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16. Abstract

Because of the lack of standard utility installation construction specifications at the Texas Department of Transportation (TxDOT), many different versions of utility installation special specifications and special provisions exist around the state. Those specifications and provisions frequently contain very similar information. Closely related to the need to standardize construction specifications for utility installations is the need to standardize methodologies and procedures for the determination of utility relocation costs. In practice, there is a wide range of ways in which utility companies submit utility relocation costs for reimbursement. This lack of standardization translates into difficulties such as how to verify the validity of the data utility companies provide and how to adequately prepare for audits and other internal and external inquiries.

Report 0-4998-1, *A Unit Cost and Construction Specification Framework for Utility Installations*, describes a prototype framework of construction specifications and corresponding unit cost work items for utility installations at TxDOT and recommendations on how to implement that framework in Texas. This report complements Report 0-4998-1 by providing a set of specification requirements for water and sanitary sewer utility installations that could be used to prepare the construction specifications. The requirements for each specification include a summary table that outlines the main characteristics of the proposed specification and provides a listing of bid items, subsidiary items, and units of measurement, followed by a list of specification requirements that follow TxDOT's 2004 standard construction specification style.

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CONSTRUCTION SPECIFICATION REQUIREMENTS FOR WATER AND SANITARY SEWER INSTALLATIONS

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DISCLAIMER

The contents of this document reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Federal Highway Administration (FHWA) or the Texas Department of Transportation (TxDOT). This document does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. The engineer in charge of the project was Cesar Quiroga, P.E. (Texas Registration #84274).

The United States Government and the State of Texas do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

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LIST OF ACRONYMS, ABBREVIATIONS, AND TERMS

ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials (now known as ASTM International)
AWWA	American Water Works Association
CFR	Code of Federal Regulations
CIPP	Cured in Place Pipe
CL	Coating or Lining
FHWA	Federal Highway Administration
FP	Folded Pipe
HAB	Horizontal Auger Boring
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
J	Jacking
MT	Microtunneling
NCTCOG	North Central Texas Council of Governments
NSF	National Sanitation Foundation (now known as NSF International)
OSHA	Occupational Safety and Health Administration
PE	Polyethylene
PR	Pipe Replacement
PVC	Polyvinyl Chloride
R	(Pipe) Ramming
ROW	Right of Way
SDR	Standard Dimension Ratio
SL	Sliplining
T	Tunneling
TCEQ	Texas Commission on Environmental Quality
TTC	Trenchless Technology Center
TxDOT	Texas Department of Transportation
UAR	Utility Accommodation Rules

CHAPTER 1. INTRODUCTION

The Utility Accommodation Rules (UAR) prescribe minimums relative to the accommodation, location, installation, adjustment, and maintenance of utility facilities on the state right of way (ROW) (*1*). The UAR only cover basic requirements, which makes it necessary to rely on additional guidelines, specifications, and special provisions to handle situations that are not covered by the rules. Because of the lack of standard utility installation construction specifications at TxDOT, many different versions of special specifications and special provisions—frequently containing similar information—exist around the state.

Closely related to the need to standardize construction specifications for utility installations is the need to standardize methodologies and procedures for the determination of utility relocation costs. According to the TxDOT *Utility Manual*, utility relocation cost estimates need to identify the items of work to be performed, as broken down into categories such as materials, labor, overhead, transportation and equipment, traffic control, betterments, and miscellaneous (*2*). In practice, there is a wide range of ways in which utility companies submit utility relocation costs for reimbursement. Frequently, the cost information is not backed by a corresponding set of specifications that could facilitate inspections in the field. This lack of standardization translates into difficulties such as how to verify the validity of the cost data utility companies provide and how to adequately prepare for audits and other internal and external inquiries.

Report 0-4998-1, *A Unit Cost and Construction Specification Framework for Utility Installations*, describes a prototype framework of construction specifications and corresponding unit cost work items for utility installations at TxDOT and recommendations on how to implement that framework in Texas (*3*). This report complements Report 0-4998-1 by providing a set of specification requirements for water and sanitary sewer utility installations that could be used to prepare the construction specifications. The requirements for each specification include a summary table that outlines the main characteristics of the proposed specification and provides a listing of bid items, subsidiary items, and units of measurement, followed by a list of specification requirements that follow TxDOT's 2004 standard construction specification style (*4*). This report is organized as follows:

- Chapter 1 is this introductory chapter.
- Chapter 2 contains all the specification requirements.

CHAPTER 2. SPECIFICATION REQUIREMENTS FOR WATER AND SANITARY SEWER INSTALLATIONS

SPECIFICATION FRAMEWORK

Using the current drainage structure framework as a model, the researchers developed a proposed framework for water and sanitary sewer utility installations (Figure 1 and Figure 2) (*3*). Taking into consideration recommended changes to some existing standard specifications, Figure 3 shows a proposed updated specification framework for drainage structures. Each proposed new or modified specification has one or more bid items and/or subsidiary items associated with it.

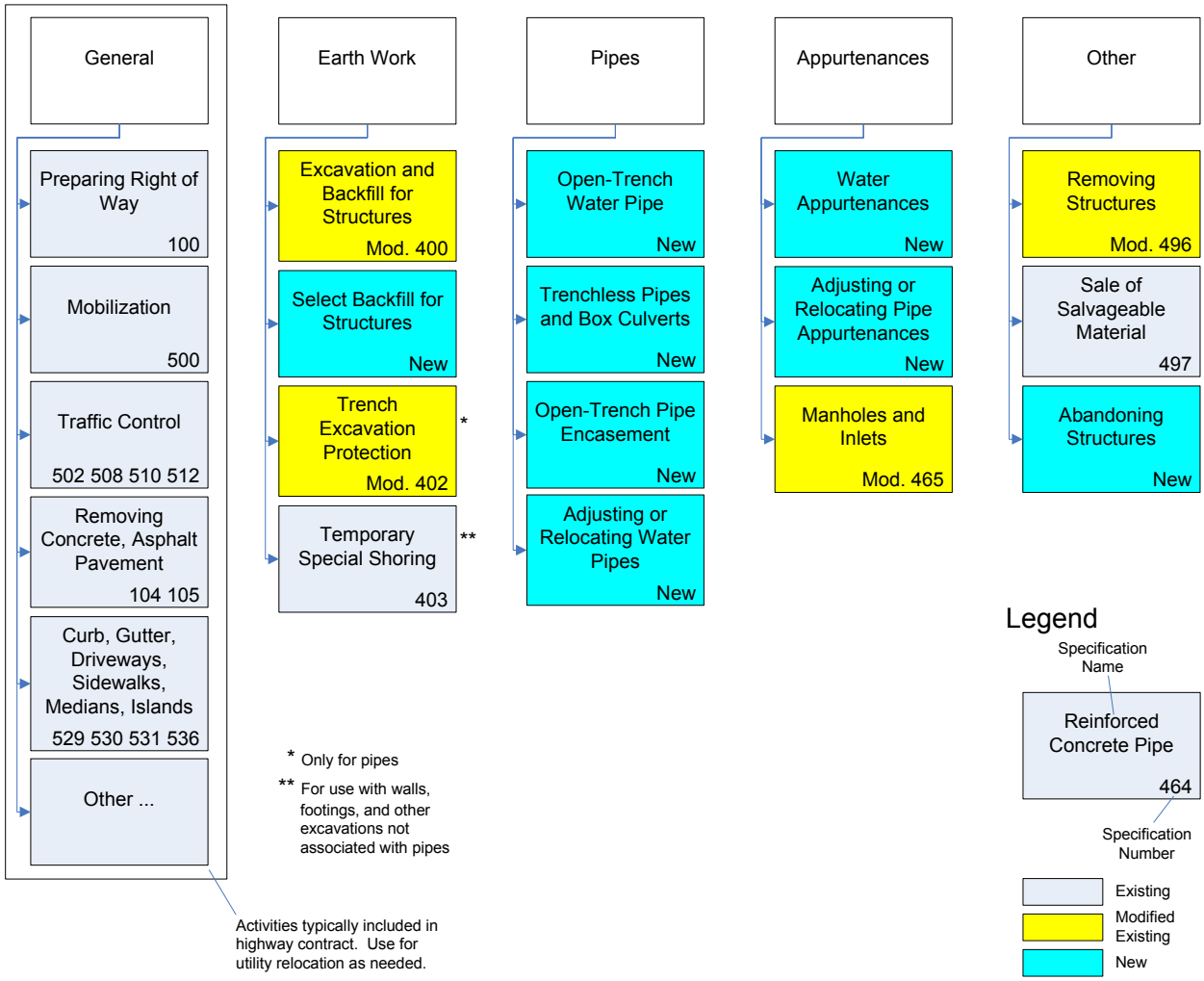

Figure 1. Proposed Water Installation Specification Framework.

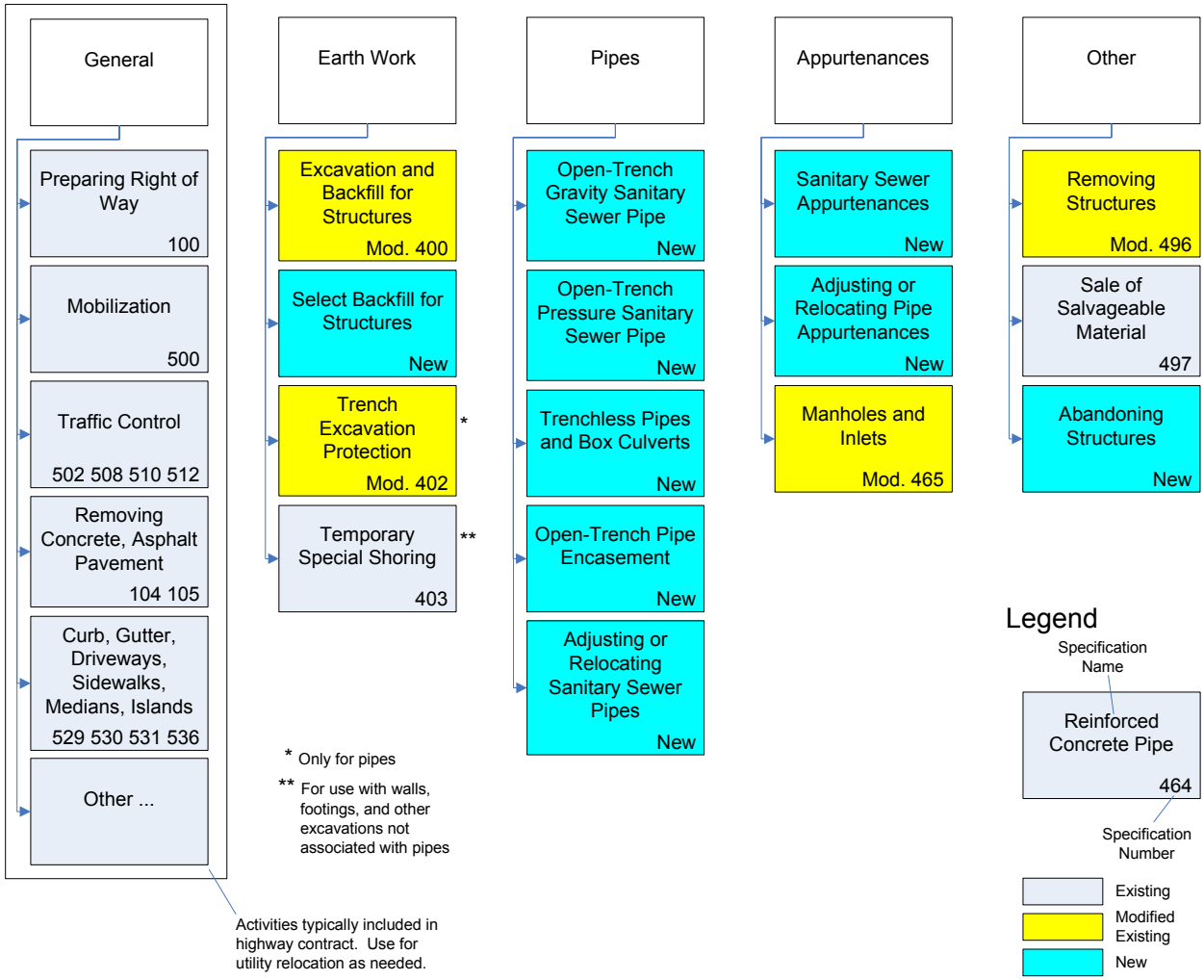

Figure 2. Proposed Sanitary Sewer Specification Framework.

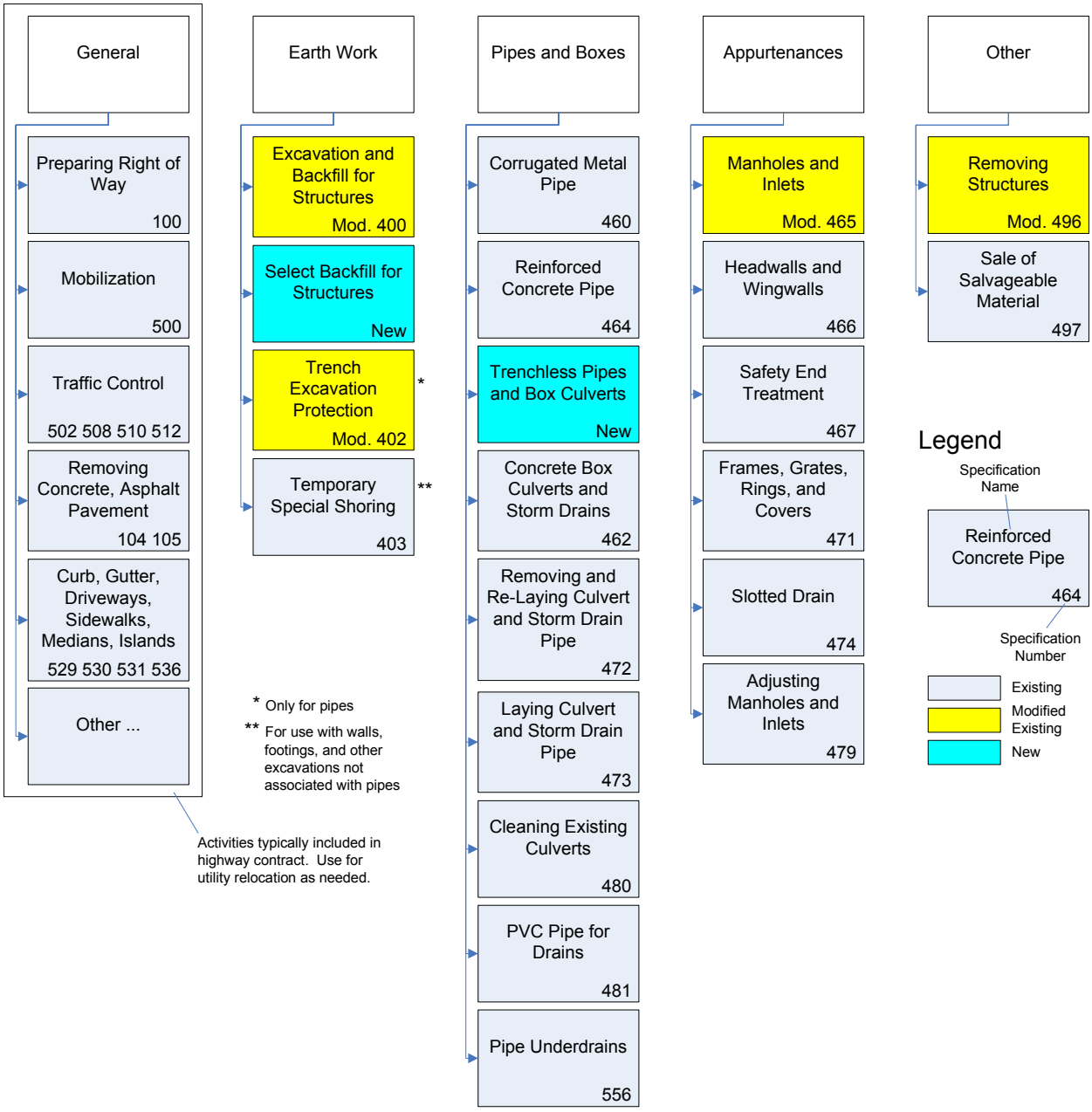

Figure 3. Proposed Drainage-Related Specification Framework.

SPECIFICATION REQUIREMENTS

The remainder of this chapter describes the specification requirements for each specification labeled as "New" or "Modified Existing" in Figure 1 and Figure 2. For simplicity, the material that follows only describes new or modified specifications, i.e., it does not cover existing standard specifications that do not require modifications. Each specification requirement conforms to the following structure:

- **Summary Table**. The summary table describes the main characteristics of the proposed new or modified specification. The table structure should make it straightforward to use TxDOT's Form 1814 to prepare and submit the corresponding specification approval request. A critical component of the summary table is a list of bid items and corresponding measurement units, as well as a list of items that are subsidiary and, therefore, are not considered pay items. Table 1 through Table 16 show the summary tables for each specification labeled as "New" or "Modified Existing" in Figure 1 and Figure 2.

- **Specification Requirements**. Following the summary table is a compilation of requirements that follow a structure that is very similar to the current TxDOT specification style (*4*). Readers should be aware that the purpose of the specification requirements is not to write the specifications (which was outside the scope of the research), but to provide a foundation upon which a specification writer could prepare the specification.

In the case of proposed modified specifications, both summary tables and specification requirements use the corresponding three-digit standard specification number (e.g., 400 in the case of excavation and backfill for structures). For proposed new specifications, the summary table and specification requirements use "XXXX" to identify the specification (e.g., in the case of open-trench water pipe).

The specification requirements include references to numerous industry standards and specifications, in particular those developed by ASTM International (previously known as the American Society for Testing and Materials) (*5*), the American Water Works Association (AWWA) (*6*), the American Society of Civil Engineers (ASCE) (*7*), and NSF International (previously known as the National Sanitation Foundation) (*8*). As needed, the requirements also include references to TxDOT standard specifications and manuals (*4*, *9*), specifications from agencies such as the North Central Texas Council of Governments (NCTCOG) (*10*) and the City of Houston (*11*), state regulations (*12*, *13*), and other publications (*14*). For simplicity, the specification requirements do not list individual references. However, the list of references is included at the end of the report.

Excavation and Backfill for Structures

Table 1. Proposed Specification: Excavation and Backfill for Structures.

Specification Number	400
Specification Title	Excavation and Backfill for Structures
Description	Excavate for placement and construction of structures and backfill for structures. Cut and restore pavement.
Previous Specifications	2004 Item 400, "Excavation and Backfill for Structures."
Proposed Changes	Delete references to select backfill, e.g., cement stabilized backfill and flowable backfill. A new special specification (Special Specification XXXX "Select Backfill for Structures," would cover all non-regular types of backfill. Expand description of bedding specification to account for pipe installation requirements other than those needed for drainage pipe. ***Note to Specification Writer***: Examples of additional bedding specifications include Year 1993 Special Specification 5737 (p. 11-21), NCTCOG construction specifications (Section 504.5, Embedment), and City of Houston Standard Specifications (02317, Excavation and Backfill for Utilities).
Comment	Unless specified as a pay item, structural excavation is subsidiary to pertinent items (installation of bridges, boxes, and pipes).

Bid Item	**Measurement Unit**
Structural Excavation (Bridge) (if specified)	Cubic yard
Structural Excavation (Box) (if specified)	Cubic yard
Structural Excavation (Pipes) (if specified)	Cubic yard
Cutting and Restoring Pavement	Square yard
Removing Unstable or Incompressible Material	Cubic yard
Overexcavation (according to overexcavation table)	Cubic yard
Specification Writer: Add other select items as indicated on the plans or other design documents	Varies

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation (Bridge)	400	Bridge construction
Structural Excavation (Box)		Box installation
Structural Excavation (Pipes)		Pipe installation
Bedding		Corresponding item installation
Conventional Backfill		Corresponding item installation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		

Specification Requirements

400.2. Materials.

- Remove references to flowable fill, hydraulic cement concrete, and hydraulic cement. These materials are select backfill materials, which will become part of Special Specification XXXX, "Select Backfill for Structures."
- Insert the following text: "Remove unsuitable, unstable, or incompressible material as shown on the plans or as directed by the Engineer." ***Note to Specification Writer***: Include testing requirements such as gradation and plasticity index to assist in the assessment of material suitability.
- Insert the following text: "Provide bedding material as shown on the plans, as directed by the Engineer, or as recommended by the pipe manufacturer." ***Note to Specification Writer***: Refer to bedding material using the naming convention in ASTM D2487, "Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)." Likewise, include requirements for select bedding material such as crushed stone, gravel, and sand, taking into consideration appropriate testing requirements according to gradation, liquid limit, plasticity index, and bar linear shrinkage.

400.3. Construction.

- **400.3.A.1.c. Utilities.** Add the following text at the end of the second paragraph: "Use an appropriate pole bracing system to ensure the structure stability of all poles and lines found."
- **400.3.A.4. Culverts and Storm Drains.** Change the title of this section to "Culverts and Pipes."
- **400.3.A.4.a. Unstable Material.** Replace "unless the Engineer authorizes additional depth" with "unless the Engineer authorizes a different or additional depth."
- **400.3.B. Shaping and Bedding.**
    - Replace "Where cement-stabilized backfill is indicated on the plans, undercut the excavation at least 4 in. and backfill with stabilized material to support the pipe or box at the required grade" with "Where select backfill is indicated on the plans, undercut the excavation at least 4 in. and backfill with stabilized material to support the pipe or box at the required grade."
    - ***Note to Specification Writer***: For clarity, it is advisable to divide this section into separate subsections for box sections, storm sewer pipe, water pipe, and sanitary sewer pipe. For water pipe and sanitary sewer pipe, provide bedding diagrams similar to those shown in Item 400 (Figure 1, Bedding diagrams). Examples of additional bedding specifications include Year 1993 Special Specification 5737, "Water Mains and Sanitary Sewers," NCTCOG construction specifications (Section 504.5, Embedment), and City of Houston Standard Specifications (02317, Excavation and Backfill for Utilities).

- **400.3.C.1. General.** Replace "Obtain backfill from excavation or from other sources" with "Backfill using material from the excavation or from other sources as shown on the plans or directed by the Engineer."
- **400.3.C.3. Pipe.** Replace "at most 8 in. deep (loose measurement)" with "at most 8 in. deep, or as shown on the plans or directed by the Engineer (loose measurement)."
- **400.3.C.4. Cement-Stabilized Backfill.** Remove this section. Special Specification XXXX, "Select Backfill for Structures," covers it. ***Note to Specification Writer***: As currently written, this section includes specifications both for materials and construction. When developing Special Specification XXXX, "Select Backfill for Structures," it would be advisable to move material-related text to article XXXX.2, Materials.
- **400.3.C.5. Flowable Backfill.** Remove this section. Special Specification XXXX, "Select Backfill for Structures," covers it.

400.4. Measurement.

- **400.4.C. Cement-Stabilized Backfill.** Remove this section. Special Specification XXXX, "Select Backfill for Structures," covers it.

400.5. Payment.

- **400.5.C. Cutting and Restoring Pavement.** Delete reference to flowable backfill.

Select Backfill for Structures

Table 2. Proposed Specification: Select Backfill for Structures.

Specification Number	XXXX
Specification Title	Select Backfill for Structures
Description	Furnish and place select backfill for trench, hole, or other void.
Previous Specifications	2004 Item 400, "Excavation and Backfill for Structures." 2004 Item 401, "Flowable Backfill."
Proposed Changes	Create new specification to handle various select backfill types (such as cement stabilized backfill, flowable backfill, and lime stabilized backfill). Specify payment to include the incremental price above conventional backfill (because, according to Item 400, "Excavation and Backfill for Structures," conventional backfill is considered subsidiary to the installation of the pipe).
Comment	Including cost above regular backfill eliminates redundancy and facilitates unit cost comparisons.

Bid Item	**Measurement Unit**
Cement Stabilized Backfill	Cubic yard
Flowable Backfill	Cubic yard
Lime Stabilized Backfill	Cubic yard
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Loading and Hauling Select Material		Select backfill installation
Loading and Hauling Waste Material		Select backfill installation
Disposal of Waste Material		Select backfill installation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		Select backfill installation

Specification Requirements

XXXX.1. Description. Furnish and place select backfill for trench, hole, or other void.

XXXX.2. Materials.

- Insert Sections 401.2.A, 401.2.B, 401.2.C, 401.2.D, and 401.2.E from Item 401, "Flowable Backfill."
- Insert a new section for lime and add the following text: Furnish lime conforming to ASTM C977, "Specification for Quicklime and Hydrated Lime for Soil Stabilization."

XXXX.3. Construction.

- Divide section into three subsections: Cement Stabilized Backfill, Flowable Backfill, and Lime Stabilized Backfill.
- Insert Sections 401.3.A and 401.3.B from Item 401, "Flowable Backfill" into the flowable backfill section.
- Insert text related to cement stabilized backfill from Item 400, "Excavation and Backfill for Structures."
- Add the following references to standards and specifications:
    - Cement Stabilized Backfill:
        - ASTM WK2799, "Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory"
        - ASTM D806, "Standard Test Method for Cement Content of Hardened Soil-Cement Mixtures"
        - ASTM D2901, "Standard Test Method for Cement Content of Freshly Mixed Soil-Cement"
    - Flowable Backfill:
        - ASTM D5971, "Standard Practice for Sampling Freshly Mixed Controlled Low-Strength Material"
        - ASTM D6103, "Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)"
        - ASTM D6023, "Standard Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)"
    - Lime Stabilized Backfill:
        - ASTM D6236, "Standard Guide for Coring and Logging Cement- or Lime-Stabilized Soil"
        - ASTM D3551-02, "Standard Practice for Laboratory Preparation of Soil-Lime Mixtures Using a Mechanical Mixer"

XXXX.4. Measurement. This Item will be measured by the cubic yard of material placed. Measurement will not include additional volume caused by slips, slides, or cave-ins resulting from the Contractor's operations.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Cement Stabilized Backfill," "Flowable Backfill," or "Lime Stabilized Backfill." This price is the incremental price above the price for conventional backfill, which, according to Item 400, "Excavation and Backfill for Structures," is considered subsidiary to the installation of the structure in question.

Trench Excavation Protection

Table 3. Proposed Specification: Trench Excavation Protection.

Specification Number	402	
Specification Title	Trench Excavation Protection	
Description	Furnish and place excavation protection for trenches deeper than 5 feet.	
Previous Specifications	2004 Item 402, "Trench Excavation Protection."	
Proposed Changes	Modify current standard specification to clarify that protection can be needed not just to satisfy Occupational Safety and Health Administration (OSHA) requirements, but, also, in general, whenever there is a technical reason (e.g., presence of other utilities, excavation next to the ROW line).	
Comment		
Bid Item		**Measurement Unit**
Trench Excavation Protection		Foot
Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**

Specification Requirements

402.2. Construction. Replace paragraph with the following: "Provide vertical or sloped cuts, benches, shields, support systems, or other systems providing the necessary protection in accordance with OSHA regulations, 29 C.F.R. 1926, Subpart P – Excavations. Protect the stability of adjoining buildings, walls, sidewalks, pavements, other structures, or when excavating close to the right of way line."

Open-Trench Water Pipe

Table 4. Proposed Specification: Open-Trench Water Pipe.

Specification Number	XXXX
Specification Title	Open-Trench Water Pipe
Description	Furnish and install open-trench water pipe and fittings (except valves, hydrants, and meters, which Special Specification XXXX, "Water Pipe Appurtenances" covers).
Previous Specifications	Several, including: 1993 Special Specification 3513, "Water Mains." 1993 Special Specification 5740, "Water Mains and Service Lines." 1993 Special Specification 5885, "Water and Sanitary Sewer Systems."
Proposed Changes	Create new specification for open-trench water pipes.
Comment	Specification includes water mains and service lines, as well as dry connections to water mains. Tapping sleeve and valves (Special Specification XXXX, "Water Appurtenances") covers wet connections to water mains.

Bid Item	**Measurement Unit**
Open-Trench Water Pipe (Prestressed Concrete) (several diameters)	Foot
Open-Trench Water Pipe (Bar-Wrapped Concrete) (several diameters)	Foot
Open-Trench Water Pipe (Ductile Iron) (several diameters)	Foot
Open-Trench Water Pipe (Steel) (several diameters)	Foot
Open-Trench Water Pipe (PVC) (several diameters)	Foot
Open-Trench Water Pipe (PVC SDR) (several diameters)	Foot
Open-Trench Water Pipe (HDPE) (several diameters)	Foot
Open-Trench Water Pipe (Copper) (several diameters)	Foot
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation (Pipes)	400	Pipe installation
Bedding	400	Pipe installation
Fittings (but not Valves or Meters)		Pipe installation
Backfill	400	Pipe installation
Corrosion Control		Pipe installation
Thrust Restraint		Pipe installation
Disinfection and Hydrostatic Test		Pipe installation
Warning Tape for Non-Metallic Pipes		Pipe installation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		Pipe installation

Specification Requirements

XXXX.1. Description. Furnish and install open-trench water pipe and fittings (except valves, hydrants, and meters, which Special Specification XXXX, "Water Appurtenances" covers).

XXXX.2. Materials.

A. General Standards and Rules. Applicable standards and rules include the following:

1. National Sanitation Foundation/American National Standards Institute (NSF/ANSI) Standard 61, "Drinking Water System Components - Health Effects"
2. Texas Commission on Environmental Quality (TCEQ) Rule 290, "Public Drinking Water, 290.44(a)"

B. Concrete Pressure Pipe and Fittings.

1. **Standards.** Applicable standards include the following:
   - AWWA C301, "Pre-stressed Concrete Pressure Pipe – Steel Cylinder Type, for Water and Other Liquids"
   - AWWA C303, "Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type"
   - AWWA C304, "Standard for Design of Pre-stressed Concrete Cylinder Pipe"
   - AWWA M9, "Concrete Pressure Pipe"
   - ASTM C497, "Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile"

C. Ductile Iron Pressure Pipe and Fittings.

1. **Standards.** Applicable standards include the following:
   - AWWA C104, "Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water"
   - AWWA C105, "Polyethylene Encasement for Ductile-Iron Pipe Systems"
   - AWWA C110, "Ductile Iron and Gray Iron Fittings for Water"
   - AWWA C111, "Gasket Joints for Ductile Iron Pressure Pipe and Fittings"
   - AWWA C115, "Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges"
   - AWWA C116, "Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings"
   - AWWA C150, "Standard for Thickness Design of Ductile Iron Pipe"
   - AWWA C151, "Standard for Ductile Iron Pipe Centrifugally Cast for Water or Other Liquids"
   - AWWA C153, "Ductile-Iron Compact Fittings for Water Service"
   - AWWA C606, "Grooved and Shouldered Joints"

- ASTM A304, "Standard Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements"
- ASTM A325, "Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength"
- ASTM A674, "Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids"

2. **General.** Submit manufacturer's certification of pipe compliance with AWWA C151.

D. Steel Pipe and Fittings.

1. **Standards.** Applicable standards include the following:
   - AWWA C200, "Steel Water Pipe 6 In. (150 mm) and Larger"
   - AWWA C203, "Coal-Tar Protective Coatings & Linings for Steel Water Pipelines, Enamel & Tape, Hot-Applied"
   - AWWA C205, "Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 In. (100 mm) and Larger, Shop Applications"
   - AWWA C207, "Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)"
   - AWWA C208, "Dimensions for Fabricated Steel Water Pipe Fittings"
   - AWWA C209, "Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipe"
   - AWWA C210, "Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines"
   - AWWA C213, "Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines"
   - AWWA C214, "Tape Coating Systems for the Exterior of Steel Water Pipelines"
   - AWWA C222, "Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings"
   - ASTM A139, "Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)"
   - ASTM A283, "Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates"
2. **General.** Submit manufacturer's certification of pipe compliance with AWWA C200, "Steel Water Pipe 6 In. (150 mm) and Larger."

E. Polyvinyl Chloride (PVC) Water Pipe and Fittings.

1. **Standards.** Applicable standards include the following:

   - AWWA C900, "Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In.-12 In. (100 mm-300 mm), for Water Dist."
   - AWWA C905, "Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In.-48 In. (350 mm-1,200 mm)"
   - AWWA C907, "Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm)"
   - AWWA C909, "Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In.-24 In. (100 mm-600 mm), for Water Distribution"
   - AWWA C110, "Ductile Iron and Gray Iron Fittings for Water"
   - AWWA C153, "Ductile-Iron Compact Fittings for Water Service"
   - ASTM D2241, "Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)"
   - ASTM D3139, "Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals"
   - ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"
   - Acceptance procedures by the State Fire Insurance Commission.

F. High Density Polyethylene (HDPE) Water Pipe.

1. **Standards.** Applicable standards include the following:

   - AWWA C901, "Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service"
   - AWWA C903, "Polyethylene-Aluminum-Polyethylene Composite Pressure Pipes"
   - AWWA C906, "Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In. (1,575 mm), for Water Distribution and Transmission"
   - ASTM D3035, "Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter"
   - ASTM D3350, "Standard Specification for Polyethylene Plastics Pipe and Fittings Materials"
   - ASTM F714, "Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter"
   - ASTM D2609, "Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe"

- ASTM D2683, "Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing"
- ASTM D3261, "Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing"

G. Copper Water Pipe.

1. Standards. Applicable standards include the following:

- ASTM B88, "Standard Specification for Seamless Copper Water Tube"
- ASTM B62-02, "Standard Specification for Composition Bronze or Ounce Metal Castings"

H. Markings. Ensure that all PVC pipe and fittings that transport potable water bear the seal or "NSF" mark of the National Sanitation Foundation.

I. Nonmetallic Pipe Detection Method. Provide a method approved by the Engineer or as shown on the plans for detecting nonmetallic pipes.

J. Thrust Restraint.

1. Standards. Applicable standards include the following:

- AWWA C111, "Gasket Joints for Ductile Iron Pressure Pipe and Fittings"
- AWWA C153, "Ductile-Iron Compact Fittings for Water Service"
- ASTM D3139, "Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals"
- ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"
- ASTM F1674, "Standard Test Method for Joint Restraint Products for Use with PVC Pipe"

2. General.

- Use thrust restraint as specified on the plans.
- Horizontal and vertical bends between zero and 10 degrees deflection angle do not require thrust blocks or restrained joints.

3. Concrete Thrust Blocks.

- ***Note to Specification Writer***: Consider developing standard details and tables (see, e.g., NCTCOG Standard Specifications for Public Works Construction, Standard Drawings 4010A through 4040).
- Place thrust blocks between undisturbed ground and fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Extend concrete from 6 inches below pipe or fitting to 12 inches above.

- Reinforced concrete encasement of pipe and fittings may be used in lieu of manufactured joint restraint systems. Design concrete encasement reinforcement for all loads, including internal pressure and longitudinal forces.

4. Mechanical Joint Restraint.

- Follow manufacturer's recommendations for installation of mechanical joint restraint.

K. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of the finished pipe at the project site before and during installation.

L. Rejections.

1. List causes for rejection of individual sections of pipe including fractures, cracks, and damaged ends where such damage would prevent making a satisfactory joint.

2. Allow access for the marking of rejected pipe. The Engineer will plainly mark rejected pipe by painting colored spots. Remove the rejected pipe from the project and replace with pipe meeting the requirements of this item.

M. Bedding Material. Furnish bedding in accordance with Item 400, "Excavation and Backfill for Structures."

N. Backfill Material. Furnish conventional backfill material in accordance with Item 400, "Excavation and Backfill for Structures," or select backfill in accordance with Special Specification XXXX, "Select Backfill for Structures," as specified on the plans.

XXXX.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," and Special Specification XXXX, "Select Backfill for Structures," except as described below:

1. Do not excavate more than the maximum length ahead of backfilling operations, as shown on the plans or as approved by the Engineer.

2. Protect adjacent property and infrastructure in accordance with Item 402, "Trench Excavation Protection," if excavation is deeper than 5 feet.

3. Trench dimensions:

- 24 inches or outside pipe diameter plus 16 inches (whichever is greater) for 24-inch pipe or smaller.
- Outside pipe diameter plus 24 inches for pipe larger than 24 inches.

4. Excavate the trench to a depth of 6 inches below the bottom of the pipe.

B. Laying Pipe.

1. Standards. Applicable standards include the following:

- AWWA C600, "Installation of Ductile-Iron Water Mains and Their Appurtenances"

- AWWA C602, "Cement-Mortar Lining of Water Pipelines in Place—4 In. (100 mm) and Larger"
- AWWA C605, "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water"
- AWWA C606, "Grooved and Shouldered Joints"
- AWWA C206, "Field Welding of Steel Water Pipe"
- ASTM D2657, "Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings"

2. General.

- Verify that no section of pipe deviates from the alignment shown on the plans by more than the maximum tolerance allowed. For any section of pipe, unless otherwise directed by the Engineer or as indicated on the plans, the maximum horizontal tolerance will be 0.25 foot and the maximum vertical tolerance will be 0.1 foot. ***Note to Specification Writer***: There is conflicting information regarding maximum tolerances. For example, the City of Houston specifies a maximum horizontal deviation of 3 inches (0.25 foot) and a maximum vertical deviation of 2 inches (0.17 foot) for any section of pipe. However, for large diameter pipes, the same specifications limit horizontal and vertical deviations to 0.1 foot. The TxDOT Survey Guide recommends a horizontal requirement of 0.5 foot for staking and a vertical requirement of 0.1 foot.
- Measure and record "as-built" horizontal and vertical alignment at no more than every 100 feet on the on-site recorded plans.
- Where plans show curves without special fittings, deflect pipe at the joints using standard lengths of pipe. Do not exceed maximum deflection amounts recommended by the pipe manufacturer.
- If deviations are necessary due to obstructions not shown on the plans, deflect pipe from the horizontal or vertical alignments only as directed by the Engineer. Do not exceed maximum deflection amounts recommended by the pipe manufacturer.
- Do not lay more than 50 feet of pipe in the trench ahead of backfilling operations.
- Unload pipe, fittings, and accessories at the point of delivery and haul to the site of the project. Position the material such that water or runoff does not enter or pass through the pipe. Do not skid or roll pipe handled on skidways against pipe already on the ground.
- When laying pipe is not in progress, close the open end of the pipe in the trench with a watertight plug or similar device approved by the Engineer.
- Place water lines above sanitary sewers, unless the plans show a special design.

- Confirm that separation between water lines, gravity or force sanitary sewers, and manholes is at least 9 feet in all directions, unless the plans show a special design or in accordance with the following:

  (1) Parallel water line and gravity or force sanitary sewer or manhole with no leaks: minimum 4 foot outside horizontal clearance.

  (2) Water line crossing above a gravity sanitary sewer or force main with no leaks: minimum 2 foot outside vertical clearance.

- Provide encasement as shown on the plans or as directed by the Engineer in accordance with Special Specification XXXX, "Open-Trench Pipe Encasement."

C. Disinfection.

1. Standards. Applicable standards include the following:

- AWWA C651, "Disinfecting Water Mains"

2. General.

- Purge water pipe using the poly-pig method or the flushing method, as approved by the Engineer.
- After purging, at the Engineer's request, provide water samples from designated sampling points (not hydrants because of unreliability concerns). If the bacteria count is below the limit according to established purity standards, no further disinfection is necessary, unless the Engineer specifically requires it.
- Disinfect entire water pipe or complete selected sections, as approved by the Engineer.
- Use the continuous feed method or the slug method of disinfection, as approved by the Engineer.
- Unless otherwise specified, an Engineer's representative will inject the disinfectant into the conduit, monitor the solution, take water samples from a suitable tap (not from a hydrant), and perform the water analysis.

D. Hydrostatic Test.

1. Standards. Applicable standards include the following:

- AWWA C600, "Installation of Ductile Iron Water Mains and Their Appurtenances"
- AWWA C605, "Underground Installation of PVC Pressure Pipe and Fittings for Water"
- ASTM F2164, "Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure"

2. General.

- ***Note to Specification Writer***: Some cities (e.g., City of Houston) have more stringent leakage testing requirements (both test duration and maximum leakage allowed) than the AWWA standards.
- Disinfect water line prior to hydrostatic testing.
- Test water lines between valves, or plugs, of not more than 4,000 feet.
- For water lines of materials in combination, test for the type of pipe material with the least stringent hydraulic test pressure maintained over the duration of the test.
- Test polyethylene pipe after installation is complete, either the full system or in sections, where the length of the test section is determined by the testing equipment.
- Gradually pressurize polyethylene pipe before the test to control the initial expansion of the pipe. At the conclusion of the test, gradually depressurize the test section.

XXXX.4. Measurement. This Item will be measured by the foot along the centerline of the pipe, from center to center of fittings and valves. No length deductions will be made for fittings and valves. Water pipes will not be classified for measurement according to the depth of the trench.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Open-Trench Water Pipe" of the type and size specified (see Table 4). All other items are considered subsidiary.

Trenchless Pipes and Box Culverts

Table 5. Proposed Specification: Trenchless Pipes and Box Culverts.

Specification Number	XXXX
Specification Title	Trenchless Pipes and Box Culverts
Description	Furnish and install pipes and box culverts using trenchless construction or renewal methods.
Previous Specifications	Several, including: 2004 Item 476, "Jacking, Boring, or Tunneling Pipe or Box." 1993 Special Specification 3633, "Horizontal Directional Drilling." 1993 Special Specification 3666, "Boring 3 Inch PVC." 1993 Special Specification 4882, "Horizontal Directional Drilling." 1993 Special Specification 5885, "Water and Sanitary Sewer Systems." 1993 Special Specification 4059, "Jacking or Boring Concrete Box Culverts." 1993 Special Specification 4783, "Jacking or Boring Concrete Box Culverts." 1995 Special Specification 5368, "Boring, Jacking, and Tunneling."
Proposed Changes	Create new specification that addresses limitations of Item 476, "Jacking, Boring, or Tunneling Pipe or Box." Expand scope of Item 476 to include water and sewer installations. Create specification that reflects recent trends in trenchless construction and renewal methods: - Include requirements for horizontal auger boring (HAB), horizontal directional drilling (HDD), ramming (R), microtunneling (MT), jacking (J), tunneling (T), cured in place pipe (CIPP), folded pipe (FP), coating or lining (CL), sliplining (SL), and pipe replacement (PR). - Use "horizontal auger boring" instead of "jack and bore."
Comment	Specification describes trenchless construction and renewal methods.

Bid Item	**Measurement Unit**
Water Pipe (Ductile Iron) (MT) (several diameters)	Foot
Water Pipe (Ductile Iron) (HDD) (several diameters)	Foot
Water Pipe (Steel) (HAB) (several diameters)	Foot
Water Pipe (Steel) (HDD) (several diameters)	Foot
Water Pipe (Steel) (MT) (several diameters)	Foot
Water Pipe (Steel) (R) (several diameters)	Foot
Water Pipe (PVC) (HDD) (several diameters)	Foot
Water Pipe (PVC SDR) (HDD) (several diameters)	Foot
Water Pipe (HDPE) (HDD) (several diameters)	Foot
Gravity Sanitary Sewer Pipe (Reinforced Concrete) (HAB) (several diameters)	Foot

Table 5. Proposed Specification: Trenchless Pipes and Box Culverts (Continued).

Bid Item	Measurement Unit
Gravity Sanitary Sewer Pipe (Reinforced Concrete) (MT) (several diameters)	Foot
Gravity Sanitary Sewer Pipe (PVC) (HDD) (several diameters)	Foot
Gravity Sanitary Sewer Pipe (PE) (HDD) (several diameters)	Foot
Gravity Sanitary Sewer Pipe (Vitrified Clay) (MT) (several diameters)	Foot
Pressure Sanitary Sewer Pipe (Ductile Iron) (MT) (several diameters)	Foot
Pressure Sanitary Sewer Pipe (Ductile Iron) (HDD) (several diameters)	Foot
Pressure Sanitary Sewer Pipe (PVC) (HDD) (several diameters)	Foot
Concrete Box Culvert (T) (several diameters)	Foot
Concrete Box Culvert (J) (several diameters)	Foot
Water Pipe Renewal (CIPP) (several diameters)	Foot
Water Pipe Renewal (FP) (several diameters)	Foot
Water Pipe Renewal (CL) (several diameters)	Foot
Water Pipe Renewal (SL) (several diameters)	Foot
Water Pipe Renewal (PR) (several diameters)	Foot
Gravity Sanitary Sewer Pipe Renewal (CIPP) (several diameters)	Foot
Gravity Sanitary Sewer Pipe Renewal (FP) (several diameters)	Foot
Gravity Sanitary Sewer Pipe Renewal (CL) (several diameters)	Foot
Gravity Sanitary Sewer Pipe Renewal (SL) (several diameters)	Foot
Gravity Sanitary Sewer Pipe Renewal (PR) (several diameters)	Foot
Pressure Sanitary Sewer Pipe Renewal (CIPP) (several diameters)	Foot
Pressure Sanitary Sewer Pipe Renewal (FP) (several diameters)	Foot
Pressure Sanitary Sewer Pipe Renewal (CL) (several diameters)	Foot
Pressure Sanitary Sewer Pipe Renewal (SL) (several diameters)	Foot
Pressure Sanitary Sewer Pipe Renewal (PR) (several diameters)	Foot
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Table 5. Proposed Specification: Trenchless Pipes and Box Culverts (Continued).

Subsidiary Item (if specified)	Referenced Item	Subsidiary to
Excavation and Backfill	400	Pipe installation or renewal
Trench Excavation Projection	402	Pipe installation or renewal
Grout		Pipe installation or renewal
Steel Casing Pipe		Pipe installation or renewal
Reinforced Concrete Casing Pipe		Pipe installation or renewal
Ductile Iron Casing Pipe		Pipe installation or renewal
Casing Spacer System		Pipe installation or renewal
Renewal Liner System		Pipe renewal
Disinfection and Hydrostatic Test		Pipe installation or renewal
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		Pipe installation or renewal

Specification Requirements

XXXX.1. Description. Furnish and install pipes and box culverts using trenchless construction or renewal methods.

XXXX.2. Materials.

A. Carrier Pipe or Box Culvert.

1. Standards. Applicable standards and specifications include the following:

- Water pipe: Special Specification XXXX, "Open-Trench Water Pipe"
- Gravity sanitary sewer: Special Specification XXXX, "Open-Trench Gravity Sanitary Sewer Pipe"
- Pressure sanitary sewer: Special Specification XXXX, "Open-Trench Pressure Sanitary Sewer Pipe"
- Concrete box culvert: Item 462, "Concrete Box Culverts and Storm Drains"
  Note to Specification Writer: Item 462 may benefit from the addition of the following standards:

  (1) ASTM C1433-04e1, "Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers"

B. Steel Casing Pipe.

1. Standards. Applicable standards include the following:

- AWWA C200, "Steel Water Pipe 6 In. (150 mm) and Larger"
- AWWA C207, "Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)"

- AWWA C208, “Dimensions for Fabricated Steel Water Pipe Fittings”
- AWWA C214, “Tape Coating Systems for the Exterior of Steel Water Pipelines”
- ASTM A139, “Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)”
- ASTM A36, “Standard Specification for Carbon Structural Steel”
- ASTM A572, “Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel”
- ASTM A283, “Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates”

C. Ductile Iron Casing Pipe.

1. Standards. Applicable standards include the following:

- AWWA C150, “Thickness Design of Ductile Iron Pipe”
- AWWA C151, “Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids”
- ASTM A716, “Standard Specification for Ductile Iron Culvert Pipe”
- ASTM A746, “Standard Specification for Ductile Iron Gravity Sewer Pipe”

D. Reinforced Concrete Pipe.

1. Standards. Applicable standards and specifications include the following:

- ASCE 27-00, “Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction”
- ASTM C76, “Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe”
- ASTM C1417, “Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design”
- ASTM C497, “Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile”
- ASTM C443, “Joints for Circular Concrete Sewer and Culvert Pipe”
- Item 464, “Reinforced Concrete Pipe”

E. Cured in Place Pipe (CIPP).

1. Standards. Applicable standards include the following:

- ASTM D638, “Standard Test Method for Tensile Properties of Plastics”
- ASTM D790, “Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials”

F. Folded Pipe (FP).

1. Standards. Applicable standards include the following:

- ASTM F1504, "Standard Specification for Folded Poly (Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation"
- ASTM F1871, "Standard Specification for Folded/Formed Poly (Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation"

G. Sliplining (SL).

1. Standards. Applicable standards include the following:

- ASTM F1735, "Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for PVC Liners for Rehabilitation of Existing Man-Entry Sewers and Conduits"
- ASTM F1697, "Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for Machine Spiral-Wound Liner Pipe Rehabilitation of Existing Sewers and Conduits"

H. Casing Spacer System.

1. Provide a casing spacer system that meets the performance requirements shown on the plans, or as approved by the Engineer. At a minimum:

- Protect the carrier pipe from corrosion from spacer bands.
- Provide shock protection to the carrier pipe.

I. Joints. Provide joints as shown on the plans.

J. Non-metallic pipe detection. Provide a method approved by the Engineer or as shown on the plans for detecting nonmetallic pipes.

K. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of the finished pipe at the project site before and during installation.

L. Rejections.

1. List causes for rejection of individual sections of pipe including fractures, cracks, and damaged ends where such damage would prevent making a satisfactory joint.

2. Allow access for the marking of rejected pipe. The Engineer will plainly mark rejected pipe by painting colored spots. Remove the rejected pipe from the project and replace with pipe meeting the requirements of this item.

XXXX.3. Construction.

A. General.

1. The Engineer will make available to the Contractor a geotechnical baseline report that contains a project description, available existing information, geology description, geologic profile, groundwater conditions, and contaminant information.

2. Furnish any information required to correct the geotechnical condition of the location after installation.

3. Furnish a plan for approval describing the proposed method of trenchless construction or renewal, including location of bore pits, equipment setup and structural support, construction schedule, proposed line profile in the case of horizontal directional drilling (HDD), and horizontal and vertical control method and expected accuracies.
4. Install casing pipe within horizontal and vertical tolerances to ensure the carrier pipe will comply with required tolerances in accordance with the corresponding item specification.

B. Excavation and Backfill.

1. Excavate and backfill shafts, bore pits, or trenches in accordance with Item 400, "Excavation and Backfill for Structures"; Special Specification XXXX, "Select Backfill for Structures"; and Item 402, "Trench Excavation Protection."

C. Horizontal Auger Boring (HAB).

1. **Standards.** Applicable standards/guidelines include the following:
   - ASCE Manuals and Reports on Engineering Practice No. 106, "Horizontal Auger Boring Projects"
2. **General.** ***Note to Specification Writer***: Use appropriate text from current Item 476, article 476.3 (B).

D. Horizontal Directional Drilling (HDD).

1. **Standards.** Applicable standards/guidelines include the following:
   - ASCE Manuals and Reports on Engineering Practice No. 108, "Pipeline Design for Installation by Horizontal Directional Drilling"

E. Microtunneling (MT).

1. **Standards.** Applicable standards/guidelines include the following:
   - CI/ASCE 36-01, "Standard Construction Guidelines for Microtunneling"
   - ASTM A36, "Carbon Structural Steel (for Steel Ribs)"
   - ASTM D198, "Static Tests of Lumber in Structural Sizes (for lagging)"

F. Pipe Ramming (R).

1. **Standards.** Applicable standards/guidelines include the following:
   - ASCE pipe ramming manual of practice (expected for publication in 2007).
   - Trenchless Technology Center (TTC) Technical Report #2001.04, "Guidelines for Pipe Ramming"

G. Jacking (J).

1. **Standards**. Applicable standards include the following:
   - ASCE 27-00, "Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction"

2. **General.** ***Note to Specification Writer***: Use text from current Item 476, article 476.3 (A).

H. Tunneling (T).

1. **General.** ***Note to Specification Writer***: Use text from current Item 476, article 476.3 (C).

I. Cured in Place Pipe (CIPP).

1. **Standards.** Applicable standards include the following:

   - ASTM F2019, "Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe"
   - ASTM D5813, "Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems"
   - ASTM F1743, "Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe"
   - ASTM F1216, "Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube"
   - ASCE 27-00, "Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction"

J. Folded Pipe (FP).

1. **Standards.** Applicable standards include the following:

   - ASTM F1867, "Standard Practice for Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation"
   - ASTM F1947, "Standard Practice for Installation of Folded Poly (Vinyl Chloride) (PVC) Pipe into Existing Sewers and Conduits"

K. Sliplining (SL).

1. **Standards.** Applicable standards include the following:

   - ASTM F1741, "Standard Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride) (PVC) Liner Pipe for Rehabilitation of Existing Sewers and Conduits"

L. Pipe Replacement (PR).

1. **Standards.** Applicable standards/guidelines include the following:

   - ASCE pipe bursting manual of practice (expected for publication in 2007).
   - Trenchless Technology Center (TTC) Technical Report #2001.02, "Guidelines for Pipe Bursting"

M. Carrier Pipe or Box Culvert Installation.

1. **General.** Install carrier pipe or box culvert inside casing pipe within horizontal and vertical tolerances in accordance with the corresponding item specification:
    - For water pipe, Special Specification XXXX, "Open-Trench Water Pipe"
    - For gravity sanitary sewer pipe, Special Specification XXXX, "Open-Trench Gravity Sanitary Sewer Pipe"
    - For pressure sanitary sewer pipe, Special Specification XXXX, "Open-Trench Pressure Sanitary Sewer Pipe"
    - For box culverts, Special Specification XXXX, "Laying Culvert and Storm Sewer Pipe"
    - For gravity reinforced concrete pipe, make the joints in accordance with Item 464, "Reinforced Concrete Pipe."
    - For reinforced concrete box, make the joints in accordance with Item 462, "Concrete Box Culverts and Storm Drains."
2. **Disinfection.** For water pipes, conduct disinfection in accordance with Special Specification XXXX, "Open-Trench Water Pipe."
3. **Testing.**
    - Water pipe. Conduct testing, including hydrostatic testing, as shown on the plans, Special Specification XXXX, "Open-Trench Water Pipes," or as directed by the Engineer.
    - Gravity sanitary sewer pipe. Conduct testing as indicated on the plans, in accordance with Special Specification XXXX, "Open-Trench Gravity Sanitary Sewer Pipe," or as directed by the Engineer.
    - Pressure sanitary sewer pipe. Conduct testing as indicated on the plans, in accordance with Special Specification XXXX, "Open-Trench Pressure Sanitary Sewer Pipe," or as directed by the Engineer.

XXXX.4. Measurement. This Item will be measured by the foot along the centerline of the pipe or box culvert.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Pipe" of the type, method, and size specified; "Gravity Sanitary Sewer Pipe" of the type, method, and size specified; "Pressure Sanitary Sewer Pipe" of the type, method, and size specified; "Concrete Box Culvert" of the method and size specified; "Water Pipe Renewal" of the method and size specified; "Gravity Sanitary Sewer Pipe Renewal" of the method and size specified; or "Pressure Sanitary Sewer Pipe Renewal" of the method and size specified (see Table 5). All other items are considered subsidiary.

Open-Trench Pipe Encasement

Table 6. Proposed Specification: Open-Trench Pipe Encasement.

Specification Number	XXXX
Specification Title	Open-Trench Pipe Encasement
Description	Furnish and install encasement protection for open-trench pipes.
Previous Specifications	Several, including: 1995 Special Specification 4259, "Trench Excavation, Embedment, Backfill and Encasement." 1993 Special Specification 4977, "Steel Casing." 1993 Special Specification 4811, "Steel Casing Pipe." 1993 Special Specification 5094, "Water Line Casing." 1993 Special Specification 5354, "Utility Line Casing." 1993 Special Specification 5376, "Water Line Casing." 1993 Special Specification 5890, "Sanitary Sewers (Concrete Encasement)." 1993 Special Specification 7681, "Steel Casing."
Proposed Changes	Create new specification for open-trench pipe encasement.
Comment	"Encasement" refers to the general action of protecting a carrier pipe using a rigid enclosure, normally cast-in-place concrete placed on or around the carrier pipe. "Casing" refers to the placement of a prefabricated pipe to protect the carrier pipe. This specification covers only the installation of encasement and excludes all activities related to carrier pipe installation such as excavation and backfill, select bedding, and trench excavation protection.

Bid Item	**Measurement Unit**
Casing Pipe (Steel) (several diameters)	Foot
Casing Pipe (Aluminized Steel) (several diameters)	Foot
Casing Pipe (Polyethylene) (several diameters)	Foot
Casing Pipe (PVC) (several diameters)	Foot
Casing Pipe (Reinforced Concrete) (several diameters)	Foot
Cast-in-Place Trench Cap (Concrete)	Cubic yard
Cast-in-Place Encasement (Concrete)	Cubic yard
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Casing Spacer System		Casing pipe installation
Casing Pipe Joints		Casing pipe installation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		

Specification Requirements

XXXX.1. Description. Furnish and install encasement protection for open-trench pipes.

XXXX.2. Materials.

A. Steel Pipe.

1. Standards. Applicable standards include the following:

- ASTM A-36, "Standard Specification for Carbon Structural Steel"

B. Aluminized Steel Pipe.

1. Standards. Applicable standards include the following:

- A760/A760M-06, "Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains"

C. Reinforced Concrete Pipe.

1. Standards. Applicable standards include the following:

- ASTM C76, "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe"

D. Polyethylene Pipe.

1. Standards. Applicable standards include the following:

- ASTM A674-05, "Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids"
- AWWA C105/A21.5-05, "Polyethylene Encasement for Ductile-Iron Pipe Systems"

E. PVC Pipe.

1. Standards. Applicable standards include the following:

- ASTM D3034-04a, "Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings"

F. Cast-in-Place Concrete Trench Cap.

1. Standards. Applicable standards include the following:

- Item 421, "Hydraulic Cement Concrete"

G. Cast-in-Place Encasement Concrete.

1. Standards. Applicable standards include the following:

- Item 421, "Hydraulic Cement Concrete"

H. Casing Spacer System.

1. Provide a casing spacer system that meets the performance requirements shown on the plans, or as approved by the Engineer. At a minimum:

a. Protect the carrier pipe from corrosion from spacer bands.

b. Provide shock protection to the carrier pipe.

I. Joints. Provide joints for the casing pipe as shown on the plans or as approved by the Engineer. Install casing pipe end treatment as shown on the plans.

J. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of the encasement at the project site before and during installation.

K. Rejections.

1. List causes for rejection of individual sections of casing pipe including fractures, cracks, and damaged ends where such damage would prevent making a satisfactory joint.

2. Allow access for the marking of rejected pipe. The Engineer will plainly mark rejected pipe by painting colored spots. Remove the rejected pipe from the project and replace with pipe meeting the requirements of this item.

XXXX.3. Construction.

A. Cast-in-Place Concrete Trench Cap and Encasement Concrete. Furnish concrete in accordance with the details shown on plans or in accordance with Item 421, "Hydraulic Cement Concrete."

B. Laying Casing Pipe.

1. General.

- Install casing pipe within horizontal and vertical tolerances to ensure the carrier pipe will comply with required tolerances in accordance with the corresponding item specification (Special Specification XXXX, "Open-Trench Water Pipe," Special Specification XXXX, "Open-Trench Gravity Sanitary Sewer Pipe," or Special Specification XXXX, "Open-Trench Pressure Sanitary Sewer Pipe").

XXXX.4. Measurement. This Item will be measured by the cubic yard of concrete trench cap or encasement, or foot along the centerline of casing pipe.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Casing Pipe" of the type and size specified; "Cast-in-Place Trench Cap" of the type specified; or "Cast-in-Place Encasement" of the type and size specified (see Table 6). All other items are considered subsidiary.

Adjusting or Relocating Water Pipes

Table 7. Proposed Specification: Adjusting or Relocating Water Pipes.

Specification Number	XXXX
Specification Title	Adjusting or Relocating Water Pipes
Description	Adjust or relocate water pipes. Adjusting pipes involves changes in vertical alignment (raising or lowering) but not changes in horizontal alignment. Relocating pipes involves changes in horizontal alignment and, if required, changes in vertical alignment.
Previous Specifications	Several, including: 2004 Item 495, "Raising Existing Structures." 2004 Item 472, "Removing and Re-Laying Culvert and Storm Drain Pipe."
Proposed Changes	Create new specification for adjusting (lowering or raising) or relocating water pipes.
Comment	

Bid Item	**Measurement Unit**
Adjust Water Pipe (several diameters)	Foot
Relocate Water Pipe (several diameters)	Foot

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation (Pipes)	400	Pipe adjustment or relocation
Bedding	400	Pipe adjustment or relocation
Backfill	400	Pipe adjustment or relocation
Adjust or Relocate Fittings		Pipe adjustment or relocation
Disinfection and Hydrostatic Test		Pipe adjustment or relocation
Warning Tape for Non-Metallic Pipes		Pipe adjustment or relocation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		

Specification Requirements

XXXX.1. Description. Adjust or relocate water pipes. Adjusting pipes involves changes in vertical alignment (raising or lowering) but not changes in horizontal alignment. Relocating pipes involves changes in horizontal alignment and, if required, changes in vertical alignment.

XXXX.2. Materials.

A. General. Replace unsuitable or damaged pipe, fittings, or joints with new items in accordance with Special Specification XXXX, "Open-Trench Water Pipe." If items designated for reuse are damaged by the Contractor, replace them at no charge to the Department with new material or restore them to previous condition, as approved by the Engineer.

B. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of the pipe at the project site before and during installation.

C. Bedding Material. Furnish bedding in accordance with Item 400, "Excavation and Backfill for Structures."

D. Backfill Material. Furnish conventional backfill material in accordance with Item 400, "Excavation and Backfill for Structures," or select backfill in accordance with Special Specification XXXX, "Select Backfill for Structures," as specified on the plans.

XXXX.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," and Special Specification XXXX, "Select Backfill for Structures," except as described below:

1. Do not excavate more than the maximum length ahead of backfilling operations, as shown on the plans or as approved by the Engineer.

2. Protect adjacent property and infrastructure in accordance with Item 402, "Trench Excavation Protection," if excavation is deeper than 5 feet.

3. Trench dimensions:

- 24 inches or outside pipe diameter plus 16 inches (whichever is greater) for 24-inch pipe or smaller.
- Outside pipe diameter plus 24 inches for pipe larger than 24 inches.

4. Excavate the trench to a depth of 6 inches below the bottom of the pipe.

B. Preparation. Remove any debris in the pipe prior to relocation. Clean joints adequate for reuse prior to re-laying pipe. Mark the top and bottom of pipe joints before removal and adjustment or relocation.

C. Laying Pipe.

1. Install adjusted or relocated pipe and fittings in accordance with Special Specification XXXX, "Open-Trench Water Pipe."

2. Provide encasement as shown on the plans or as directed by the Engineer in accordance with Special Specification XXXX, "Open-Trench Pipe Encasement."

D. Disinfection and Hydrostatic Test. Conduct disinfection and hydrostatic test in accordance with Special Specification XXXX, "Open-Trench Water Pipe."

XXXX.4. Measurement. This Item will be measured by the foot along the centerline of pipe adjusted or relocated, from center to center of fittings and valves. Water pipe adjustment or relocation will not be classified for measurement according to the depth of the trench.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Adjust Water Pipe" or "Relocate Water Pipe" of the size specified (see Table 7). All other items are considered subsidiary.

Water Appurtenances

Table 8. Proposed Specification: Water Appurtenances.

Specification Number	XXXX
Specification Title	Water Appurtenances
Description	Furnish and install appurtenances in connection with the installation of water lines.
Previous Specifications	Several, including: 1993 Special Specification 3513, "Water Mains." 1993 Special Specification 3514, "Water Mains and Sanitary Sewers." 1993 Special Specification 3596, "Water and Wastewater Infrastructures and Appurtenances." 1993 Special Specification 5740, "Water Mains and Service Lines." 1993 Special Specification 5885, "Water and Sanitary Sewer Systems."
Proposed Changes	Create new specification for water appurtenances.
Comment	

Bid Item	**Measurement Unit**
Water Meter (several diameters)	Each
Water Meter Box (several sizes)	Each
Water Valve (Air Release & Vacuum) (several diameters)	Each
Water Valve (Butterfly) (several diameters)	Each
Water Valve (Gate) (several diameters)	Each
Water Valve (Tap Sleeve and Valve) (several diameters)	Each
Blow Off Assembly (several diameters)	Each
Hydrant (several type assemblies)	Each
Pressure Reducing Station	Each
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation	400	Appurtenance installation
Bedding	400	Appurtenance installation
Backfill	400	Appurtenance installation
Valve Cover, Stack, and Box		Valve installation
Disinfection and Hydrostatic Test		Appurtenance installation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		Appurtenance installation

Specification Requirements

XXXX.1. Description. Furnish and install appurtenances for water lines.

XXXX.2. Materials.

A. General Standards and Rules. Applicable standards and rules include the following:

1. National Sanitation Foundation (NSF) Standard 61, "Drinking Water System Components – Health Effects"
2. Texas Commission on Environmental Quality (TCEQ) Rule 290, "Public Drinking Water, 290.44(a)"

B. Water Meter.

1. **Standards.** Applicable standards include the following:
   - AWWA C700-02, "Cold-Water Meters – Displacement Type, Bronze Main Case"
   - AWWA C701-02, "Cold-Water Meters – Turbine Type, for Customer Service"
   - AWWA C702-01, "Cold-Water Meters – Compound Type"
   - AWWA C703-96, "(R04) Cold-Water Meters – Fire Service Type"
   - AWWA C706-96, "(R05) Direct-Reading, Remote-Registration Systems for Cold-Water Meters"
   - AWWA C707-05, "Encoder-Type Remote-Registration Systems for Cold-Water Meters"
   - AWWA C708-05, "Cold-Water Meters – Multijet Type"
   - AWWA C710-02, "Cold-Water Meters – Displacement Type, Plastic Main Case"
   - AWWA C712-02, "Cold-Water Meters – Singlejet Type"
   - AWWA C713-05, "Cold-Water Meters – Fluidic-Oscillator Type"

C. Air Release & Vacuum Valve.

1. **Standards.** Applicable standards include the following:
   - AWWA M51, "Air-Release, Air/Vacuum, and Combination Air Valves"

D. Butterfly Valve.

1. **Standards.** Applicable standards include the following:
   - AWWA C504, "Rubber-Seated Butterfly Valves"

E. Gate Valve.

1. **Standards.** Applicable standards include the following:
   - AWWA C500-02, "Metal-Seated Gate Valves for Water Supply Service"
   - AWWA C509-01, "Resilient-Seated Gate Valves for Water Supply Service"

- AWWA C515-01, "Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service"

F. Tap Sleeve and Valve.

1. Standards. Applicable standards include the following:

- AWWA C110, "Ductile Iron and Gray Iron Fittings for Water"
- ASTM A285, "Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength, Grade C Carbon Steel"

G. Blow Off Assembly.

1. General. Provide materials for blow off assembly and connectors as shown on the plans.

H. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of the appurtenance at the project site before and during installation.

I. Rejections.

1. List causes for rejection of individual appurtenance including fractures, cracks, and damaged ends where such damage would prevent making a satisfactory joint.

2. Allow access for the marking of rejected appurtenances. The Engineer will plainly mark rejected appurtenances by painting colored spots. Remove the rejected appurtenance from the project and replace with another appurtenance meeting the requirements of this item.

J. Bedding Material. Furnish bedding in accordance with Item 400, "Excavation and Backfill for Structures."

K. Backfill Material. Furnish conventional backfill material in accordance with Item 400, "Excavation and Backfill for Structures," or select backfill in accordance with Special Specification XXXX, "Select Backfill for Structures," as specified on the plans.

XXXX.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," and Special Specification XXXX, "Select Backfill for Structures," except as described below:

1. Protect adjacent property and infrastructure in accordance with Item 402, "Trench Excavation Protection," if excavation is deeper than 5 feet.

2. Excavate according to the dimensions shown on the plans or as approved by the Engineer.

3. Excavate the trench to a depth of 6 inches below the bottom of the appurtenance.

B. Installing Appurtenance.

1. Standards. Applicable standards include the following:

- AWWA C600, "Installation of Ductile-Iron Water Mains and Their Appurtenances"

- AWWA C605, "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water"
- AWWA C800, "Underground Service Line Valves and Fittings"

C. Disinfection. Conduct disinfection in accordance with Special Specification XXXX, "Open-Trench Water Pipe."

D. Testing. Conduct testing, including hydrostatic testing, as shown on the plans, Special Specification XXXX, "Open-Trench Water Pipes," or as directed by the Engineer.

XXXX.4. Measurement. This Item will be measured by each water appurtenance installed and in place. Water appurtenances will not be classified for measurement according to the depth of the trench.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Meter" of the size specified, "Water Meter Box" of the size specified, "Water Valve" of the type and size specified, "Blow Off Assembly" of the size specified, "Hydrant" of the type specified, or "Pressure Reducing Station" (see Table 8). All other items are considered subsidiary.

Adjusting or Relocating Pipe Appurtenances

Table 9. Proposed Specification: Adjusting or Relocating Pipe Appurtenances.

Specification Number	XXXX
Specification Title	Adjusting or Relocating Pipe Appurtenances
Description	Adjust or relocate pipe appurtenances. Adjusting pipe appurtenances involves changes in vertical alignment (raising or lowering) but not changes in horizontal alignment. Relocating pipe appurtenances involves changes in horizontal alignment and, if required, changes in vertical alignment.
Previous Specifications	Several, including: 1993 Special Specification 5121, "Vertical Adjustment of Water Valve Cover and Valve Stack." 1993 Special Specification 5126, "Adjustment of Fire Hydrants." 1993 Special Specification 5298, "Adjustment of Water Meter Box and Flush Point." 1993 Special Specification 5511, "Relocate Existing Meters and Meter Boxes." 1993 Special Specification 5510, "Remove and Relocate Fire Hydrant." 2004 Special Specification 5257, "Routine Water Appurtenance Adjustments." 2004 Item 472, "Removing and Re-laying Culvert and Storm Drain Pipe."
Proposed Changes	Create new specification for adjusting (raising or lowering) or relocating pipe appurtenances.
Comment	This specification covers both water and sanitary sewer appurtenances.

Bid Item	**Measurement Unit**
Adjust Water Meter and Meter Box	Each
Adjust Water Valve	Each
Adjust Hydrant	Each
Relocate Water Meter and Meter Box	Each
Relocate Water Valve	Each
Relocate Hydrant	Each
Adjust Sanitary Sewer Valve	Each
Adjust Sanitary Sewer Pipe Cleanout	Each
Adjust Sanitary Sewer Pump	Each
Adjust Sanitary Sewer Valve	Each
Adjust Sanitary Sewer Pipe Cleanout	Each
Adjust Sanitary Sewer Pump	Each
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Table 9. Proposed Specification: Adjusting or Relocating Pipe Appurtenances (Continued).

Subsidiary Item (if specified)	Referenced Item	Subsidiary to
Structural Excavation (Pipes)	400	Appurtenance adjustment or relocation
Bedding	400	Appurtenance adjustment or relocation
Backfill	400	Appurtenance adjustment or relocation
Adjust or Relocate Fittings		Appurtenance adjustment or relocation
Adjust or Relocate Valve Cover, Stack, or Cover		Valve adjustment or relocation
Disinfection and Hydrostatic Test		Appurtenance adjustment or relocation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		

Specification Requirements

XXXX.1. Description. Adjust or relocate pipe appurtenances. Adjusting pipe appurtenances involves changes in vertical alignment (raising or lowering) but not changes in horizontal alignment. Relocating pipe appurtenances involves changes in horizontal alignment and, if required, changes in vertical alignment.

XXXX.2. Materials.

A. General. Replace damaged appurtenances with new items in accordance with Special Specification XXXX, "Water Appurtenances" or Special Specification XXXX, "Sanitary Sewer Appurtenances." If items designated for reuse are damaged by the Contractor, replace them at no charge to the Department with new items or restore them to previous condition, as approved.

B. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of pipe appurtenances at the project site before and during installation.

C. Bedding Material. Furnish bedding in accordance with Item 400, "Excavation and Backfill for Structures."

D. Backfill Material. Furnish conventional backfill material in accordance with Item 400, "Excavation and Backfill for Structures," or select backfill in accordance with Special Specification XXXX, "Select Backfill for Structures," as specified on the plans.

XXXX.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," and Special Specification XXXX, "Select Backfill for Structures," except as described below:

1. Protect adjacent property and infrastructure in accordance with Item 402, "Trench Excavation Protection," if excavation is deeper than 5 feet.
2. Excavate according to the dimensions shown on the plans or as approved by the Engineer.
3. Excavate the trench to a depth of 6 inches below the bottom of the appurtenance.

B. Preparation. Remove any debris in the appurtenance prior to relocation.

C. Installing appurtenances. Install adjusted or relocated appurtenance in accordance with Special Specification XXXX, "Water Appurtenances" or Special Specification XXXX, "Sanitary Sewer Appurtenances."

D. Disinfection. For water appurtenances, conduct disinfection in accordance with Special Specification XXXX, "Open-Trench Water Pipe."

E. Testing.

1. **Water Appurtenances.** Conduct testing, including hydrostatic testing, as shown on the plans, Special Specification XXXX, "Open-Trench Water Pipes," or as directed by the Engineer.
2. **Gravity Sanitary Sewer Appurtenances.** Conduct testing as indicated on the plans, in accordance with Special Specification XXXX, "Open-Trench Gravity Sanitary Sewer Pipe," or as directed by the Engineer.
3. **Pressure Sanitary Sewer Appurtenances.** Conduct testing as indicated on the plans, in accordance with Special Specification XXXX, "Open-Trench Pressure Sanitary Sewer Pipe," or as directed by the Engineer.

XXXX.4. Measurement. This Item will be measured by each appurtenance adjusted or relocated.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Adjust Water Meter and Meter Box," "Adjust Water Valve," "Adjust Hydrant," "Relocate Water Meter and Meter Box," "Relocate Water Valve," "Relocate Hydrant," "Adjust Sanitary Sewer Valve," "Adjust Sanitary Sewer Pipe Cleanout," "Adjust Sanitary Sewer Pump," "Adjust Sanitary Sewer Valve," "Adjust Sanitary Sewer Pipe Cleanout," or "Adjust Sanitary Sewer Pump" (see Table 9). All other items are considered subsidiary.

Manholes and Inlets

Table 10. Proposed Specification: Manholes and Inlets.

Specification Number	465
Specification Title	Manholes and Inlets
Description	Construct manholes and inlets, complete in place or to the stage detailed, including furnishing and installing frames, grates, rings, and covers. Drainage junction boxes are classified as manholes.
Previous Specifications	2004 Item 465, "Manholes and Inlets."
Proposed Changes	Modify specification to ensure compatibility with water and sanitary sewer manhole characteristics and requirements. Add fiberglass and connectors to the list of materials. Add testing to the construction section. Add bid items for manholes and inlets to account for different types and depths of manholes.
Comment	

Bid Item	**Measurement Unit**
Manhole (several types) (Complete) (several depths)	Each
Manhole (several types) (Stage I) (several depths)	Each
Manhole (several types) (Stage II) (several depths)	Each
Inlet (several types) (Complete) (several depths)	Each
Inlet (several types) (Stage I) (several depths)	Each
Inlet (several types) (Stage II) (several depths)	Each
Inlet Extension (several types)	Each
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation	400	Manhole or Inlet Installation
Backfill	400	Manhole or Inlet Installation
Testing		Manhole or Inlet Installation
Seals		Manhole or Inlet Installation
Extensions		Manhole or Inlet Installation
Covers	471	Manhole or Inlet Installation
Rings	471	Manhole or Inlet Installation
Grates	471	Manhole or Inlet Installation
Frames	471	Manhole or Inlet Installation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		

Specification Requirements

465.2. Materials.

- Insert section **465.2.G. Fiberglass** to list of materials and add the following text: "Furnish fiberglass manholes in accordance with ASTM D3753, "Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells.""
- Insert section **465.2.H. Joints** to list of materials and add the following text: "Unless otherwise shown on the plans or as directed by the Engineer, furnish joints between concrete manholes and pipes in accordance with ASTM C478, "Precast Reinforced Concrete Manhole Sections.""
- Insert section **465.2.I. Connectors** to list of materials and add the following text: "Unless otherwise shown on the plans or as directed by the Engineer, furnish connectors between manholes and laterals in accordance with ASTM C923, "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals," or ASTM C1478, "Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes, and Laterals.""

465.3. Construction.

- Insert section **465.3.J. Testing** and add the following text: "Test manhole by hydrostatic exfiltration, vacuum testing, other method approved by TCEQ, or as shown on the plans or directed by the Engineer. For vacuum testing, use ASTM C1244, "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.""

465.5. Payment.

- Replace "type" with "type and depth" in sections **465.5.A**, **465.5.B**, **465.5.D**, **465.5.E**, **465.5.F**, and **465.5.G**.

Removing Structures

Table 11. Proposed Specification: Removing Structures.

Specification Number	496
Specification Title	Removing Structures
Description	Remove and either dispose of or salvage structures.
Previous Specifications	2004 Item 496, "Removing Structures." 1993 Special Specification 5062, "Salvaging Water Lines, Sanitary Sewer Lines, Fire Hydrants, Valves and Fittings." 1993 Special Specification 5000, "Transporting Salvaged Items." 1993 Special Specification 8326, "Remove Rigid Metal Conduit." 1993 Special Specification 8634, "Remove Rigid Metal Conduit."
Proposed Changes	Modify specification to include the removal of utility appurtenances.
Comment	Removing water appurtenances includes removing valves, meters, meter boxes, and hydrants. Removing sanitary sewer appurtenances includes removing valves, cleanouts, and pumps. All other fittings are subsidiary to pipe removal. ***Specification Writer***: The proposed modifications do not include a provision for asbestos cement pipe because TxDOT is revising Items 1 through 9 to more explicitly account for the presence of asbestos at the job site.

Bid Item	**Measurement Unit**
Removing Structures (Pipe) (several diameters)	Foot
Removing Structures (Water Appurtenance)	Each
Removing Structures (Sanitary Sewer Appurtenance)	Each
Removing Structures (Concrete, Brick, or Stone Structures)	Each
Removing Structures (Steel)	Each
Removing Structures (Timber)	Each
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation (Pipes)	400	Item removal
Backfill	400	Item removal
Remove Pipe Fittings		Item removal
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		

Specification Requirements

496.1. Description. Remove and either dispose of or salvage structures.

496.4. Payment. The work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Removing Structures" of the type of structure specified (see Table 11). This price is full compensation for loading, hauling, disposal, stockpiling, removal of appurtenances, excavation and backfill, equipment, labor, tools, and incidentals.

Abandoning Structures

Table 12. Proposed Specification: Abandoning Structures.

Specification Number	XXXX
Specification Title	Abandoning Structures
Description	Abandon and permanently remove from service utility structures such as pipes, manholes, and underground fuel storage tank systems.
Previous Specifications	1993 Special Specification 7321, "Abandonment and Permanent Removal from Service of Underground Fuel Storage Tank Systems." 1993 Special Specification 7328, "Abandonment and Permanent Removal from Service of Underground Fuel Storage Tank Systems." 1993 Special Specification 5740, "Water Mains and Service Lines."
Proposed Changes	Create new specification for abandoning and permanently removing utility structures from service.
Comment	

Bid Item	**Measurement Unit**
Abandon Pipe (Cut and Plug End) (several diameters)	Each
Abandon Pipe (Grout Fill)	Cubic yard
Abandon Manhole (Grout Fill)	Cubic yard
Abandon Underground Fuel Storage Tank System	Lump sum
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Abandon Appurtenance		Abandon Pipe
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		

Specification Requirements

XXXX.1. Description. Abandon and permanently remove from service utility structures such as pipes, manholes, and underground fuel storage tank systems.

XXXX.2. Materials.

A. Grout and Plug. Provide grout and plug material of the type and composition shown on the plans or as approved by the Engineer.

XXXX.3. Construction.

A. Abandon Pipe (Cut and Plug End). Cut, cap, plug, and block each end of the abandoned pipe to isolate that pipe from the existing operational pipe.

B. Abandon Pipe or Manhole (Grout Fill).

1. Submit for the Engineer's review the method to grout fill the abandoned pipe or manhole.
2. Grout fill abandoned valve boxes and extensions to within 8 inches of the finished surface. Fill the remaining 8 inches with Class "D" concrete in accordance with Item 421, "Hydraulic Cement Concrete," or as shown on the plans or approved by the Engineer.
3. Salvage valve covers as directed by the Engineer.

C. Abandon Underground Fuel Storage Tank System.

1. **Standards and Codes.** Applicable standards and codes include the following:
   - American Petroleum Institute Recommended Practice 1604, "Closure of Underground Storage Tanks"
   - Code of Federal Regulations Title 40, Part 280, Subpart G, "Out of Service UST Systems and Closure"
   - Texas Administrative Code Title 30, Chapter 334, "Underground and Aboveground Storage Tanks"

XXXX.4. Measurement. This Item will be measured by each structure abandoned in place according to the provisions of this specification.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Abandon Pipe" of type and size specified, "Abandon Manhole," or "Abandon Underground Fuel Storage Tank System" (see Table 12). All other items are considered subsidiary.

Open-Trench Gravity Sanitary Sewer Pipe

Table 13. Proposed Specification: Open-Trench Gravity Sanitary Sewer Pipe.

Specification Number	XXXX
Specification Title	Open-Trench Gravity Sanitary Sewer Pipe
Description	Furnish and install open-trench gravity sanitary sewer pipe and fittings (except valves which Special Specification XXXX, "Sanitary Sewer Pipe Appurtenances" covers).
Previous Specifications	Several, including: 1993 Special Specification 3514, "Water Mains and Sanitary Sewers." 1993 Special Specification 5885, "Water and Sanitary Sewer Systems." 2004 Special Specification 5095, "Sanitary Sewer Mains."
Proposed Changes	Create new specification for open-trench gravity sanitary sewer pipes.
Comment	

Bid Item	**Measurement Unit**
Open-Trench Gravity Sanitary Sewer Pipe (Reinforced Concrete) (several diameters)	Foot
Open-Trench Gravity Sanitary Sewer Pipe (Nonreinforced Concrete) (several diameters, typically less than 12 inches)	Foot
Open-Trench Gravity Sanitary Sewer Pipe (PVC) (several diameters)	Foot
Open-Trench Gravity Sanitary Sewer Pipe (PE) (several diameters)	Foot
Open-Trench Gravity Sanitary Sewer Pipe (Fiberglass) (several diameters)	Foot
Open-Trench Gravity Sanitary Sewer Pipe (Vitrified Clay) (several diameters)	Foot
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation (Pipes)	400	Pipe installation
Bedding	400	Pipe installation
Fittings		Pipe installation
Backfill	400	Pipe installation
Corrosion Control		Pipe installation
Testing		Pipe installation
Warning Tape for Non-Metallic Pipes		Pipe installation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		Pipe installation

Specification Requirements

XXXX.1. Description. Furnish and install open-trench gravity sanitary sewer pipe and fittings (except valves, which Special Specification XXXX, "Sanitary Sewer Pipe Appurtenances" covers).

XXXX.2. Materials.

A. Concrete Pipe and Fittings.

1. Standards. Applicable standards include the following:

- ASTM C76, "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe"
- ASTM C655, "Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe"
- ASTM C1417, "Standard Specification for Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design"
- ASTM C443, "Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets"
- ASTM C497, "Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile"
- ASTM C14, "Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe"

B. Polyvinyl Chloride (PVC) Sanitary Sewer Pipe and Fittings.

1. Standards. Applicable standards include the following:

- ASTM D3034, "Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings"
- ASTM D3212, "Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals"
- ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"
- ASTM F679, "Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings"
- ASTM F789, "Standard Specifications for Type PS-46 and Type PS-115 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings"
- ASTM F794, "Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter"
- ASTM F949, "Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings"

- ASTM F1803, "Standard Specification for Poly (Vinyl Chloride) (PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter"

C. Polyethylene (PE) Pipe.

1. Standards. Applicable standards include the following:

- ASTM F714, "Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter"
- ASTM F894, "Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe"
- ASTM D3350, "Standard Specification for Polyethylene Plastics Pipe and Fittings Materials"
- ASTM D3212, "Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals"
- ASTM D2657, "Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings"
- ASTM F1290, "Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings"

D. Fiberglass Pipe.

1. Standards. Applicable standards include the following:

- ASTM D3262, "Standard Specification for Fiberglass (Glass-Fiber Reinforced Thermosetting-Resin) Sewer Pipe"
- ASTM D3754, "Standard Specification for Fiberglass (Glass-Fiber Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe"
- ASTM D4161, "Standard Specification for Fiberglass (Glass-Fiber Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals"
- ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"

E. Vitrified Clay Pipe.

1. Standards. Applicable standards include the following:

- ASTM C700, "Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated"
- ASTM C425, "Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings"
- ASTM C301, "Standard Test Methods for Vitrified Clay Pipe"

F. Nonmetallic Pipe Detection Method. Provide a method approved by the Engineer or as shown on the plans for detecting nonmetallic pipes.

G. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of the finished pipe at the project site before and during installation.

H. Rejections.

1. List causes for rejection of individual sections of pipe including fractures, cracks, and damaged ends where such damage would prevent making a satisfactory joint.

2. Allow access for the marking of rejected pipe. The Engineer will plainly mark rejected pipe by painting colored spots. Remove the rejected pipe from the project and replace with pipe meeting the requirements of this item.

I. Bedding Material. Furnish bedding in accordance with Item 400, "Excavation and Backfill for Structures."

J. Backfill Material. Furnish conventional backfill material in accordance with Item 400, "Excavation and Backfill for Structures," or select backfill in accordance with Special Specification XXXX, "Select Backfill for Structures," as specified on the plans.

XXXX.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," and Special Specification XXXX, "Select Backfill for Structures," except as described below:

1. Do not excavate more than the maximum length ahead of backfilling operations, as shown on the plans or as approved by the Engineer.

2. Protect adjacent property and infrastructure in accordance with Item 402, "Trench Excavation Protection," if excavation is deeper than 5 feet.

3. Trench dimensions:

- 24 inches or outside pipe diameter plus 16 inches (whichever is greater) for 24-inch pipe or smaller.
- Outside pipe diameter plus 24 inches for pipe larger than 24 inches.

4. Excavate the trench to a depth of 6 inches below the bottom of the pipe.

B. Laying Pipe.

1. Standards. Applicable standards include the following:

- ASTM D2321, "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications"
- ASTM C12, "Standard Practice for Installing Vitrified Clay Pipe Lines"
- ASTM C1479, "Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations"

2. General.

- Verify that no section of pipe deviates from the alignment shown on the plans by more than the maximum tolerance allowed. For any section of pipe, unless otherwise directed by the Engineer or as indicated on the plans, the maximum

horizontal tolerance will be 0.25 foot and the maximum vertical tolerance will be 0.01 foot for grades up to 0.05 percent or 0.1 foot for grades above 0.05 percent.

- Measure and record "as-built" horizontal and vertical alignment at no more than every 100 feet on the on-site recorded plans.
- Where plans show curves without special fittings, deflect pipe at the joints using standard lengths of pipe. Do not exceed maximum deflection amounts recommended by the pipe manufacturer.
- If deviations are necessary due to obstructions not shown on the plans, deflect pipe from the horizontal or vertical alignments only as directed by the Engineer. Do not exceed maximum deflection amounts recommended by the pipe manufacturer.
- Do not lay more than 50 feet of pipe in the trench ahead of backfilling operations.
- Unload pipe, fittings, and accessories at the point of delivery and haul to the site of the project. Position the material such that water or runoff does not enter or pass through the pipe. Do not skid or roll pipe handled on skidways against pipe already on the ground.
- When laying pipe is not in progress, close the open end of the pipe in the trench with a watertight plug or similar device approved by the Engineer.
- Place water lines above sanitary sewers, unless the plans show a special design.
- Confirm that separation between water lines and sanitary sewers or manholes is at least 9 feet in all directions, unless the plans show a special design or are in accordance with the following:

  (1) Parallel water line and sanitary sewer or manhole with no leaks: minimum 4 foot outside horizontal clearance.

  (2) Water line crossing above a sanitary sewer with no leaks: minimum 2 foot outside vertical clearance.
- Provide encasement as shown on the plans or as directed by the Engineer in accordance with Special Specification XXXX, "Open-Trench Pipe Encasement."

C. Pipe Testing.

1. Standards. Applicable standards include the following:

- ASTM C969, "Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines"
- ASTM C1091, "Standard Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines"
- ASTM C1103, "Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines"
- ASTM C828, "Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines"

- ASTM C924, "Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method"
- ASTM F1417, "Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air"
- ASTM C1214, "Practice for Testing Concrete Pipe Sewer Lines by Negative Air Pressure (Vacuum) Test Method"
- Texas Commission on Environmental Quality (TCEQ) Rule 317, "Design Criteria for Sewerage Systems, 317.2(a)(4)"

2. General.

- Conduct infiltration test, exfiltration test, or air test as indicated on the plans or as directed by the Engineer.
- Use groundwater or flooding for infiltration test, as approved by the Engineer.
- Follow appropriate standards according to pipe material.
- Backfill at least 1 foot over the pipe on the section to be tested. Additional cover may be necessary on larger pipes to prevent the pipe from floating out of grade.

3. Deflection Test for Flexible Pipe.

- Conduct vertical deflection test for flexible sanitary sewer pipe at least 30 days after complete pipe placement and backfill densification.
- Unless indicated on the plans or as directed by the Engineer, use mandrel to conduct deflection test for pipes 27 inches or smaller nominal inner diameter. Provide certification of mandrel's suitability for the test.
- Use alternative testing method for pipes larger than 27 inches nominal inner diameter, as shown on the plans or as approved by the Engineer.

XXXX.4. Measurement. This Item will be measured by the foot along the centerline of the pipe, from center to center of fittings, manholes, and valves. No length deductions will be made for fittings, manholes, and valves. Gravity sanitary sewer pipes will not be classified for measurement according to the depth of the trench.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Open-Trench Gravity Sanitary Sewer Pipe" of the type and size specified (see Table 13). All other items are considered subsidiary.

Open-Trench Pressure Sanitary Sewer Pipe

Table 14. Proposed Specification: Open-Trench Pressure Sanitary Sewer Pipe.

Specification Number	XXXX
Specification Title	Open-Trench Pressure Sanitary Sewer Pipe
Description	Furnish and install open-trench pressure sanitary sewer pipe and fittings (except valves, which Special Specification XXXX, "Sanitary Sewer Pipe Appurtenances" covers).
Previous Specifications	Several, including: 1993 Special Specification 4731, "Concrete Thrust Block." 1993 Special Specification 5885, "Water and Sanitary Sewer Systems." 1993 Special Specification 5521, "Sanitary Sewer." 2004 Special Specification 5095, "Sanitary Sewer Mains." 2004 Special Specification 5195, "Sanitary Sewer." 2004 Special Specification 5289, "Sanitary Sewer."
Proposed Changes	Create new specification for open-trench pressure sanitary sewer pipes.
Comment	

Bid Item	**Measurement Unit**
Open-Trench Pressure Sanitary Sewer Pipe (Pre-stressed Concrete) (several diameters)	Foot
Open-Trench Pressure Sanitary Sewer Pipe (Bar-Wrapped Concrete) (several diameters)	Foot
Open-Trench Pressure Sanitary Sewer Pipe (Ductile Iron) (several diameters)	Foot
Open-Trench Pressure Sanitary Sewer Pipe (PVC) (several diameters)	Foot
Open-Trench Pressure Sanitary Sewer Pipe (Fiberglass) (several diameters)	Foot
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation (Pipes)	400	Pipe installation
Bedding	400	Pipe installation
Fittings (but not Valves)		Pipe installation
Backfill	400	Pipe installation
Corrosion Control		Pipe installation
Thrust Restraint		Pipe installation
Leakage Testing		Pipe installation
Warning Tape for Non-Metallic Pipes		Pipe installation
Specification Writer: Add other items as indicated on the plans or as required by this specification.		Pipe installation

Specification Requirements

XXXX.1. Description. Furnish and install open-trench pressure sanitary sewer pipe and fittings (except valves, which Special Specification XXXX, "Sanitary Sewer Pipe Appurtenances" covers).

XXXX.2. Materials.

A. Concrete Pressure Pipe and Fittings.

1. Standards. Applicable standards include the following:

- AWWA C301, "Pre-stressed Concrete Pressure Pipe – Steel Cylinder Type, for Water and Other Liquids"
- AWWA C303, "Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type"
- AWWA C304, "Standard for Design of Pre-stressed Concrete Cylinder Pipe"
- AWWA M9, "Concrete Pressure Pipe"
- ASTM C497, "Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile"

B. Ductile Iron Pressure Pipe and Fittings.

1. Standards. Applicable standards include the following:

- AWWA C151, "Standard for Ductile Iron Pipe Centrifugally Cast for Water or Other Liquids"
- AWWA C104, "Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water"
- AWWA C105, "Polyethylene Encasement for Ductile-Iron Pipe Systems"
- AWWA C110, "Ductile Iron and Gray Iron Fittings"
- AWWA C111, "Gasket Joints for Ductile Iron Pressure Pipe and Fittings"
- AWWA C115, "Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges"
- AWWA C116, "Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Supply Service"
- A674, "Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids"
- AWWA C150, "Standard for Thickness Design of Ductile Iron Pipe"
- AWWA C606, "Grooved and Shouldered Joints"

2. General.

- Submit manufacturer's certification of pipe compliance with AWWA C151, "Standard for Ductile Iron Pipe Centrifugally Cast for Water or Other Liquids."

C. Polyvinyl Chloride (PVC) Pressure Sanitary Sewer Pipe and Fittings.

1. **Standards.** Applicable standards include the following:

   - ASTM D2241, "Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)"
   - ASTM D3139, "Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals"
   - ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"

D. Fiberglass Pipe.

1. **Standards.** Applicable standards include the following:

   - ASTM D3262, "Standard Specification for Fiberglass (Glass-Fiber Reinforced Thermosetting-Resin) Sewer Pipe"
   - ASTM D3754, "Standard Specification for Fiberglass (Glass-Fiber Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe"
   - ASTM D4161, "Standard Specification for Fiberglass (Glass-Fiber Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals"
   - ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"

E. Nonmetallic Pipe Detection Method. Provide a method approved by the Engineer or as shown on the plans for detecting nonmetallic pipes.

F. Thrust Restraint.

1. **Standards.** Applicable standards include the following:

   - AWWA C111, "Gasket Joints for Ductile Iron Pressure Pipe and Fittings"
   - AWWA C116, "Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings"
   - AWWA C153, "Ductile-Iron Compact Fittings for Water Service"
   - ASTM D3139, "Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals"
   - ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"
   - ASTM F1674, "Standard Test Method for Joint Restraint Products for Use with PVC Pipe"

2. **General.**

   - Use thrust restraint as specified on the plans.
   - Horizontal and vertical bends between zero and 10 degrees deflection angle do not require thrust blocks or restrained joints.

3. **Concrete Thrust Blocks.**

   - ***Note to Specification Writer***: Consider developing standard details and tables (see, e.g., NCTCOG Standard Specifications for Public Works Construction, Standard Drawings 4010A through 4040).
   - Place thrust blocks between undisturbed ground and fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Extend concrete from 6 inches below pipe or fitting to 12 inches above.
   - Reinforced concrete encasement of pipe and fittings may be used in lieu of manufactured joint restraint systems. Design concrete encasement reinforcement for all loads, including internal pressure and longitudinal forces.

4. **Mechanical Joint Restraint.**

   - Follow manufacturer's recommendations for installation of mechanical joint restraint.

G. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of the finished pipe at the project site before and during installation.

H. Rejections.

1. List causes for rejection of individual sections of pipe including fractures, cracks, and damaged ends where such damage would prevent making a satisfactory joint.
2. Allow access for the marking of rejected pipe. The Engineer will plainly mark rejected pipe by painting colored spots. Remove the rejected pipe from the project and replace with pipe meeting the requirements of this item.

I. Bedding Material. Furnish bedding in accordance with Item 400, "Excavation and Backfill for Structures."

J. Backfill Material. Furnish conventional backfill material in accordance with Item 400, "Excavation and Backfill for Structures," or select backfill in accordance with Special Specification XXXX, "Select Backfill for Structures," as specified on the plans.

XXXX.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," and Special Specification XXXX, "Select Backfill for Structures," except as described below:

1. Do not excavate more than the maximum length ahead of backfilling operations, as shown on the plans or as approved by the Engineer.
2. Protect adjacent property and infrastructure in accordance with Item 402, "Trench Excavation Protection," if excavation is deeper than 5 feet.
3. Trench dimensions:

   - 24 inches or outside pipe diameter plus 16 inches (whichever is greater) for 24-inch pipe or smaller.
   - Outside pipe diameter plus 24 inches for pipe larger than 24 inches.

4. Excavate the trench to a depth of 6 inches below the bottom of the pipe.

B. Laying Pipe.

1. General.

- Verify that no section of pipe deviates from the alignment shown on the plans by more than the maximum tolerance allowed. Unless otherwise directed by the Engineer or as indicated on the plans, for any section of pipe the maximum horizontal tolerance will be 0.25 foot and the maximum vertical tolerance will be 0.1 foot. ***Note to Specification Writer***: There is conflicting information regarding maximum tolerances. For example, the City of Houston specifies a maximum horizontal deviation of 3 inches (0.25 foot) and a maximum vertical deviation of 2 inches (0.17 foot) for any section of pipe. However, for large diameter pipes, the same specifications limit horizontal and vertical deviations to 0.1 foot. The TxDOT Survey Guide recommends a horizontal requirement of 0.5 foot for staking and a vertical requirement of 0.1 foot.
- Measure and record "as-built" horizontal and vertical alignment at no more than every 100 feet on the on-site recorded plans.
- Where plans show curves without special fittings, deflect pipe at the joints using standard lengths of pipe. Do not exceed maximum deflection amounts recommended by the pipe manufacturer.
- If deviations are necessary due to obstructions not shown on the plans, deflect pipe from the horizontal or vertical alignments only as directed by the Engineer. Do not exceed maximum deflection amounts recommended by the pipe manufacturer.
- Do not lay more than 50 feet of pipe in the trench ahead of backfilling operations.
- Unload pipe, fittings, and accessories at the point of delivery and haul to the site of the project. Position the material such that water or runoff does not enter or pass through the pipe. Do not skid or roll pipe handled on skidways against pipe already on the ground.
- When laying pipe is not in progress, close the open end of the pipe in the trench with a watertight plug or similar device approved by the Engineer.
- Place water lines above sanitary sewers, unless the plans show a special design.
- Confirm that separation between water lines and sanitary sewers or manholes is at least 9 feet in all directions, unless the plans show a special design or are in accordance with the following:

  (1) Parallel water line and sanitary sewer or manhole with no leaks: minimum 4 foot outside horizontal clearance.

  (2) Water line crossing above a sanitary sewer with no leaks: minimum 2 foot outside vertical clearance.

- Provide encasement as shown on the plans or as directed by the Engineer in accordance with Special Specification XXXX, "Open-Trench Pipe Encasement."

C. Hydrostatic Test.

1. Standards. Applicable standards include the following:

- AWWA C600, "Installation of Ductile Iron Water Mains and Their Appurtenances"
- AWWA C605, "Underground Installation of PVC Pressure Pipe and Fittings for Water"

2. General.

- Purge pressure sanitary sewer pipe using the poly-pig method or the flushing method, as approved by the Engineer, prior to hydrostatic testing.
- Test pressure sanitary sewer pipes between valves, or plugs, of not more than 4,000 feet.
- For pressure sanitary sewer pipes of materials in combination, test for the type of pipe material with the least stringent hydraulic test pressure maintained over the duration of the test.

XXXX.4. Measurement. This Item will be measured by the foot along the centerline of the pipe, from center to center of fittings and valves. No length deductions will be made for fittings and valves. Pressure sanitary sewer pipes will not be classified for measurement according to the depth of the trench.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Open-Trench Pressure Sanitary Sewer Pipe" of the type and size specified (see Table 14). All other items are considered subsidiary.

Adjusting or Relocating Sanitary Sewer Pipes

Table 15. Proposed Specification: Adjusting or Relocating Sanitary Sewer Pipes.

Specification Number	XXXX
Specification Title	Adjusting or Relocating Sanitary Sewer Pipes
Description	Adjust or relocate sanitary sewer pipes. Adjusting pipes involves changes in vertical alignment (raising or lowering) but not changes in horizontal alignment. Relocating pipes involves changes in horizontal alignment and, if required, changes in vertical alignment.
Previous Specifications	Several, including: 2004 Item 495, "Raising Existing Structures." 2004 Item 472, "Removing and Re-Laying Culvert and Storm Drain Pipe." 1993 Special Specification 5570, "Relocate Sanitary Sewer."
Proposed Changes	Create new specification for adjusting (raising or lowering) or relocating sanitary sewer pipes.
Comment	

Bid Item	**Measurement Unit**
Adjust Sanitary Sewer Pipe (several diameters)	Foot
Relocate Sanitary Sewer Pipe (several diameters)	Foot
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation (Pipes)	400	Pipe adjustment or relocation
Bedding	400	Pipe adjustment or relocation
Backfill	400	Pipe adjustment or relocation
Adjust or Relocate Fittings		Pipe adjustment or relocation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		

Specification Requirements

XXXX.1. Description. Adjust or relocate pressure or gravity sanitary sewer pipes. Adjusting pipes involves changes in vertical alignment (raising or lowering) but not changes in horizontal alignment. Relocating pipes involves changes in horizontal alignment and, if required, changes in vertical alignment.

XXXX.2. Materials.

A. General. Replace unsuitable or damaged pipe, fittings, or joints with new items in accordance with Special Specification XXXX, "Open-Trench Pressure Sanitary Sewer Pipe" or Special Specification XXXX, "Open-Trench Gravity Sanitary Sewer Pipe." If items designated for reuse are damaged by the Contractor, replace them at no charge to

the Department with new material or restore them to previous condition, as approved by the Engineer.

B. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of the pipe at the project site before and during installation.

C. Bedding Material. Furnish bedding in accordance with Item 400, "Excavation and Backfill for Structures."

D. Backfill Material. Furnish conventional backfill material in accordance with Item 400, "Excavation and Backfill for Structures," or select backfill in accordance with Special Specification XXXX, "Select Backfill for Structures," as specified on the plans.

XXXX.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," and Special Specification XXXX, "Select Backfill for Structures," except as described below:

1. Do not excavate more than the maximum length ahead of backfilling operations, as shown on the plans or as approved by the Engineer.

2. Protect adjacent property and infrastructure in accordance with Item 402, "Trench Excavation Protection," if excavation is deeper than 5 feet.

3. Trench dimensions:

- 24 inches or outside pipe diameter plus 16 inches (whichever is greater) for 24 inch pipe or smaller.
- Outside pipe diameter plus 24 inches for pipe larger than 24 inches.

4. Excavate the trench to a depth of 6 inches below the bottom of the pipe.

B. Preparation. Remove any debris in the pipe prior to relocation. Clean pipe as shown on the plans or as directed by the Engineer. Clean joints adequate for reuse prior to re-laying pipe. Mark the top and bottom of pipe joints before removal and adjustment or relocation.

C. Laying Pipe.

1. Install adjusted or relocated pipe and fittings in accordance with Special Specification XXXX, "Open-Trench Sanitary Sewer Pipe."

2. Provide encasement as shown on the plans or as directed by the Engineer in accordance with Special Specification XXXX, "Open-Trench Pipe Encasement."

D. Testing. For gravity flow applications conduct testing in accordance with Special Specification XXXX, "Open-Trench Gravity Sanitary Sewer Pipe." For pressure applications conduct testing in accordance with Special Specification XXXX, "Open-Trench Pressure Sanitary Sewer Pipe."

XXXX.4. Measurement. This Item will be measured by the foot along the centerline of pipe adjusted or relocated, from center to center of fittings and valves. Sewer pipe adjustment or relocation will not be classified for measurement according to the depth of the trench.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Adjust Sanitary Sewer Pipe" or "Relocate Sanitary Sewer Pipe" of the size specified (see Table 15). All other items are considered subsidiary.

Sanitary Sewer Appurtenances

Table 16. Proposed Specification: Sanitary Sewer Appurtenances.

Specification Number	XXXX
Specification Title	Sanitary Sewer Appurtenances
Description	Furnish and install appurtenances for sanitary sewer lines.
Previous Specifications	Several, including: 1993 Special Specification 3596, "Water and Wastewater Infrastructure and Appurtenances." 1993 Special Specification 5493, "Water Mains and Wastewater Appurtenances." 2004 Special Specification 5033, "Water and Wastewater Main Appurtenances." 2004 Special specification 5061, "Water and Wastewater Main Appurtenances."
Proposed Changes	Create new specification for sanitary sewer appurtenances.
Comment	

Bid Item	**Measurement Unit**
Sanitary Sewer Gate Valve (several diameters)	Each
Sanitary Sewer Pipe Cleanout (several sewer line diameters)	Each
Sanitary Sewer Tap Valve and Sleeve (several diameters)	Each
Sanitary Sewer Pump (several types) (several diameters)	Each
Specification Writer: Add other pay items as indicated on the plans or as required by this specification.	

Subsidiary Item (if specified)	**Referenced Item**	**Subsidiary to**
Structural Excavation	400	Appurtenance installation
Bedding	400	Appurtenance installation
Backfill	400	Appurtenance installation
Valve Cover, Stack, and Box		Valve installation
Testing		Appurtenance installation
Specification Writer: Add other subsidiary items as indicated on the plans or as required by this specification.		Appurtenance installation

Specification Requirements

XXXX.1. Description. Furnish and install appurtenances for sanitary sewer.

XXXX.2. Materials.

A. Gate Valve.

1. Standards. Applicable standards include the following:

- AWWA C500-02, "Metal-Seated Gate Valves for Water Supply Service"

- AWWA C509-01, "Resilient-Seated Gate Valves for Water Supply Service"
- AWWA C515-01, "Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service"

B. Pipe Cleanout.

1. Furnish materials for the construction and assembly of sanitary sewer pipe cleanout as shown on the plans or as directed by the Engineer.

C. Tap Valve and Sleeve. Furnish tap valve and sleeve as shown on the plans.

D. Pump. Furnish sanitary sewer pump as shown on the plans.

E. Inspections. Provide facilities and access to allow for inspection. Provide access for inspection of the appurtenance at the project site before and during installation.

F. Rejections.

1. List causes for rejection of individual appurtenance including fractures, cracks, and damaged ends where such damage would prevent making a satisfactory joint.

2. Allow access for the marking of rejected appurtenances. The Engineer will plainly mark rejected appurtenances by painting colored spots. Remove the rejected appurtenance from the project and replace with another appurtenance meeting the requirements of this item.

G. Bedding Material. Furnish bedding in accordance with Item 400, "Excavation and Backfill for Structures."

H. Backfill Material. Furnish conventional backfill material in accordance with Item 400, "Excavation and Backfill for Structures," or select backfill in accordance with Special Specification XXXX, "Select Backfill for Structures," as specified on the plans.

XXXX.3. Construction.

A. Excavation, Shaping, Bedding, and Backfill. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," and Special Specification XXXX, "Select Backfill for Structures," except as described below:

1. Protect adjacent property and infrastructure in accordance with Item 402, "Trench Excavation Protection," if excavation is deeper than 5 feet.

2. Excavate according to the dimensions shown on the plans or as approved by the Engineer.

3. Excavate the trench to a depth of 6 inches below the bottom of the appurtenance.

B. Installing Appurtenance.

1. Standards. Applicable standards include the following:

a. AWWA C800, "Underground Service Line Valves and Fittings"

C. Valve Stack, Box, and Cover. Valve stack, box, and cover shall be installed as shown on the plans or as directed by the Engineer.

D. Testing.

1. **Gravity Sanitary Sewer Appurtenance.** Conduct testing as indicated on the plans, in accordance with Special Specification XXXX, "Open-Trench Gravity Sanitary Sewer Pipe," or as directed by the Engineer.
2. **Pressure Sanitary Sewer Appurtenance.** Conduct testing as indicated on the plans, in accordance with Special Specification XXXX, "Open-Trench Pressure Sanitary Sewer Pipe," or as directed by the Engineer.

XXXX.4. Measurement. This Item will be measured by each water appurtenance installed and in place. Sanitary sewer appurtenances will not be classified for measurement according to the depth of the trench.

XXXX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Sanitary Sewer Gate Valve" of the size specified, "Sanitary Sewer Pipe Cleanout" of the size specified, "Sanitary Sewer Tap Valve and Sleeve" of the size specified, or "Sanitary Sewer Pump" of the type and size specified (see Table 16). All other items are considered subsidiary.

REFERENCES

1. *Texas Administrative Code, Title 43, Part 1, Chapter 21, Subchapter C*. 43TAC1.21C. http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=43&pt=1&ch=21&sch=C&rl=Y. Accessed September 19, 2005.
2. *Utility Manual*. Texas Department of Transportation, Austin, Texas, July 2005.
3. C. Quiroga, S. Kranc, D. Ford, E. Kraus, and T. Taylor. *A Unit Cost and Construction Specification Framework for Utility Installations*. Draft. Publication FHWA/TX-07/0-4998-1. Texas Department of Transportation, Austin, Texas, 2006.
4. *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges*. Texas Department of Transportation, Austin, Texas, 2004.
5. Standards. ASTM International, West Conshohocken, Pennsylvania, 2006. http://www.astm.org/cgi-bin/SoftCart.exe/NEWSITE_JAVASCRIPT/index.shtml?L+mystore+epgc2883+1154326448. Accessed August 30, 2006.
6. AWWA Standards. American Water Works Association, Denver, Colorado, 2006. http://www.awwa.org/bookstore/Category.cfm?cat=3. Accessed August 30, 2006.
7. ASCE Downloadable Standards. American Society of Civil Engineers, Reston, Virginia, 2006. http://www.techstreet.com/ascegate.tmpl. Accessed August 30, 2006.
8. Standards and Publications. NSF International, Ann Arbor, Michigan, 2006. http://www.nsf.org/business/standards_and_publications/. Accessed August 30, 2006.
9. *Survey Guide*. Texas Department of Transportation, Austin, Texas, 1999.
10. *Public Works Construction Standards*. North Central Texas Council of Governments, Arlington, Texas, 2004.
11. Standard Construction Specifications for Wastewater Collection Systems, Water Lines, Storm Drainage, and Street Paving. Department of Public Works and Engineering, City of Houston, Houston, Texas, October 2002. http://www.publicworks.cityofhouston.gov/documents/index.htm. Accessed August 30, 2006.
12. *Texas Administrative Code, Title 43, Part 1, Chapter 21, Subchapter C*. 43TAC1.21C. http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=43&pt=1&ch=21&sch=C&rl=Y. Accessed September 19, 2005.
13. *Texas Administrative Code, Title 30, Part 1, Chapter 290, Subchapter D*. 30TAC1.290D. http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=290&rl=44. Accessed August 30, 2006.
14. Publications. Trenchless Technology Center, Louisiana Tech University, Ruston, Louisiana, 2006. http://www.ttc.latech.edu/publications/index.htm. Accessed December 21, 2006.