
PAVEMENT 8" @ 18" O.C.

NOTES: PAVEMENT STRUCTURE CROSSING

1. FOR AGGREGATE SURFACED AREAS, SELECT GRANULAR BACKFILL SHALL EXTEND TO 6" BELOW FINAL ELEVATION SURFACE
2. PROVIDE TEMPORARY SURFACE AT ROAD AND DRIVEWAY CROSSINGS TO MAINTAIN ACCESS
3. THIS DETAIL SHALL ALSO APPLY TO ALL TRENCHES WITHIN 2 FEET PARALLELING ROADWAYS
4. REBARS YIELD STRENGTH OF 60,000 PSI AND CONCRETE 3000 PSI IN 24 HOURS.

TYPICAL TRENCH INSTALLATION DETAIL-PAVEMENT STRUCTURE CROSSINGS

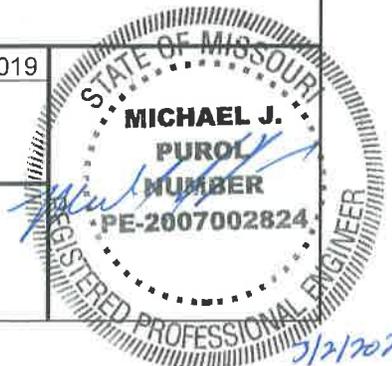
STANDARD DETAIL No. 02001

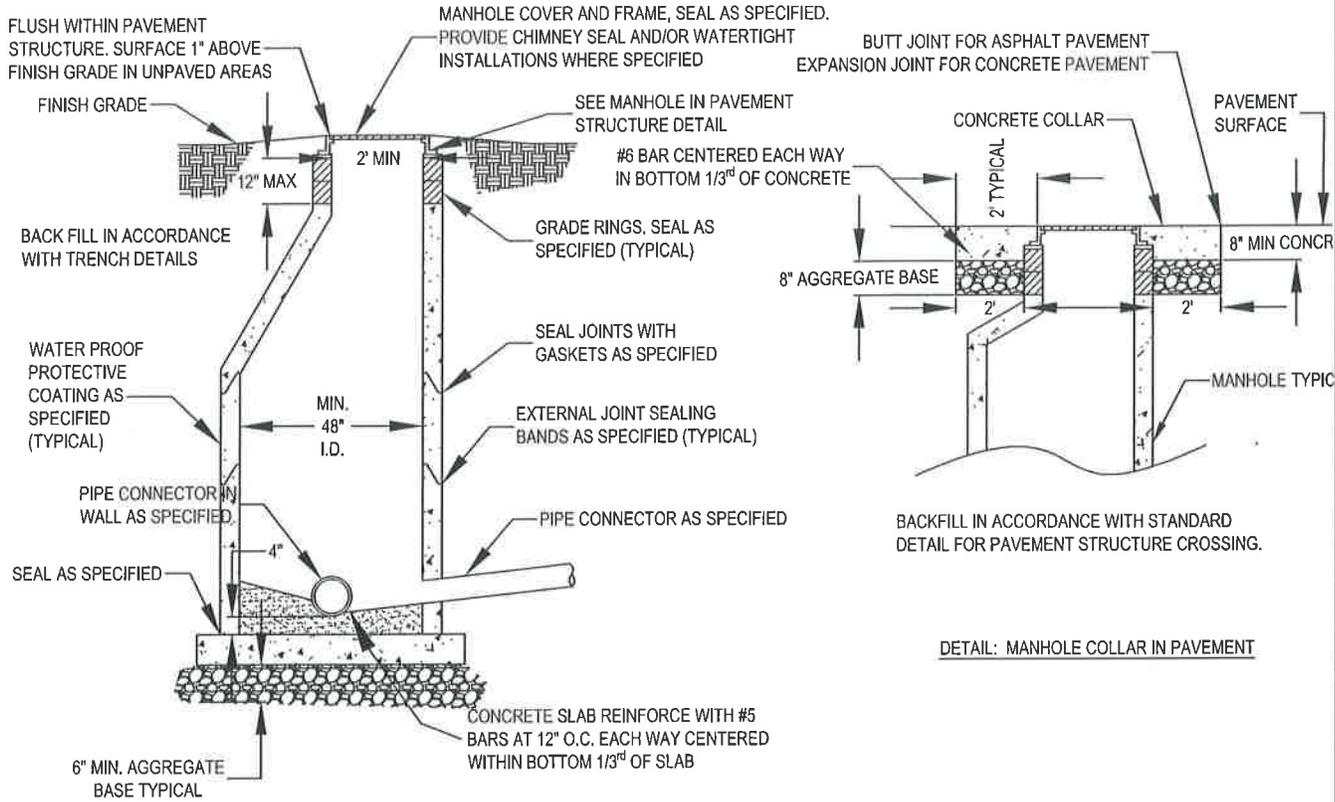
REVISION DATE: 10-08-2019

SANITARY SEWER CONSTRUCTION
TYPICAL SEWER MAIN IN TRENCH INSTALLATIONS
CITY OF MOBERLY, MISSOURI

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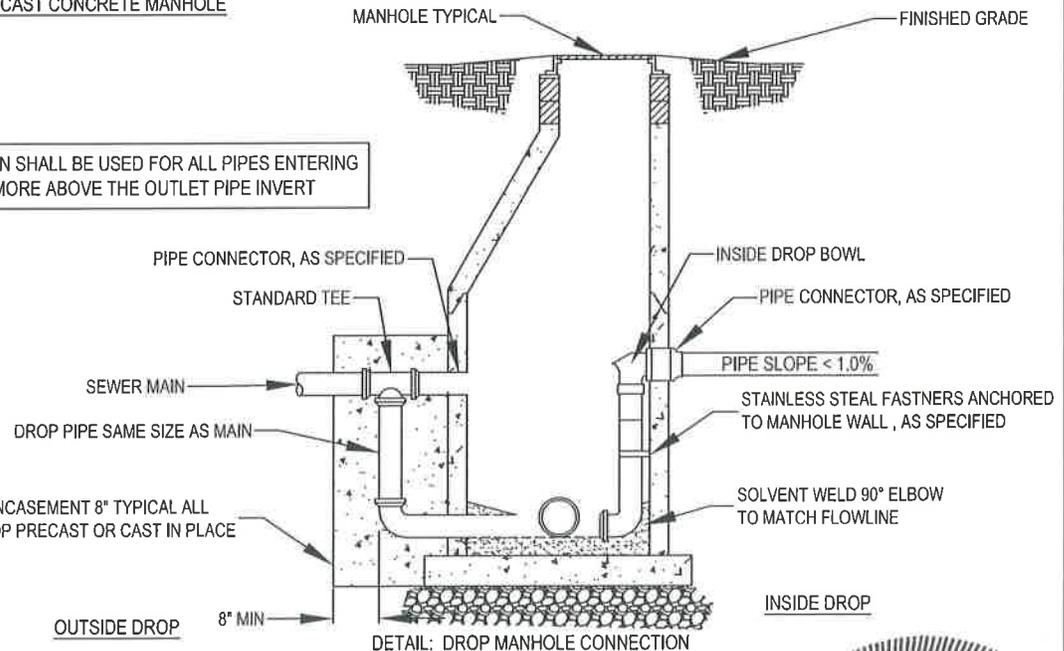
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TYPICAL PRECAST CONCRETE MANHOLE

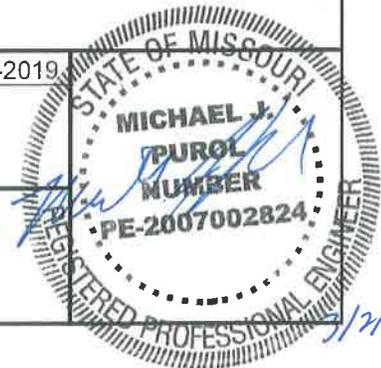
DROP CONNECTION SHALL BE USED FOR ALL PIPES ENTERING MANHOLE 24" OR MORE ABOVE THE OUTLET PIPE INVERT



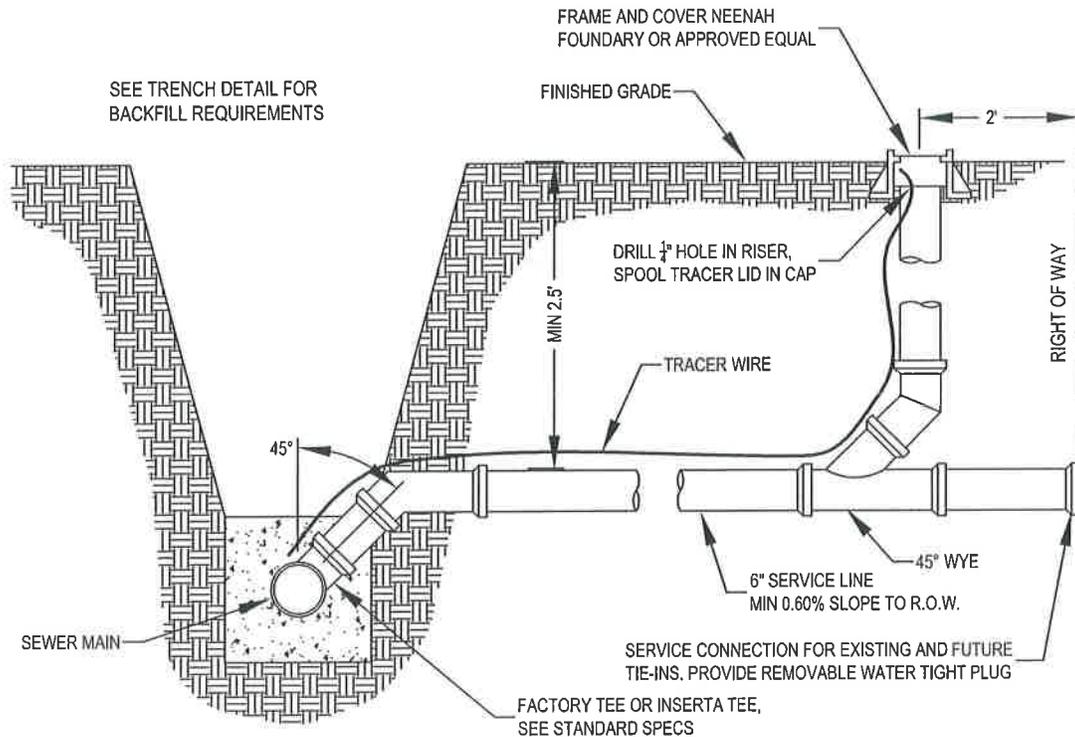
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SANITARY SEWER CONSTRUCTION
TYPICAL SANITARY SEWER MANHOLE
CITY OF MOBERLY, MISSOURI



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NOTES:

1. CONTRACTOR TO RECORD SERVICE LOCATION RELATIVE TO MANHOLES FOR ALL SERVICE CONNECTIONS AND PROVIDE TO THE CITY PRIOR TO PROJECT COMPLETION.
2. MINIMUM SERVICE LINE SHALL BE 6", UNLESS OTHERWISE APPROVED.
3. SERVICE WYE TO BE INSTALLED, SUBJECT TO ALL TEST REQUIREMENTS.
4. SERVICE WYE AND SERVICE LINE TO BE THE SAME MATERIAL AS SEWER MAIN, UNLESS OTHERWISE APPROVED.
5. PROVIDE TRACER WIRE AND WARNING TAPE FROM WYE TO CLEANOUT.
6. MARK TIE-IN LOCATION AT GROUND SURFACE WITH SURVEY LATHE OR STEEL POST.

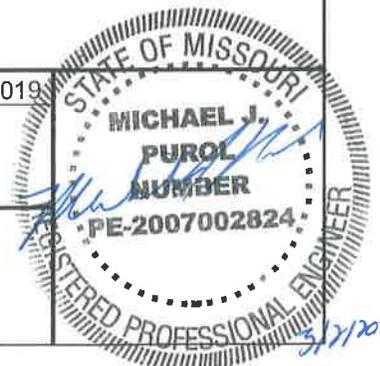
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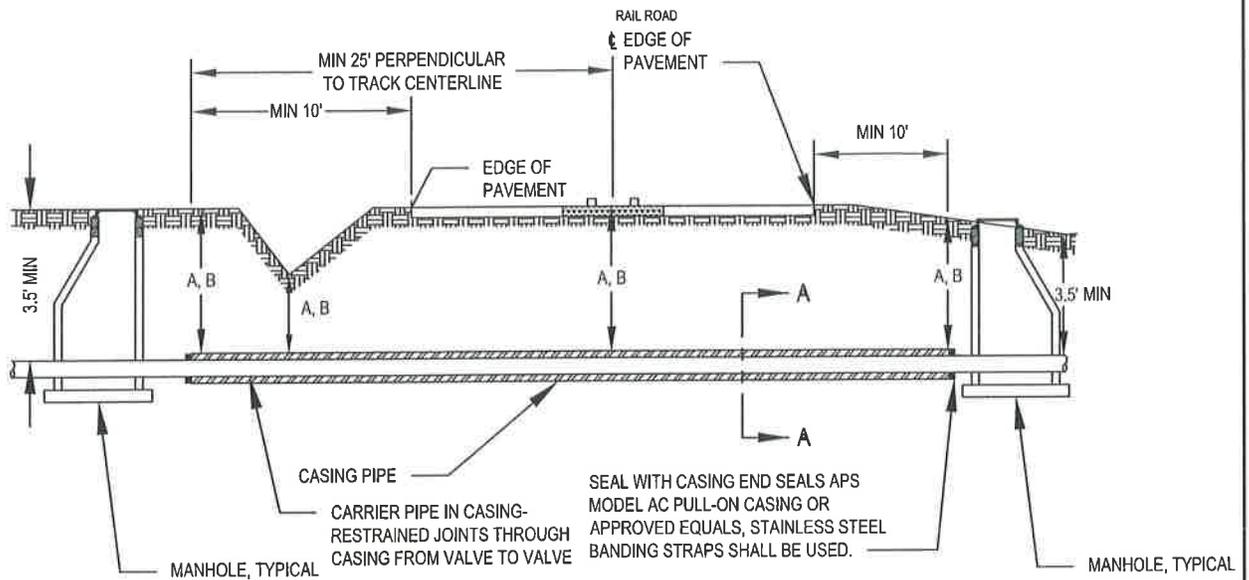
REVISION DATE: 10-08-2019

SANITARY SEWER CONSTRUCTION
TYPICAL SERVICE CONNECTION AND CLEANOUT
CITY OF MOBERLY, MISSOURI

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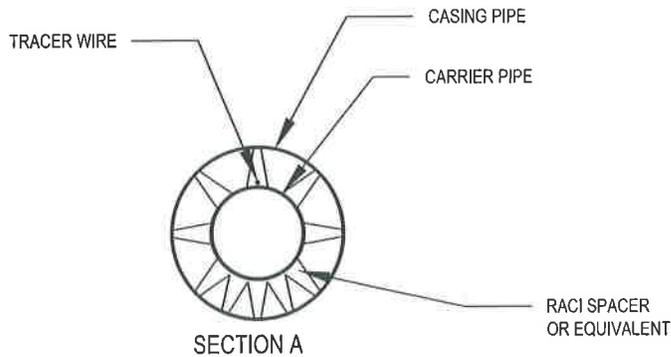


NOTES:

1. CONTRACTOR MEANS AND METHODS FOR TRENCHLESS CONSTRUCTION METHOD MUST BE APPROVED.
2. IF DIRECTIONAL DRILLING METHOD IS USED, THE MINIMUM EMBEDMENT DEPTH TO TOP OF FINISHED CASING SHALL BE 8 FEET.
3. SEE STANDARD SPECIFICATIONS FOR ALLOWABLE CASING PIPE MATERIALS.
4. CONTRACTOR SHALL OBTAIN NECESSARY PERMITS AND APPROVALS FROM APPROPRIATE REGULATORY AUTHORITY. ALL WORK SHALL MEET ALL REQUIREMENTS OF RESPONSIBLE REGULATORY AUTHORITY
5. CASING SPACERS SHALL BE RACI OR APPROVED EQUAL WITH STAINLESS STEEL BOLTS AND NUTS. CASING SPACERS SHALL BE INSTALLED AT INTERVALS NOT TO EXCEED MANUFACTURER'S SPECIFICATIONS OR 6' WHICHEVER IS LESS. DOUBLE SPACERS SHALL BE INSTALLED 1' FROM EACH END OF THE CASING. ONE CASING SPACER MUST BE WITHIN 2' OF EACH SIDE OF A PIPE JOINT. SPACERS SHALL HAVE A MINIMUM HEIGHT THAT EXCEEDS THE PIPE BELL HEIGHT AND RESTRAINED JOINT HEIGHT.
6. ALL JOINTS BETWEEN GATE VALVES SHALL BE RESTRAINED JOINTS.

NOTES:

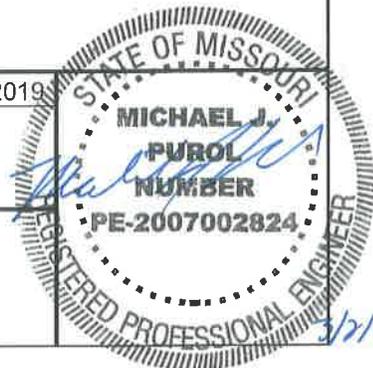
- A. MINIMUM COVER OVER CASING FOR ROADWAY CROSSINGS SHALL BE 4 FEET WITHIN LIMITS SHOWN
- B. MINIMUM COVER OVER CASING FOR RAILWAY CROSSING SHALL BE 6 FEET WITHIN LIMITS SHOWN
- C. COVER DEPTH GREATER THAN MINIMUMS MAY BE REQUIRED AS A CONDITION OF AUTHORITY HAVING JURISDICTION FOR ROAD OR RAILROAD



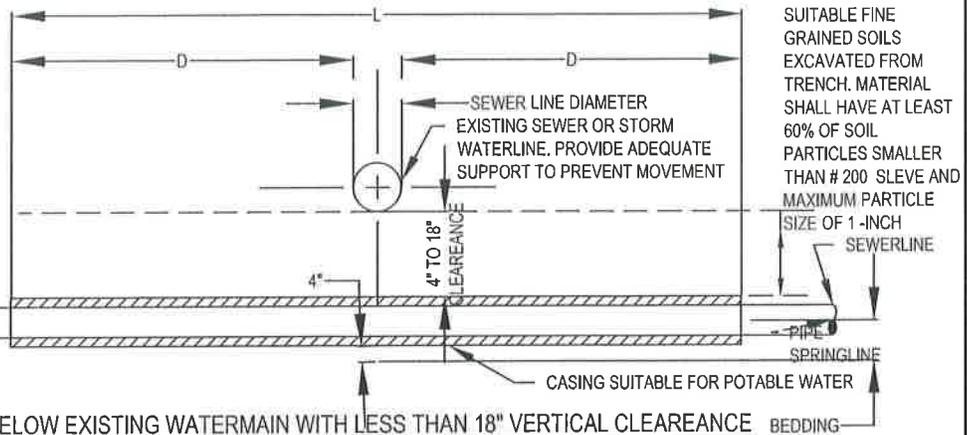
STANDARD DETAIL No. 02004

REVISION DATE: 10-08-2019

SANITARY SEWER CONSTRUCTION
TYPICAL SEWER MAIN IN CASING
CITY OF MOBERLY, MISSOURI

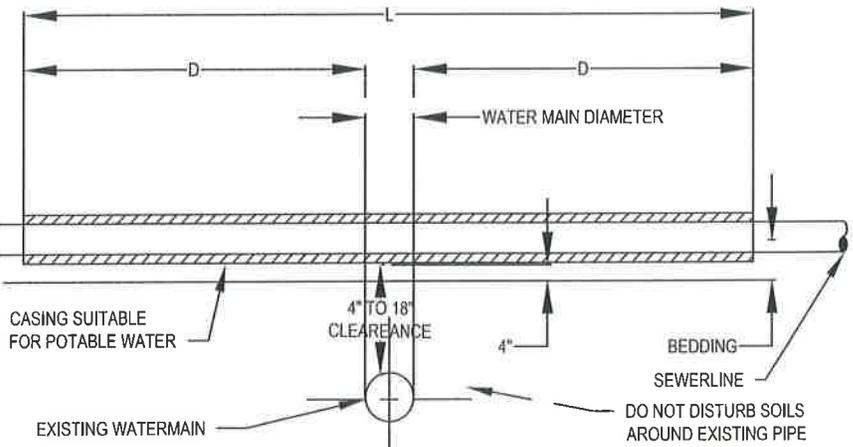


1. BACKFILL FROM 1' ABOVE PIPE UP TO SURFACE IN ACCORDANCE WITH TYPICAL TRENCH DETAILS
2. IN NO CASE SHALL WATER MAIN BE LESS THAN 1.5' BELOW STORM WATER OR SEWER LINE
3. D= DISTANCE REQUIRED TO PROVIDE 10 FEET SEPARATION MEASURED PERPENDICULAR TO EXISTING STORMWATER OR SEWER LINE
4. L= LENGTH OF CASING REQUIRED
5. JOINTS SHALL BE RESTRAINED WITHIN CASING
6. USE PROJECTION TYPE CASING SPACERS, RACI OR APPROVED EQUAL



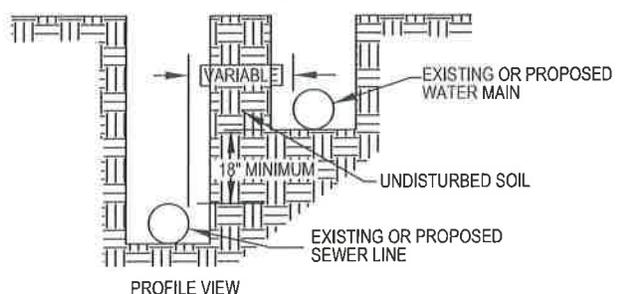
PROPOSED SEWERLINE BELOW EXISTING WATERMAIN WITH LESS THAN 18" VERTICAL CLEARANCE

1. JOINTS SHALL BE RESTRAINED WITHIN CASING
2. BEDDING AND BACKFILL FOR WATER MAIN IN ACCORDANCE WITH TYPICAL TRENCH DETAILS
3. USE PROJECTION TYPE CASING SPACERS RACI OR APPROVED EQUAL
4. MINIMUM SEPARATION BETWEEN CASING PIPE AND EXISTING LINE SHALL BE NO LESS THAN 4"
5. D= DISTANCE REQUIRED TO PROVIDE 10' SEPARATION MEASURED PERPENDICULAR TO EXISTING STORMWATER OR SEWERLINE PIPE.
6. L= LENGTH OF CASING REQUIRED

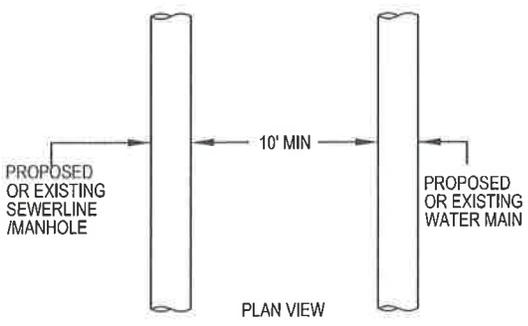


PROPOSED SEWERLINE ABOVE EXISTING WATERMAIN WITH LESS THAN 18" VERTICAL SEPARATION

PROPOSED SEWER (OR WATER) IS LOCATED 10 FEET OR LESS FROM EXISTING WATER (OR SEWER).



WATER AND NON-POTABLE SEPARATION REQUIREMENTS (VERTICAL SEPARATION)



WATER AND SEWER SEPARATION REQUIREMENTS (HORIZONTAL SEPARATION)

STANDARD DETAIL No. 02005
 SANITARY SEWER CONSTRUCTION
 TYPICAL SEWER MAIN SEPARATION REQUIREMENTS
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