Request for Bid
Group 3 Relay Addendum No. 2 to
RFB No. 419770.71.0418
June 13, 2024

The following information encompasses Addendum No. 2 for the above referenced RFB. Bidders shall fully consider and acknowledge this Addendum in the preparation and submittal of its formal Bid. Failure to do so may result in the rejection of the Bid.

Section 1 – Mandatory Pre-Bid Meeting Notes and Questions, Additional Bidder Questions Received to Date, and Sign-In Sheet

Section 2 – 00370.3.1 Unit Pricing

Section 3 – Updated Technical Specifications

All other conditions and requirements remain unchanged.

Section 1
Mandatory Pre-Bid Meeting Notes and Questions, Additional Bidder Questions Received to Date, and Sign-In Sheet

Q1: Spec. Section 02950-3.05.A; The specs. call out to match existing thickness, or 2" minimum thickness. What asphalt thickness do you want bidding contractors to bid, as existing thicknesses are not provided, so we can all bid the same thickness?

SARP10: For base bid purposes, use a thickness of 2-inches.

Q2: Bid Form Item Number 02530-6.01; Please define what a "Mainline Terminus" is and what will we be exposing- capped mainline, or other?

SARP10: Refer to revised spec 2530 Section 6.01. A in addendum 2.

Q3: Group 3 Relay Rehab Project Pipe Bid Schedule; Please clarify the 6" pipe noted on the schedule, as 6" pipe is not called out on the bid form for replacement. Are we installing 6" pipe and the bid form needs to be revised to include this size of pipe?

SARP10: All pipes that indicate 6-inch in the bid schedule will be upsized to 8-inch.

Q4: Group 3 Relay Rehab Project Pipe Bid Schedule; For "Pipe ID FS021549.02S" with a diameter of 12" , the depth for that section is labeled at 0.0'. If there is a known depth for that pipe?

SARP10: The estimated depth of this pipe is 8-feet deep.

Q5: Bypass Pumping: Please provide flow information for determination of flows we can expect and for sizing of bypass pumps.

SARP10: For base bid.

Q6: Bid Form Item Number 02530-6.06: This bid item has a bid quantity of 61 lump sum, please define the quantity of 61, is number of locations, or other?

SARP10: The bid quantity will be revised to a Per Each in addendum 2.

Q7: Plan Set Drawings: There are several locations on the plans noted by a yellow pentagon, this notation is not provided on the "Pipe Rehab" legend. Should this notation be a yellow square to represent "Install New Manhole"?

SARP10: Revised on maps in addendum 2.

Q8: Bid Form Item Number 02530-6.03.15.10.03; The bid form calls for 10" pipe, this size piping is not called out on the plans. Where is the 10" pipe to be installed?

SARP10: Refer to revised bid tab in addendum 1.

Q9: Bid Form Item Number 02530-6.08; Hydroexcavating/Hand Digging is not defined in spec. section 02530-4.01 and 4.02. Please define the scope of this work as it relates to section 4.01 and 4.02.

SARP10: Refer to revised specs section 3.01 G. Excavation Around Obstacles 3. Hydroexcavation/Hand Digging in addendum 2.

Q10: Bid Form Item Number 02950-4.01-D; The bidding documents do not define the thickness of gravel for the driveways. What is the thickness of crushed stone?

SARP10: The gravel driveway restoration will match existing thickness.

Q11: Bid Form Item Number 02530-6.04; Please clarify that the lateral from the main to the private connection point is being replaced, as the pay item is not defined as "Linear Foot", rather than each. Per each would indicate that we are only making a reconnection point to the main, rather than the complete lateral line.

SARP10: The scope of this work is to reconnect the lateral line at the connection point. For bidding purposes, the lateral will be replaced in same trench as relay.

Q12: Bid Form Item Number 02530-6.04; Pending the answer to the above question, if complete lateral replacement, will new cleanouts be required? We are assuming no since payment item 4.02-C is not being used on this project.

SARP10: The lateral is not being replaced in this contract.

Q13: Bid Form Item Number 02531-4.01.A.2/ B.1/ B.2/ B.3; Can you provide Manhole IDs for the manholes, for reference on the drawings.

SARP10: Refer to revised bid schedule in addendum 2.

Q14: Bid Form Item Number 02544-4.01.A; Can you provide Manhole IDs for the manholes needing GPS coordinates.

SARP10: All manholes that are the upstream or downstream manhole of a relay and/or rehabilitated are to have post construction GPS completed.

Q15: Bid Form Item Number 02544-4.01.C; Can you provide Manhole IDs for the manholes needing inspections.

SARP10: All manholes that are the upstream or downstream manhole of a relay and/or rehabilitated are to have post construction inspections.

Q16: Bid Form Item Number 02950-4.01.C; Should the unit of measurement be in "LF"?

SARP10: Refer to revised bid tab in Addendum 1.

Q17: Do we have existing information on utilities locations?

SARP10: No existing utilities mapping has been obtained.

Q18: Have all the manholes been exposed so we can locate the manholes in the field?

SARP10: If the manhole is not raised, the contractor will work with the Program team will work to get them raised.

Q19: Have the houses and residents around the relay locations been informed of future work?

SARP10: It is the contractor's responsibility to coordinate with property owners while working on private property. The Program team will assist with the contractor if there are any issues that arise from property owners.

Q20: How do we need to turn in the electronic bid paperwork with physical bid paperwork?

SARP10: Yes, per specification documents Section 00170.1, Electronic copy is required with physical bid.

SIGN-IN SHEET

Project:	SARP10	**Meeting Date:**	June 11, 2024
Meeting:	Group 3 ~~CIPP~~ Relay Meeting	**Time:**	~~9:00~~ 10 AM – ~~10:00~~ 11 AM
Facilitator:	Josh Grabowski	**Place/Room:**	EM 2865 Frayser Blvd Memphis TN

Name	Company	Phone	E-Mail
Justin Avent	SARP10	901-849-6554	justin.avent@gresham smith.com
John Coleman	Magnolia Underground	901 603 5095	jcoleman@magnoliaunderground.c
Wiley Richards	W&T	901-497-1291	WileyRichards at W+Tcontracting co,
Terrell Richards	W&T	901-331-1780	terrellrichards@wtcontrac tra corp.com
Trenton Moore	Cambridge Construction	770/652/1444	tmoore.ccminc@outlook.
NATHAN STRENGEL	W&T	901.326.7558	nathan strengel@wtcontracting co
Tyler Jagielski	Garney	256-724-1371	Tyler.Jagielski@garney.com
Aaron Heppner	Garney	510-376-6984	garneynashville@garney.com
JEFF OLD	BV/SARP10	901-351-9697	oldjw@bv.com
Scott McAnnis	GS/SARP10	865-809-8618	scott.mcannis@greshamsmith.com
Kristina Krug	United Rentals	901-663-0919	kkrug@ur.com
Bryce McLane	BV	901 482 8884	McLaneBC@bv.com
Riley Thompson	BV	9014955605	ThompsonRM@bv.com
Jones Leonard	BV	901 530 1808	LeonardJH@bv.com
Jerry Caldwell	BV	901-530-1805	Caldwellj@bv.com
Casey Lewis	ENSCOR, LLC	901-334-6361	casey@enscor.net
Cody Williamson	V. Con, LLC.	901-454-0522	cody@vconllc.com

SIGN-IN SHEET

Project:	SARP10	**Meeting Date:**	June 11, 2024
Meeting:	Group 3 Relay Meeting	**Time:**	10:30 AM – 11:30 AM
Facilitator:	Josh Grabowski	**Place/Room:**	EM2865 Frayser Blvd Memphis TN

Name	Company	Phone	E-Mail
Austin Acuff	Acuff Enterprises, Inc	901.386.1981	austin@acuffenterprises.com
Josh Grabowski	SARP	870-514-1715	JGrabowski@allworldmail.com
Ceily Fessel Doan	BV/SARP10	517-262-9252	fesseldoanca@bv.com
Isabella Selvera	(612) 420 6679	4WPM	iselvera@allworldmail.com
Riley Thorpe	BV	901 Memphis	Thorpe@bv.com

Mandatory Pre-Bid Meeting
Attendee List

Program: SARP10	**Meeting Date: June 11, 2024**
Project: Group 3 Relay	**Time: 10:00 AM**
Facilitator: Josh Grabowski	**Place/Room: EM Facility (2865 Frayser Blvd, Memphis, TN)**

Name	Company	Phone	E-Mail
Justin Avent	Gresham Smith	901-849-6554	justin.avent@greshamsmith.com
John Coleman	Magnolia Underground	901-603-5095	jcoleman@magnoliaunderground.us
Wiley Richards	W&T Contracting Corp	901-497-1291	wileyrichards@wtcontractingcorp.com
Terrell Richards	W&T Contracting Corp	901-331-1780	terrellrichards@wtcontractingcorp.com
Trenton Moore	Cambridge Construction Management	770-652-1444	tmoore@ccminc.us
Nathan Stengel	W&T	901-326-3558	nathanstengel@wtcontractingcorp.com
Tyler Jagielski	Garney	256-724-1371	tyler.jagielski@garney.com
Aaron Heppner	Garney	510-376-6984	garneynashville@garney.com
Jeff Old	Black & Veatch	901-351-9697	oldjw@bv.com
Scott McAmis	Gresham Smith	865-809-8618	scott.mcamis@greshamsmith.com
Kristina Krug	United Rentals	901-663-0919	kkrug@ur.com
Bryce McLane	Black & Veatch	901-482-8884	mclanebc@bv.com
Riley Thompson	Black & Veatch	901-495-5605	thompsonrr@bv.com
Jones Leonard	Black & Veatch	901-530-1808	leonardjh@bv.com
Jerry Caldwell	Black & Veatch	901-530-1805	caldwellj@bv.com
Casey Lewis	Enscor LLC	901-334-6361	casey@enscor.net
Cody Williamson	VuCon LLC	901-454-0522	cody@vuconllc.com
Austin Acuff	Acuff Enterprises Inc	901-386-1981	austin@acuffenterprises.com
Josh Grabowski	AWPM	870-514-1719	jgrabowski@allworldmail.com
Ceily Fessel Doan	Black & Veatch	517-262-9252	fesseldoanca@bv.com
Isabella Selvera	Allworld	662-420-6679	iselvera@allworldmail.com

Section 2
00370.3.1 Unit Pricing

Table 00370.3.1 - Unit Price Bid Form

Bidder should refer to Section 00270, Instructions to Bidders, when completing this Bid Form. Bidder shall complete this form entirely and return it with Bidder's Bid.

Bid Submitted by: (Company Name)

00370.3 Bid Pricing Information

00370.3.1 Unit Pricing

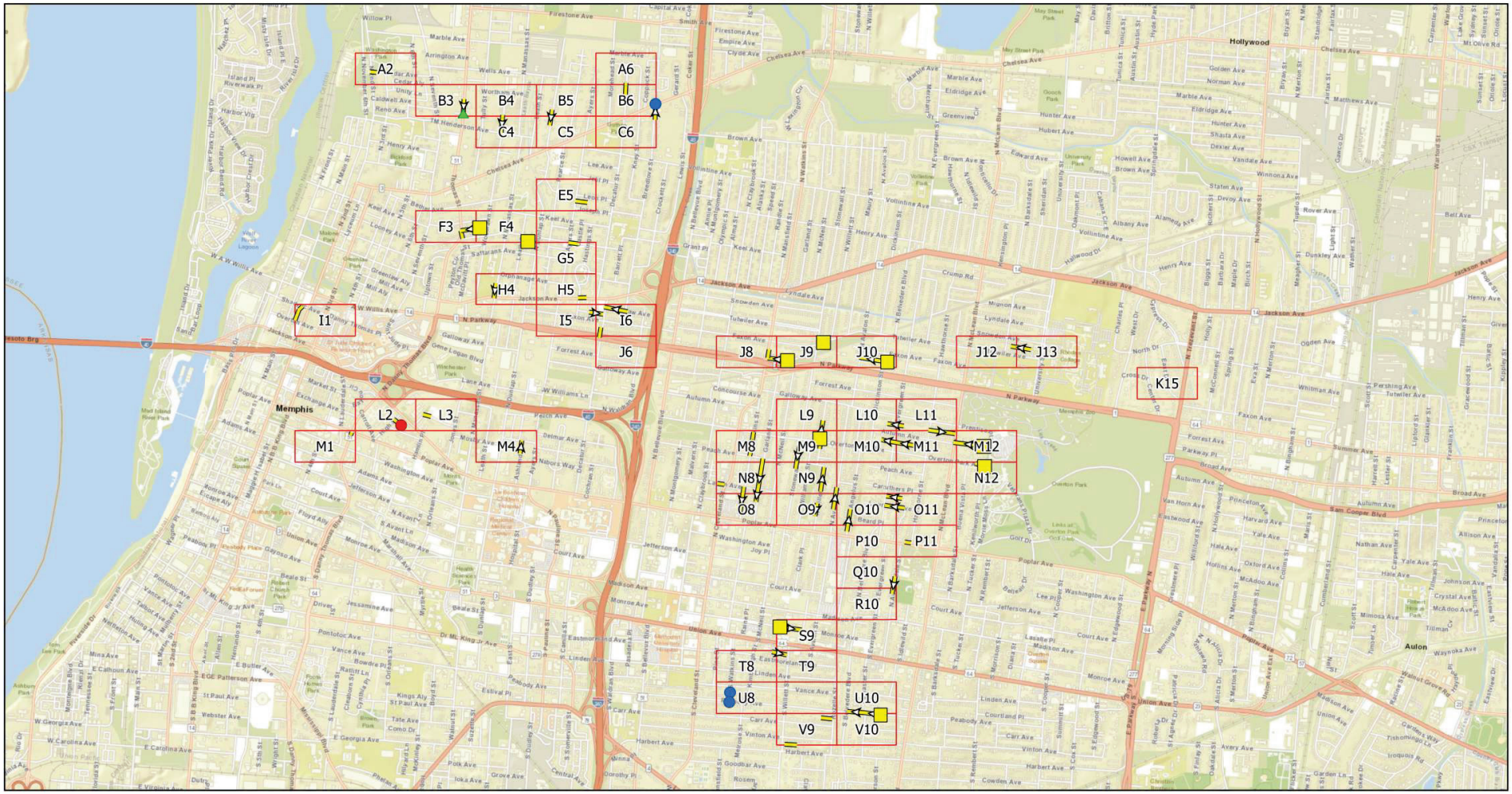
Bidder proposes to complete the RFB Work based on firm, fixed, unit prices (US dollars), which prices multiplied by the final Work quantities would represent the full consideration to Bidder for its complete and satisfactory performance of the Work in compliance with all the terms and conditions of the RFB Documents. The Unit Prices in this Table include the cost of all the work which is required or implied by the RFB documents or which may be inferred therefrom, and which is customarily provided in furnishing a complete and finished work item of its kind. Further, any and all alterations, modifications, and adjustments to the work item, which is reasonably foreseeable or customarily encountered in providing and installing equipment, material, and services of the work item kind, will be performed without additional compensation.

In the event of a Purchaser-approved change in the scope of Work for which a unit price from this Table is not applicable, as determined by the Purchaser, the Subcontractor shall provide a new unit price for review and acceptance by the Purchaser. Subcontractor shall provide all information requested by the Purchaser to substantiate the value of the new unit price.

00370.3.1.1 Unit Prices Breakdown

Item Number	Item Description	Unit of Measure	Estimated Quantity	Bidder Response Columns: Unit Price	Bidder Response Columns: Extension Price
71.0418 Group 3 Relay					
Pipe Replacement					
02530-6.01	Locate and Expose Mainline Terminus	Each	10		$ -
02530-6.02	Undercut Backfill	Ton	1,500		$ -
02530-6.03.15.08.01	8" Polyvinyl Chloride (PVC) Pipe (0'-6' Depth)	Linear Foot	~~4,285~~ 3,268		$ -
02530-6.03.15.08.02	8" Polyvinyl Chloride (PVC) Pipe (6.1'-10' Depth)	Linear Foot	~~13,130~~ 13,798		$ -
02530-6.03.15.08.03	8" Polyvinyl Chloride (PVC) Pipe (10.1'-14' Depth)	Linear Foot	~~2,250~~ 2,481		$ -
~~02530-6.03.15.10.03~~	~~10" Polyvinyl Chloride (PVC) Pipe (10.1'-14' Depth)~~	~~Linear Foot~~	~~320~~		~~$ -~~
02530-6.03.15.12.01	12" Polyvinyl Chloride (PVC) Pipe (6.1'-10' Depth)	Linear Foot	75		$ -
02530-6.04	Service Lateral Removal and Replacement for Pipe Replacement	Each	~~506~~ 503		$ -
02530-6.05	Pavement Backfill for Pipe Replacement	Cubic Yards	21,108		$ -
02530-6.06	Bypass Pumping	~~Lump Sum~~ **Each**	61		$ -
02530-6.08	Hydroexcavating/Hand Digging	Linear Foot	~~20,060~~ 19,622		$ -
Manhole Replacement / Installation					
02531-4.01.A.2	Precast Manhole Replacement ~~(6.1'-10' Depth)~~	Each	1		$ -
02531-4.01.B.1	Precast Manhole Installation ~~(0'-6' Depth)~~	Each	1		$ -
~~02531-4.01.B.2~~	~~Precast Manhole Installation (6.1'-10' Depth)~~	~~Each~~	~~8~~		~~$ -~~
~~02531-4.01.B.3~~	~~Precast Manhole Installation (10.1'-15' Depth)~~	~~Each~~	~~1~~		~~$ -~~
02531-4.01.C	Pavement Backfill for Manholes	Cubic Yards	60		$ -
Manhole Rehabilitation					
02533-4.01.A	Manhole Rehabilitation - Cementitious Coating	Vertical Foot	36		$ -
02533-4.01.B	Invert and Bench Replacement	Each	1		$ -
Post-Rehabilitation PACP Inspection					
02541-4.01.A	Post Rehab CCTV Inspection ~~(8" diameter)~~ (for all diameters)	Linear Foot	~~19,665~~ 20,060		$ -
~~02541-4.01.A~~	~~Post Rehab CCTV Inspection (10" diameter)~~	~~Linear Foot~~	~~320~~		~~$ -~~
~~02541-4.01.A~~	~~Post Rehab CCTV Inspection (12" diameter)~~	~~Linear Foot~~	~~75~~		~~$ -~~
Post-Rehabilitation MACP Inspection					
02544-4.01.A	GPS Coordinates of Manhole Cover	Each	~~15~~ 128		$ -
02544-4.01.C-1	Post Rehab MACP Level 2 Manhole Inspections	Each	~~15~~ 128		$ -
Site Preparation and Restoration					
02630-4.01	Miscellaneous Site Preperation and Restoration	Lump Sum	1		$ -
Pavement and Incidentals					
02950-4.01.A-1	Asphaltic Concrete Pavement Removal and Replacement	Square Yard	~~15,000~~ 40,875		$ -
02950-4.01.A-2	Concrete Pavement Removal and Replacement	Square Yard	905		$ -
~~02950-4.01.A-3~~	~~Temporary Cold Patch Asphalt Removal and Replacement~~	~~Square Yard~~	~~1,500~~		~~$ -~~
02950-4.01.B	Concrete Sidewalk Removal and Replacement	Square Yard	565		$ -
02950-4.01.C	Concrete Curb and Gutter Removal and Replacement	~~Square Yard~~ Linear Foot	~~6,980~~ 3,000		$ -
02950-4.01.D	Gravel Driveway and Gravel Area Removal and Replacement With Crushed Stone	Ton	17		$ -
	SRF Signs	Each	~~1~~ 2		$ -
			71.0418 Group 3 Relay - Total Estimated Unit Price Value		$ -

Section 3
Updated Technical Specifications



Manhole Rehab

- Install New Manhole (10)
- Install Inside Drop (0)
- Cementitous Coating (3)
- Repair Bench/Channel (0)
- Cementitous Coating and Install Inside Drop (0)
- Cementitous Coating and Repair Bench/Channel (1)
- Repair Bench/Channel and Install Inside Drop (0)
- Structurally Replace Manhole (1)

Mainline Relay (59)

Manhole (No Rehab)

Gravity Main (No Rehab)

N

BLACK & VEATCH
Building a world of difference.

SARP10 Rehabilitation Project
Group 3 Relay

Overview

Current Grid:

Note: Recorded manhole rim to invert measurements are indicated below the Facility ID. Point Repair locations are approximate. Maps have some some overlap with other map pages.

SECTION 02530
SEWER PIPE INSTALLATION

PART 1 - SCOPE

1.01 This Work shall consist of the construction of sanitary sewers, siphons, service connections, and/or the removal & replacement of existing sanitary sewers and service connections of the kinds and dimensions shown on the Plans, stipulated in Contract Documents, or as directed by the Purchaser. The construction shall be accomplished by these Specifications and in conformity with the lines, grades, and details shown on the Drawings or established by the Purchaser. The Subcontractor shall perform all work necessary to complete the Contract with the best modern practice. Without specifications that state the quality of any work, the Subcontractor is required to perform such items using first-quality construction. Unless otherwise provided, the Subcontractor shall furnish all material, equipment, tools, labor and incidentals necessary to complete the Work.

PART 2 – MATERIALS AND EQUIPMENT

2.01 MATERIAL

A. Construction Material

1. All material furnished by the Subcontractor shall be new, high quality and free from defects. Previously used material in acceptable condition may be used for bracing, forms, false work, and similar uses. Material not conforming to the requirements of the Specifications shall be considered defective and will be removed immediately from the site.

B. Higher Strength Pipe

1. The Subcontractor may substitute a higher strength pipe of the same type as that specified subject to the approval of the Purchaser.

C. Qualifications of Manufacturers

1. Pipe for sanitary sewers shall be the standard product of an established, reputable manufacturer made in a permanent plant. Suppliers for each material to be used by the Subcontractor shall be subject to approval by the Purchaser. No material shall be delivered until the manufacturer and product have been approved by the Purchaser. For any construction project, pipe and appurtenances for each pipe material shall be the product of a single manufacturer having a minimum of 10 years domestic experience producing the type of pipe supplied.

D. Material Inspection and Testing

1. Representative samples of material intended for incorporation in the work shall be submitted for examination when so specified or requested. All material to be used in the work shall be sampled, inspected, and tested by current ASTM specifications, or other standard specifications approved by the Purchaser. The Subcontractor shall furnish the Purchaser with three copies of certified reports from a reputable testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. Each length of pipe delivered to the project shall show the laboratory's stamp. The performance or cost of all testing is the responsibility of the Subcontractor.

2. The Subcontractor shall notify the Purchaser before any deliveries of material and shall

make whatever provisions are necessary to aid the Purchaser in the inspection and culling of the material before installation.

E. Storage

1. The Subcontractor shall provide and maintain storage facilities and exercise such measures to maintain the specified quality and fitness of material to be incorporated in the work. The interior and sealing surfaces of the pipe, fittings, and adapters shall be kept free from dirt and foreign matter. PVC pipe, fittings, and adapters stored outside and exposed to sunlight shall be covered with an opaque material with proper ventilation. All precautions taken to ensure safe storage of materials shall be the responsibility of the Subcontractor.

F. Polyvinyl Chloride (PVC) Gravity Pipe and Fittings (6-15 inch Diameter)

1. All PVC gravity pipe and fittings 6-15 inches in diameter shall be solid wall PVC; no profile wall PVC pipe is allowed for pipes 15 inches or less in diameter. PVC solid wall pipe and fittings for gravity sewer applications shall conform to the requirements of ASTM D 3034. The standard dimension ratio (SDR) shall be SDR 26 (Type PSM). PVC resin shall conform to ASTM D 1784 cell class 12454C. A different cell class shall be allowed only if the material meets the requirements of a superior cell class than 12454C. 6-inch diameter PVC pipe shall only be used for service laterals. Fittings for PVC gravity sewer pipe shall be fabricated from PVC meeting the respective ASTM PVC pipe standard for molded or extruded PVC. The wall thicknesses of the waterway and bell of fittings shall be no less than the respective minimum thicknesses for the equivalent pipe. All fittings shall be compatible with the pipe to which they are attached.

2. All PVC gravity pipe joints shall be gasketed bell and spigot push-on type conforming to ASTM D 3212, unless directed otherwise in these Specifications. Gaskets shall be part of a complete pipe section and purchased as such. Lubricant shall be as recommended by the pipe manufacturer.

G. Polyvinyl Chloride (PVC) Profile Pipe and Fittings (18-36 inch Diameter)

1. All 18-36 inch diameter PVC sewer pipe and fittings shall be designed and manufactured in accordance with ASTM F 679, F 794, F 949, or F 1803. All PVC sewer pipe and fittings shall be manufactured from PVC resin with a cell classification of either 12454C or 12364C as defined in specification ASTM D 1784. The pipe shall be furnished complete with gaskets, fittings, lubricant, etc. as required for proper installation and completion of the line. The minimum pipe stiffness at 5% deflection shall be 46 psi when tested in accordance with ASTM D 2412 and as specified in ASTM F 679, F 794, F 949, or F 1803, as applicable. Samples of the type of pipe to be used shall be tested in accordance with ASTM D 2412. Impact tests shall be conducted in accordance with ASTM D 2444 and shall comply with ASTM F 679, F 794, F 949, or F 1803. Tests shall be conducted by the manufacturer in the presence of the Purchaser's Resident Project Representative, unless otherwise directed by the Purchaser. The Owner and Purchaser will have the right to make unannounced visits to the pipe manufacturer's facility to inspect the manufacturing process.

2. All joints shall be the bell and spigot type and conform to ASTM D 3212. Gaskets shall meet ASTM F 477. All bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket which is positively retained. No solvent cement joints shall be permitted in field construction.

3. The pipe manufacturer shall furnish to the Purchaser a notarized certificate(s) of inspection stating that each piece of pipe used on this project was made and tested in accordance with these specifications.

4. All pipeline material shall be generically the same throughout the project with the permissible exception of utilizing different material for piping used for tie-ins of smaller lines, or as noted on the Drawings or as approved by the Purchaser.

H. Glass Fiber Reinforced Polymer Mortar Pipe and Fittings (up to 72 inch Diameter)

1 Pipe shall meet the requirements of ASTM D 3262 - Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe. The pipe shall be manufactured to form a dense, non-porous, corrosion-resistant, composite pipe that is resistant to corrosion from hydrogen sulfide and other corrosive materials normally found in sewerage systems, all without the use of special HDPE or PVC liners.

2 Minimum acceptable nominal length for joints of pipe shall be 20 feet except where field conditions require otherwise.

3 Design: The design of the pipe shall comply with all requirements of the latest revision of ASTM D - 3262 for non-pressure (gravity) flow conditions. The pipe shall also be designed for a variable depth of cover as shown on the profile; the maximum trench loading that can occur on an empty pipe after backfill is in place; and a live load equal to the AASHTO HS20 loading or the minimum live load as specified in the latest revision of ASTM D - 3262, whichever gives the greater live load.

4 Resin Systems: These shall be only polyester resin systems with a proven history of satisfactory performance in sewage applications. Historical data shall have been acquired from a composite material of similar construction and composition.

5 Glass Reinforcements: Reinforcing glass fibers used in the manufacture of the pipe shall be of the highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

6 Interior Lining: All interior surfaces of the pipe shall be lined with a fiberglass reinforced polyester lining as a part of the manufacturing process.

7 Joints: The pipe shall be field connected with fiberglass sleeve couplings that utilize full face elastomeric sealing gaskets of EPDM rubber compound, providing a zero leakage joint. The coupling shall be factory assembled to one end of the pipe. Each joint shall be pressure tested after installation.

8 Tests and Examinations: Tests, in-process and final examinations shall be performed by the manufacturer, or an independent testing laboratory approved by the Engineer, in accordance with the latest revision of ASTM D 3262, in order to assure conformance. All instruments, gauges, and other testing and measuring equipment shall be of the proper range, type and accuracy to verify conformance and test equipment shall be checked at least annually against calibrated and certified test gauges and instruments. The Engineer shall have access to all records of tests and inspections related to the manufacture of the pipe, and, without notice to the manufacturer, shall also have the right to witness the manufacture of the pipe and any tests being performed by the manufacturer or his suppliers relative to products, materials, or the pipe being produced. Copies of records of tests and inspections shall be submitted if requested by the Engineer.

   a. Pipes: These shall be manufactured and tested in accordance with ASTM D 3262.
   b. Joints: Coupling joints shall meet the requirements of ASTM D 4161 and/or produce a zero leakage joint.
   c. Stiffness: Minimum pipe stiffness when tested in accordance with ASTM D 2412 shall be 46 psi.

9. Fittings and Special Pipe: Fittings shall be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays, all capable of withstanding all operating conditions when installed.

10. Curves of long radius shall be formed by the use of bevel end pipe or by the use of bevel adapters. Deflection of pipe joints to form the long radius curves will not be accepted. Special pipes shall be designed to provide the same strength as the

adjacent pipe. Branch connections or openings, such as manholes and bypass pumping connections, shall be incorporated in straight pipe and shall be suitably reinforced. Special pipes shall be provided with joints corresponding to those on adjoining straight pipes. Special ends shall be provided on pipe, where required, to connect to pipe of other manufacturers and special structures.

11. Unloading Handling and Storage: All pipe shall be inspected at time of delivery, and damaged pieces rejected and removed from the site of the work. Unloading shall be done by mechanical equipment designed to properly handle the pipe, and dropping from delivery vehicles will not be permitted. Pipe shall be stored in an orderly manner to protect the pipe from injury, and from damage by freezing, all in accordance with the manufacturer's written instructions.

I. Ductile Iron

1 Ductile iron pipe for gravity sewer and service connections will conform to ASTM A 746. Ductile iron pipe for force main applications will conform to ANSI A 21.51. The pipe thickness design will conform to ANSI A 21.50. If no thickness class is specified on the Plans or Contract Documents, Class 50 or approved equivalent will be used. All ductile iron pipe will be lined with either Protecto 401 Ceramic Epoxy, SewPer Coat Cement Mortar Lining, or Polyethylene. Linings will be applied according to manufacturer's recommendations. Fittings will conform to the requirements of ANSI A 21.10. Unless otherwise specified, joints will be push-on gasket type conforming to the requirements of ANSI A 21.11. Mechanical joints will conform to the requirements of ANSI A 21.11. Flanged joints will conform to the requirements of ANSI A 21.15. Flexible joint ductile iron pipe for river crossing applications will conform to ASTM A 536 and will be Grade 70-50-05. Steel retainer rings will conform to ASTM A 148 for Grade 90-60.

J. Adapters and Couplings

1. At the direction of the Purchaser, a connection of sanitary sewer pipes, 8 inches through 16 inches, of dissimilar material, different sizes or for the repair of sanitary sewer pipes of similar material may be made by means of an approved compression or mechanical connector or adapter. The gaskets for compression connectors or adapters shall be manufactured of an approved preformed elastomeric material conforming to applicable sections of ASTM Standards C 143, C 425, C 564, and D 3212. Mechanical couplings or adapters shall have tightening clamps or devices made of 300 series stainless steel with a stainless steel shear ring and stainless steel hardware, as specified in ASTM A 167. If a stainless steel shear band is not used, a concrete collar shall be required. Each connector and adapter shall bear the manufacturer's name and required markings. Installation shall be by the manufacturer's recommendations.

2. At the direction of the Purchaser, a connection of sanitary sewer pipes (18 inches in diameter and larger) of dissimilar material, different sizes or for the repair of sanitary sewer pipes of similar material may be made in accordance with this Specification. Mechanical connectors meeting the above requirements may be used at the direction of the Purchaser.

K. Crushed Limestone

1. Crushed limestone shall be size No. 67 Coarse Aggregate meeting the requirements of the Tennessee DOT Standard Specifications for Road and Bridge Construction and the following gradation:

Total Percent by Dry Weight,

	Passing Each Sieve (U.S. Standard)				
Size No.	1"	3/4"	3/8"	No. 4	No. 8
67	100	90-100	20-55	0-10	0-5

L. Pit Run Gravel

1. Pit run gravel shall consist of one of the three gradations shown in the table below.

	Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)						
Size No.	2½"	2"	1½"	1"	3/8"	No.40	Clay *
1	100	95-100			35-65	10-30	1-12
2		100	95-100		40-65	10-30	1-12
3			100	90-100	45-65	10-35	2-12

*Clay content shall be determined by the Hydrometer Test - AASHTO T 88. Clay content up to 15 percent may be used with the approval of the Purchaser.

2. The portion passing the No. 40 sieve shall be known as the binder. The binder aggregate shall consist of hard durable particles of limestone or sound siliceous material. Shale

aggregate or pipe clay binder shall not be acceptable. The percent of silt shall not exceed the percent of clay by more than 25 percent. If the binder material is insufficient to bond the aggregate a satisfactory binding material may be incorporated, as approved by the Purchaser, so that the resultant mixture shall comply with these Specifications. The mixing shall be done uniformly, and blending of material on stockpiles or in the pits by bulldozers, clamshells, draglines, or similar equipment shall not be permitted.

M. Non-Shrinking Grout

a. Grout shall be mixed in small quantities as needed and shall not be re-tempered or used after it has begun to set. Unless otherwise specified, the grout shall consist of one part Portland cement, two parts masonry sand by volume, a non-shrinking, nonmetallic admixture and sufficient water to form a grout of proper consistency. When non-shrinking or non-shrinking fast setting grout is specified it shall be formulated by the incorporation of an admixture, or a premixed grout may be used.

N. High Density Polyethylene (HDPE) Pipe and Fittings

a. High Density Polyethylene Pipe (HDPE) may be used in construction of inverted siphons. No HDPE will be allowed in any other gravity sewer application. All HDPE shall be manufactured from virgin, extra high molecular weight, high density PE3408 or PE3608 polyethylene pipe grade resin to a minimum cell classification of PE345434C as determined by ASTM D3350. No post-consumer recycled polyethylene materials shall be allowed. The minimum material classification shall conform to III C 5 P34 as determined by ASTM D1248.

b. All HDPE pipe and fittings shall conform to ASTM F714 and ASTM D3261,

respectively, and have a Standard Dimension Ratio (SDR) of 17, maximum.

c. Successive joints of HDPE pipe shall be joined by heat fusion at a fusion pressure of 75 psi and temperature of 400° F. All such connections shall be performed in strict accordance with the manufacturer's instructions.

O. Steel Casing Pipe

1. Casing pipe will conform to ASTM A 139. Minimum yield strength will be 35,000 psi. Wall thickness will meet the requirements of the latest revision of the American Railway Engineering Association Manual of Recommended Practice unless otherwise specified. Wall thickness will be:

Nominal Thickness Inches	Nominal Diameter Inches
0.188	Less than 14
0.219	14 and 16
0.250	18
0.281	20
0.312	22
0.344	24
0.375	26
0.406	28 and 30
0.438	32
0.469	34 and 36
0.500	38, 40, and 42

2. When casing is installed without a protective coating and is not cathodically protected, the wall thickness shown above will be increased to the nearest standard size that is a minimum of 0.063 inches greater than the thickness shown. This requirement does not apply to casing diameters less than 12 3/4 inches.

2.02 EQUIPMENT

A. The Subcontractor shall furnish and maintain in good condition all equipment and facilities as required for the proper execution and inspection of the Work. All equipment and facilities shall be on site and approved by the Purchaser before work will be permitted to begin.

PART 3 - CONSTRUCTION REQUIREMENTS

3.01 EXCAVATION

A. All excavation performed under this Section including trench excavation, structure excavation, and channel excavation, but excluding undercut excavation, shall be considered unclassified excavation despite the nature of the material and objects excavated and shall not be measured or paid for separately except as specifically noted. Pavement removal and replacement shall be accomplished as specified in Specification Section 02950.

B. Trench Excavation

1. All trenches shall be open cut unless otherwise shown on the Drawings. Tunneling, boring, or jacking may be allowed by written permission of the Purchaser.

2. Trenches may be excavated by machinery to a depth that will not disturb the finished

subgrade. The remaining material shall be hand excavated so that the pipe is bedded on a firm, undisturbed subgrade.

3. No more than 300 feet of trench shall be opened ahead of the completed sanitary sewer, nor will more than 100 feet be left unfilled except by written permission from the Purchaser. In special cases, the Purchaser may limit the distance to which the trench may be opened by notifying the Subcontractor in writing.

4. The width of trenches below a level 1 foot above the outside top of pipe shall be at least 6 inches but not more than 12 inches on each side of the outside of the pipe for all sizes up to and including 16 inches in diameter. A maximum trench width dimension for these pipe sizes shall be 42 inches. For 18-inch diameter pipes, the width of trenches below a level 1 foot above the outside top of pipes shall be at least 6 inches on each side of the pipe, with a maximum trench width of 42 inches. For pipe sizes more than 18 inches, the width of trenches below a level 1 foot above the outside top of the pipe shall be at least 12 inches but no more than 15 inches on each side of the outside of the pipe. If the trench width at or below 1 foot above the top of pipe exceeds the width specified, provisions shall be made at the Subcontractor's expense to compensate for the additional load upon the pipe.

5. The sides of the trench shall be as nearly vertical as possible. The bottom of the trench shall be carefully graded, formed, and aligned according to SARP10 *Trench Cross Section Showing Terminology* Figure and to the satisfaction of the Purchaser before sanitary sewers are laid.

C. Other Excavation

1. Undercut Excavation: Undercut excavation shall consist of removing and disposing of unsatisfactory material below the grade established on the Drawings for sanitary sewers, structures, and manholes. No undercut excavation shall be done without prior authorization of the Purchaser. The limits of undercut excavation shall be determined by the Purchaser’s Resident Project Representative who will be present during the undercut operations.

2. Undercut areas shall be backfilled with No. 67 limestone or other aggregate approved by the Purchaser to the grade established on the Drawings to produce a suitable foundation. The backfill shall be placed in 6 inch maximum lifts and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698) or a minimum relative density of 0.75.

3. Unauthorized Excavation Below Subgrade or Outside Limits: Any unauthorized excavation and subsequent removal and backfilling beyond the lines and grades shown on the Drawings shall be at the Subcontractor’s expense. The excess space between the undisturbed bottom and sides of the excavation and subgrade limits shown on the Drawings shall be backfilled according to this Specification.

D. Change in Location and Grade

1. If the Purchaser orders in writing that the location or grade of a proposed sanitary sewer facility be changed from that shown on the Drawings, the following provisions will apply. If the change is made before excavation work has begun and the item being constructed is covered in the Proposal Sheet(s) by pay items with appropriate depth classifications, the appropriate pay item will apply. If the facility being constructed is not covered in the

Proposal Sheet(s) and if the average excavation per linear foot at the changed location or grade is within 10 percent of the original Plan quantity, there will be no change in the unit price for this work. If the average excavation per linear foot at the changed location varies more than 10 percent above or below original Plan quantities, a Contract Revision will be prepared to cover the new work. For purposes of comparing changed quantities with Plan quantities, a 1 foot long strip will be calculated from natural ground line to invert along both the revised and original locations. These calculations will then be multiplied by the proper lengths to determine the total cost.

2. If the change is made after excavation has already begun on the original Plan location, the procedures described above shall apply to payment for work along the changed location. If abandonment of an existing excavation is required due to a change by the Purchaser, a Contract Revision shall be prepared covering the backfilling and restoration of the abandoned excavation. Backfilling and restoration of the abandoned excavation shall be accomplished according to the appropriate section of these Specifications.

3. Filling a portion of existing excavation to meet changed grades shall be accomplished in accordance with this Specification.

4. If a change in a location and/or grade is authorized in writing by the Purchaser at the written request of the Subcontractor, the Subcontractor shall not receive any additional compensation for the changed work. Backfilling and restoration of abandoned excavation work shall be accomplished totally at the Subcontractor's expense. If changes requested by the Subcontractor result in reduced lengths and/or depth of excavation, the revised quantities using Proposal unit prices or Contract Revisions as appropriate shall be used to develop payment.

E. Disposition of Excavated Material

1. Excavated material suitable for backfill shall be stored no closer than 2 feet from the edge of the excavation. Excavated material shall not obstruct crosswalks, sidewalks, driveways, street intersections, nor interfere unreasonably with travel on streets. Gutters or other surface drainage facilities shall not be obstructed. The Subcontractor must provide access to fire hydrants, mailboxes, sewer and conduit manholes, and similar utility or municipal service facility as required. Excavated material intended for backfill shall be stored in a way that minimizes loss of excavated material due to erosion. The Subcontractor shall comply with all applicable OSHA regulations and City of Memphis Storm Water Ordinances.

2. Unless otherwise directed, all excavated material that will not be used for backfilling or restoration shall be removed from the site and disposed of by the Subcontractor. If the Subcontractor proposes to store or place such excess excavated material upon any private property, written consent of the property owner or owners must be obtained by the Subcontractor in advance. A certified copy shall be given to the Purchaser. No surplus or excess material shall be deposited in any stream channel nor anywhere that would change preconstruction surface drainage.

F. Control of Water

1. The Subcontractor shall keep all excavations free of water. If the trench subgrade consists of good soil in good condition at the time of excavation, it shall be the Subcontractor's responsibility to maintain it in suitable condition. Dams, flumes, channels, sumps, or other work and equipment necessary to keep the excavation clear of water shall be provided by the Subcontractor. Dewatering of trenches shall

be incidental to trench excavation. The Subcontractor shall avoid producing mud in the trench bottom by

his operations. If necessary or so ordered by the Purchaser, the Subcontractor shall remove any soil that becomes unacceptable and replace it with limestone or other approved aggregate at his own expense to maintain a firm, dry base.

2. Pipe embedment, laying, jointing, and the placing of concrete or masonry shall be done in a water free trench or excavation. Trenches shall be kept clear of water until pipe joints, concrete and masonry have set and are resistant to water damage. The water shall be disposed of in a manner acceptable to the Purchaser.

3. All gutters, pipes, drains, conduits, culverts, catch basins, storm water inlets, ditches, creeks, and other storm water facilities shall be kept in operation, or their flows shall be satisfactorily diverted and provided for during construction. Any facilities disturbed during construction shall be restored to the satisfaction of the Purchaser.

G. Excavation Around Obstructions

1. The Subcontractor shall cautiously excavate to find the limits of underground obstructions anticipated within the excavation. When a water pipe, gas pipe, other sanitary sewer, storm drain, or similar utility comes within the limits of the trench, such facilities will be properly supported.

2. The Subcontractor shall perform all excavation by hand where excavation machinery would endanger trees, structures, or utilities that otherwise might be saved by hand excavation.

3. Hydroexcavation/Hand Digging

a. The Subcontractor, in order to protect existing utilities, shall cautiously hydroexcavate or hand excavate the entire perimeter of the excavation to a minimum depth of four feet to locate all underground obstructions within the excavation. The excavation method to be utilized on any given repair (hydroexcavation or hand digging) is at the Subcontractor's discretion. When a water pipe, gas pipe, other sanitary sewer, storm drain, or similar utility comes within the limits of the trench, such facilities shall be properly supported.

H. Excavation for Manholes and Special Structures

1. The Subcontractor shall be responsible for performing the Work according to the lines and elevations shown on the Drawings or as directed by the Purchaser. The Subcontractor shall excavate as required for all structures with foundations carried to firm, undisturbed earth at the elevation of the underside of the structure.

2. The outside dimensions of excavations for manholes and special structure shall be at least 12 inches greater than the outside of the masonry or concrete work to permit backfilling around the structure.

3. Where structures are to be built in street rights-of-way or paved areas, the excavation shall not exceed 2 feet from the outside of the masonry or concrete work. If the excavation exceeds this limit, the Subcontractor shall be required to backfill the entire space around the structure with pit run gravel compacted as specified in this Specification.

I. Special Protection

1. Treacherous Ground: When running sand, quicksand, or other treacherous ground is encountered, the work shall be carried on with the utmost urgency and shall continue day and night should the Purchaser so direct.

2. Sheeting and Shoring: The Subcontractor shall furnish, place, and maintain sheeting and shoring as required to support the sides of any excavation to prevent earth movement that could endanger the workers or public and to prevent damage to the excavation, adjacent utilities or property. The Subcontractor shall place this sheeting and shoring without the Purchaser's instructions.

3. Sheeting shall extend below structure invert a sufficient depth to assure adequate support. In the installation of sheeting, the use of vibratory type pile drivers (as opposed to impact type) shall be limited to sheeting driven no greater than 5 feet below the invert. The sheeted trench width, as measured between those faces of the sheeting in contact with the earth trench wall, shall not exceed the maximum width of a trench. Walers and struts shall be designed and installed to present no obstructions to proper placement of the pipe, pipe embedment, cradle or encasement, and they shall not interfere with the satisfactory installation of the pipe.

4. Sheeting, bracing, and shoring shall be withdrawn and removed as the backfilling is being done, except where the Purchaser permits the material to be left in place. The Subcontractor shall cut off sheeting left in place at least 2 feet below the surface and shall remove the cut off material from the excavation.

5. All sheeting, bracing, and shoring which is not left in place under this provision shall be removed in a way that will not endanger the completed work or other structures, utilities, storm drains, sewers, or property. The Subcontractor shall be careful to prevent the opening of voids during the extraction process.

6. If sheeting and shoring are not specifically required on the Drawings or in the Specifications, steel drag shields or trench boxes may be used subject to the authorization of the Purchaser. Voids left by the advancement of the shield shall be carefully backfilled and compacted following trench backfill requirements.

7. Excess Width of Trench: If the Subcontractor is permitted to use equipment that results in wider trenches than specified, approved methods shall be used around the pipe to resist the additional load caused by the extra width. The dimensions of the cradle or other methods will be specified by the Purchaser. The Subcontractor shall be responsible for meeting all applicable OSHA requirements. No extra compensation will be allowed for the additional material or work. Excess width trenches for semi-rigid and flexible pipe shall be backfilled and compacted according to ASTM D 2321, and no concrete cradle shall be used.

8. Underpinning: When excavations require underpinning of existing structures, the Subcontractor shall submit shop drawings of underpinning details to the Purchaser for review before commencement of excavation below the foundation of the structure. Review of underpinning details by the Purchaser shall not relieve the Subcontractor of his responsibility for protection of the structure and its contents.

J. Existing Utilities

1. It shall be the Subcontractor's responsibility to arrange for the location of existing utilities prior to excavation. The Subcontractor will also be responsible for

coordinating the relocation of any existing utilities with the appropriate utility owner.

2. Protection: The Subcontractor shall protect any storm drain, sewer, or utility within the limits of the construction. The Subcontractor shall proceed with caution and shall use every means to establish the exact location of underground structures and facilities before excavating in the vicinity. The Purchaser shall not be responsible for the cost of protection or repair or replacement of any structure, pipe line, conduit, service connection, or similar facility broken or damaged by the Subcontractor's operations. All water and gas pipes and other conduits near or crossing the excavation shall be properly supported and protected by the Subcontractor.

3. If the construction requires the removal and replacement of any overhead wires or poles, underground pipes, conduits, structures or other facilities, the Subcontractor shall arrange for such work with the Owner or Owners of the facilities. No additional payment will be made by the Purchaser for this work.

4. Service Connections: Sewer and utility services between mains and buildings shall be maintained and adjusted as necessary by the Subcontractor to provide as nearly a continuous operation as can be expected. This shall be accomplished in any way that the Subcontractor chooses, provided the individual service is not interrupted for more than two consecutive hours. The occupants shall be notified by the Subcontractor at least six hours before such service interruptions. When a break occurs, the Subcontractor shall notify the affected occupant(s) of the probable length of time that the service will be interrupted. New service laterals with double-sweep cleanouts will be required to be installed to the property line for each service and reconnected to the existing service if one exists. If no service exists, the Subcontractor shall cap the pipe after installing a cleanout.

5. If existing underground facilities or utilities require removal and replacement for the performance of this work, all replacements shall be made with new material conforming to the requirements of these Specifications. If not specified, the material will be as approved by the Owner.

6. The removal and replacement of water services to adapt to new construction shall be the Subcontractor's responsibility within the limits where the new service line grade blends smoothly with the existing service line grade.

8. The Subcontractor shall be responsible for any damage to the sewer house connection because of his operations. The Purchaser does not guarantee the number, size, condition, nor length of adjustment necessary to bring a service to a new grade.

3.02 SEWER PIPE INSTALLATION

A. General

1. Sewer pipe and pipe embedment shall be constructed as shown on the Drawings. It shall be the Subcontractor's responsibility to find all underground utilities before construction to ensure there are no conflicts with the proposed line and grade. The Subcontractor’s surveyor shall verify the base information on the Drawings prior to commencement of construction. Any discrepancies in the Drawings shall be reported to the Purchaser immediately. If approved by the Purchaser, minor changes in the alignment or grade will be permitted to avoid underground facilities, if straight alignment can be maintained between manholes. If minor changes in line or grade cannot avoid a conflict with the existing utility, the Subcontractor shall arrange with the owner of said utility to have it adjusted as required to accommodate the proposed

sewer at no additional expense to the Purchaser.

B. Modifications of Existing Sanitary Sewer Facilities

1. Maintenance of Flow: Where existing sewer lines are being modified, the Subcontractor shall arrange his work so that sewage flow will be maintained during the construction period with no discharge of sewage into the open trench, and no back up of sewage in the existing line. The Subcontractor shall provide necessary bypass pumping capacity to carry flow downstream of the section to be modified.

2. Abandonment of Sewer Pipe: Sewer pipe called for in the Specifications or Drawings to be abandoned shall be sealed at each end for a minimum distance of 18 inches, or one-half the diameter of the pipe, whichever is greater. Unless otherwise specified, the pipe shall be sealed with a brick bulkhead and/or acceptable cement grout to form a solid watertight plug completely bonded to the pipe.

3. The Subcontractor shall be allowed to remove pipe to be abandoned if wanted. If the Subcontractor elects the removal method, all associated costs shall be included in the cost for other Pay items.

4. Connection to Existing Manholes: The Subcontractor shall cut suitable openings into existing manholes or remove existing pipe to accommodate the sewer pipe at the proper elevation, location, and direction, as indicated on the Drawings. Care shall be used to avoid unnecessary damage to the existing manhole.

5. All loose material shall be removed from the cut surfaces that will be completely coated with non-shrinking grout before setting the pipe. Before inserting the pipe, a sufficient thickness of grout shall be placed at the bottom and sides of the opening for proper bedding of the pipe. For semi-rigid and flexible pipe installations a water stop as approved by the pipe supplier shall be installed on the pipe according to the manufacturer's recommendations. After setting, all spaces around the pipe shall be solidly filled with non-shrinking grout and neatly pointed up on the inside to present a smooth joint, flush with the inner wall surface. Any necessary revisions on the existing manhole invert shall be made to provide a smooth, plastered surface for properly channeled sewage flow from the new connection. Plaster on the exterior of brick manholes shall be repaired with non-shrinking grout. Particular care shall be given to insure that the earth sub-base and bedding next to the manhole will provide firm solid support to the pipe.

6. Removal of Sewer Pipe: Existing pipes and manholes to be removed and their locations shall be shown on the Drawings. Existing sewer pipe and manholes that must be removed to excavate for the proposed sewer shall be included in the cost of the proposed sewer pipe and no additional compensation shall be made to the Subcontractor. The City reserves the right to retain or reject salvage of any material encountered. All remaining material becomes the property of the Subcontractor who shall be responsible for properly disposing of the same.

3.03 PIPE EMBEDMENT

A. Pipe embedment will be defined as that material supporting, surrounding and extending to 6 inches above the top of the pipe. Pipe Embedment for sewer pipe shall conform to the requirements given below. At the direction of the Purchaser or as shown on the Drawings, sewer pipe and backfill shall be encapsulated in geotextile fabric meeting the following requirements:

Physical Property	Test Method	Acceptable Test Result
Tensile Strength, wet, lbs.	ASTM D-1682	200 (min)
Elongation, wet, %	ASTM D-1682	40 (min)
Coefficient of Water Permeability, cm/sec	Constant Head	0.03 (min)
Puncture Strength, lbs.	ASTM D-751	100 (min)
Pore Size - EOS U.S. Standard Sieve	Corps of Engineers CW-02215	40 (max)

B. Crushed Limestone

1. Pipe embedment material shall be Number 67 crushed limestone. Pipe 8 inches to 24 inches in diameter shall be bedded on 4-inches of Number 67 crushed limestone. Pipe 27 inches to 48 inches in diameter shall be bedded on 6-inches of bedding material. Pipe embedment for pipes larger than 48 inches in diameter shall be by design based on anticipated soil conditions. After pipe installation, crushed limestone shall then be tamped under the haunches and continued in layers not more than 6 inches in loose thickness around and above the pipe to a level 6 inches above the outside top of the pipe. The remainder of the installation shall be as outlined in this Specification's Backfill requirements.

3.04 PIPE LAYING

A. Inspection Before Laying

1. All pipe shall be inspected upon delivery. Pipe that does not conform to the requirements of these Specifications or is not suitable for use will be rejected by the Purchaser and immediately removed from the work site.

B. Preparation of Pipe Ends

1. All surfaces of the pipe to be joined shall be clean and dry. All necessary lubricants, primer, adhesives, and similar material shall be used as recommended by the pipe or joint manufacturer's specifications.

C. Care During Hoisting, Placing, And Shoving Home

1. Equipment used to handle, lay, and join pipe shall be equipped and used as to prevent damage to the pipe. All pipe and fittings shall be carefully handled and lowered into the trench. Damaged pipe or jointing material shall not be installed.

D. Direction of Work

1. The laying of pipe shall be commenced at the lowest point. The bell or grooved end shall be laid upgrade. All pipe shall be laid with ends abutting and true to line and grade. The pipe ends shall be carefully centered so that when laid they will form a sewer with a uniform invert.

E. Uniform Pipe Bearing

1. Special care shall be taken to insure that the pipe is solidly and uniformly bedded, cradled, or encased according to the Drawings. For pipe with a bell that is larger than the barrel of the pipe, the bedding material shall be removed to a depth that will provide continuous support for the bell and barrel. No pipe shall be brought into

position for joining until the preceding length has been bedded, joined, and secured in place. Where a concrete cradle is required, the pipe shall be supported at no more than two places with masonry supports of minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete.

F. Alignment and Grade

1. Each piece of pipe shall be checked for vertical and horizontal alignment immediately after being laid. All adjustments to alignment and grade must be made by scraping away or filling in under the barrel of the pipe and not by wedging or blocking up any portion of the pipe or striking the pipe to drive it down. Curved alignments shall not be allowed except as directed by the Purchaser.

G. Backfilling to Secure Pipe

1. When the joint is made, sufficient backfill material shall be simultaneously placed along each side of the pipe to prevent moving the pipe off line and grade. Particular care shall be used to prevent disturbance or damage to the pipe and the joints during backfilling.

H. Flotation and Water in the Trench

1. The Subcontractor shall take all necessary precautions to prevent flotation of the pipe in the trench. Water shall not be allowed to rise in the trench. The Subcontractor shall use well points, sump pumps, or another approved method of dewatering as required to lower the water table below the bottom of the excavation while minimizing the migration of fines from the surrounding area. The Subcontractor shall make a request to the Purchaser and receive approval prior to the use of special dewatering equipment other than well points or sump pumps. Dewatering operations are considered incidental to the work and no additional compensation will be made to the Subcontractor.

I. Open Ends

1. Whenever pipe laying is stopped for any significant length of time, such as at the end of a workday, the unfinished end shall be protected from damage and a temporary tight fitting plug or bulkhead shall be placed in the exposed ends of the pipe to keep soil or other debris from entering the pipe.

J. Concrete Cradle Section next to Manhole

1. The pipe shall be supported from the manhole wall to the limits of the manhole excavation in a normal sewer trench with a concrete cradle, structurally continuous with the manhole base slab or footing. Cost for this work is incidental to the cost of the pipe installation.

K. Cutting Pipe

1. Cutting shall be in a neat workmanlike manner at right angles to the pipe axis without damage to the pipe. The Subcontractor shall smooth the cut end by power grinding or filing to remove burrs and sharp edges.

L. Wyes and Special Fittings

1. Wyes, stubs, reducers, fittings, or other special pipes shall be installed as shown on the Drawings or where ordered by the Purchaser. The fittings and special pipes shall

be made of a compatible material, type, and class and/or strength designation as the pipe and installed as required by the Drawings and Specifications. The cost for providing and installing the above items is incidental to the cost of the pipes.

3.05 PIPE JOINTS

A. General

1. Pipe shall be jointed immediately following the laying of each section. No pipe section shall be left overnight which has not been completely jointed to the preceding pipe section in conformance with these Specifications.

2. The following provisions will apply to insure tight and sound joints:

   a. The joint will be placed with special care to avoid breaking joints and to leave gasket, if required, in proper position.
   b. All pipe 12 inches in diameter or larger will have dead weight held by crane while being lined up and pushed home.
   c. Pipe will be pushed home with a constant and even force and not jarred home by the momentum of a moving force that will place an impact load on pipe.
   d. Cement and lubricant will be used as recommended by the manufacturer and designated by the Purchaser.

B. Compression Joints

1. The two ends to be joined shall be thoroughly cleaned and a compression gasket compatible with the type of pipe to be joined shall be at the position recommended by the pipe manufacturer.

2. Lubricant recommended by the gasket manufacturer shall be liberally applied to the gasket and both ends immediately before pipe ends are joined. The upstream pipe shall be positioned such that the spigot may enter the bell squarely. The pipe being laid shall be pushed home and the gasket position checked with a feeler gauge before installation of the next section. Flat, unconfined gaskets on concrete pipe shall be cemented to the spigot at the position recommended by the pipe manufacturer.

C. Mechanical Joints

1. The two ends to be joined shall be thoroughly cleaned with a wire brush and the plain end, socket end, and gasket shall be brushed with soapy water. The end shall be centered in the socket and adequate anchorage shall be provided to hold the pipe in position until the joint can be completed. When deflecting pipe from a straight line is necessary, the deflection shall be made after joint assembly and before tightening bolts. Pipe deflection shall not exceed that specified by ANSI C 600.

2. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. All bolts shall be torqued to the required range recommended by the pipe manufacturer. The Subcontractor shall avoid over stressing the bolts. Gauge lines on the spigot end shall be checked following assembly to ensure proper positioning of bell and spigot has been accomplished.

3. Any joints not properly positioned shall be disassembled, cleaned, and reassembled as previously indicated.

D. Flanged Joints

1. The two ends to be joined shall be thoroughly cleaned with a wire brush. Bolt holes on each pipe flange to be joined shall be aligned and bolts inserted. Bolts shall be torqued evenly by alternating tightening of bolts opposite one another until all bolts are torqued to the recommended pressure.

F. Restrained Joints

1. Restrained push-on joints are to be used as specified on the Drawings or by the Purchaser. These special joints shall be installed as specified by the manufacturer. The length of the pipe to be restrained will be determined by the Purchaser based on pipe size, internal pressure, depth of cover, and soil characteristics around the pipe.

3.06 SERVICE CONNECTIONS

A. The Subcontractor shall install a new lateral with cleanout for each house connection. Cleanouts should be located on the property line or easement with 6-inch PVC (SDR 26) with a minimum slope of 1 percent unless otherwise directed by the Purchaser.

B. The Subcontractor shall provide a Double Sweep PVC cleanout with a PVC screw plug cap and 4-inch PVC stack pipe. When installed, the cap shall lie 3-inches below finished grade.

C. If the existing service connection is 4-inch diameter, the Subcontractor shall provide a 6-inch to 4-inch concentric PVC reducer to connect the new 6-inch lateral to an existing 4-inch private property lateral.

D. The Subcontractor shall connect the new lateral to the PVC main with a PVC fitting in accordance with the details shown on *Typical Installation of Service Lateral*.

3.07 PIPE CAPS AND PLUGS

A. Wyes, stubs, or other fittings installed in the pipe for future connections shall be closed at the open end. For pipes 21 inches in diameter or smaller, an approved cap or plug shall be installed in the bell or socket using the same type joint or jointing material as required for the sewer. For pipes larger than 21 inches in diameter, temporary approved masonry bulkheads of the thickness required by the Drawings and Specifications to close the open end may be substituted for stoppers. Care in backfilling shall be used so that such closure and its seal will not be disturbed. This stopper shall be jointed so that it may be removed later without injury to the pipe itself. Work and material is incidental to the cost of the pipe installation.

3.08 INVERTED SIPHONS

A. Each siphon will include inlet, outlet, and any intermediate manholes where shown on the Plans with all foundations, pipes, and pipe encasement and other appurtenances. Pipe to be included in the cost of the siphon is to be all pipe, fittings and specials between the center of the inlet manhole and the center of the outlet manhole.

B. The Contractor will construct cofferdams, temporary bulkheads, perform all pumping and other work necessary to protect the siphon during construction. The Contractor will be required to maintain a dry trench during construction, and will never be permitted to lay pipe or place concrete with water in the trench. Trenches will be kept free from water until the material in the joints and masonry has sufficiently hardened.

C. Unless otherwise specified, inverted siphon pipe will be HDPE conforming to Specification Section 02530 Paragraph 2.01.N. The siphon pipes will be encased in concrete at the locations and to the dimensions shown on the Plans or Design Standards. The excavation, bedding, laying, jointing, pipe encasement, and backfill operations will conform to the applicable sections of this Specification.

D. When shown on the Plans, flexible joint ductile iron pipe will be used instead of push-on joint pipe as shown on Design Standards. Flexible joint pipe will be laid such that the maximum joint deflection as specified by the pipe manufacturer for each joint is not exceeded.

E. The inlet, outlet, and any intermediate manholes will be constructed according to the requirements of Specification Section 02531.

F. The inlet and outlet manhole inverts will be carefully shaped to conform to the inlet and outlet pipes and cause the least possible resistance to flow. The inlet manhole will have an invert weir constructed to contain low flows to a single siphon pipe. The invert weir will be level across the top and constructed to the elevation shown on the Plans. The outlet manhole invert will be formed to reduce backflow into the inactive siphon pipes.

3.10 BACKFILLING

A. General

1. After sanitary sewer facilities have been bedded and installed according to these Specifications and upon permission of the Purchaser, the backfill may be placed. Backfilling operations shall continue following as closely behind pipe installation as practical. All backfill shall be placed in uniform horizontal layers. Pushing backfill material down a ramp into excavated areas will not be permitted. No trash will be allowed to accumulate in the space to be backfilled. Particular care shall be taken to avoid allowing wood to be included in the backfill, other than sheeting and shoring that has been approved by the Purchaser to be left in place.

2. The Subcontractor shall be responsible for the condition of the trenches and filled areas during the contract and warranty period. The Subcontractor shall maintain frequent inspection of the same. If at any time during the 12-month warranty period the trenches or filled areas settle and sunken places appear, the Subcontractor shall be required to refill these sunken places when they are discovered with suitable material and will replace all damaged curb, gutter, and sidewalk. All soft or dangerous trenches shall be marked, barricaded and caution lighted for the protection of the public.

3. Property with an existing dwelling located on it or lots within a developed subdivision or planned development are considered improved property.

B. Street Right-of-Way and Improved Property

1. Backfill Material: Backfill for manhole and pipe trench excavations through pavements in street or highway right-of-way or where the Purchaser orders, shall be made with pit run gravel or other acceptable material as approved by the Purchaser. The backfill shall be from the top of the pipe embedment material or manhole foundation to the subgrade elevation of the pavement. Pea gravel or similar granular material approximately uniform in size and without bonding properties will not be used.

2. Backfill for manhole and pipe trench excavations beyond pavements in street or

highway right-of-way or outside public right-of-way shall be made with select earth from the top level of the pipe embedment material or foundation to the subgrade elevation in paved area, or within 1 inch of the surface in areas to be sodded, or to the surface in all other areas.

3. Select material shall be free from debris, organic matter, perishable compressible material and will contain no stones or lumps larger than 6 inches. Rocks and lumps smaller than 6 inches will not exceed an amount that will interfere with the consolidating properties of the fill material. Care shall be taken that stones and lumps are kept separated and well distributed, and that all voids are completely filled with fine material. No rocks or lumps will come in direct contact with the pipe. The upper 3 feet of backfill in sodded or planted areas will be free of rocks or lumps larger than 1 inch in diameter.

4. Placement and Compaction:

   a. Sanitary Sewer Trenches: Backfill material shall be placed by hand in 6 inch loose layers and tamped to a point 2 feet above the outside top of the pipe. Backfill will be compacted with suitable mechanical tamping equipment with special care being taken not to damage the pipe or joints. Use of compaction equipment directly above semi-rigid and flexible pipe should be avoided until sufficient backfill has been placed to ensure that the equipment will not damage the pipe. A minimum of 36 inches of compacted backfill above the top of semi-rigid and flexible pipe shall be in place before wheel loading and a minimum of 48 inches of compacted backfill before use of pneumatic tampers. From these elevations to the subgrade elevation of the pavement, bottom of the sod, or to the original ground surface, suitable backfill shall be mechanically placed in 9 inch, maximum, loose layers. All backfill material shall be compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698).

   b. Manholes and Special Structures: When the masonry or concrete work has set sufficiently to withstand compaction, and the Purchaser authorizes, backfill material will be placed in 6 inch loose layers and compacted with heavy tampers or pneumatic tampers to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698). Suitable backfill shall be placed in this manner from the foundation of the structure to the subgrade elevation of the pavement, the bottom of the sod or to the original ground surface.

C. Open Areas and Unimproved Property

1. Backfill Material: Backfill of excavations on unimproved property shall be made with select material from the top level of pipe embedment material or foundation to the surface. Non-granular select material to be used for backfill will be free from debris, organic matter and perishable compressible material, and will contain no stones or lumps or rock fragments larger than 6 inches. Rocks or lumps smaller than 6 inches in diameter will not exceed an amount that will interfere with the consolidating properties of the fill material. No rocks or lumps shall come in direct contact with the pipe. Stones and lumps shall be kept separated and well distributed, and all voids shall be completely filled with fine material.

2. Placement of Backfill: Backfill procedures specified in Specification Section 02530 Paragraph 3.10.B shall apply from the trench bottom to a point 2 feet above the outside of the pipe. From this point to slightly above the surrounding surface elevation, suitable backfill may be placed by bulldozer or other mechanical means.

E. Removal of Excess Material

1. After the trench or excavation has been properly backfilled, all excess dirt shall be removed from the streets, roadways and improved private property so pavements or turfed areas may be replaced and properties cleaned.

2. In open areas and unimproved property, the excess material may be used to fill low spots on property next to the right-of-way/easement. Before spreading excess soil, the Subcontractor shall obtain written permission from the property owner for the spreading of excess soil, and a copy of the written permission shall be submitted to the Purchaser. Such spreading or filling shall not obstruct surface drainage and be to the satisfaction of the property owner. Excess material shall be disposed of by the Subcontractor.

3.11 BYPASS PUMPING

A. As required for acceptable completion of the work and/or to avoid damages due to sewer spills or overflows, the Subcontractor shall provide for sewer flow maintenance around the line segments and manholes designated for rehabilitation. The bypass shall typically be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent sanitary sewer system. The pump and bypass lines shall be of adequate capacity and size to handle the anticipated flow. Bypassing of sanitary sewage into the storm water system will not be allowed. For all bypass pumping, pump noise shall be kept to a minimum to the satisfaction of the Purchaser. The Subcontractor shall be required to contact all residential and commercial customers whose service lines connect to the sewer main being bypassed and inform them that they will be temporarily out of service. The Subcontractor shall also advise those customers against water usage until the mainline is back in service. After completing the necessary work on the main line, the Subcontractor shall advise those customers that the sewer main is back in service.

B. Bypass pumping is defined as providing pumps, standby pumps, piping, elevated structural support for aerial crossings, manpower to operate, routine maintenance and repair capability, pipe plugs, fuel, route and pump site clearing and any other work necessary to provide a complete bypass pumping operation. Any structures proposed by the Subcontractor for construction over or penetration into the interceptor piping for the purpose of performing the bypass operations must be approved by the Purchaser prior to implementation. The Subcontractor shall submit design drawings and details that are signed and sealed by a professional engineer licensed in the State of Tennessee. All bypass pump schemes must be submitted to and approved by the Purchaser in advance.

C. Public advisory services shall be required to notify all parties whose service laterals will be out of service and to advise against water usage until the mainline is back in service.

D. The Subcontractor shall be required to provide businesses with temporary service, as needed, and shall be responsible for all necessary bypass pumping flows.

3.12 TUNNELING, BORING, AND JACKING

A. General

1. Sewer pipe will be constructed by tunneling, boring, or jacking only at those locations shown on the plans or directed by the Engineer. Carrier pipe for these applications will be of the type specified in the Plans and Specifications. Grade and alignment will be maintained through all liner pipes. The Contractor will submit shop drawings detailing the

method, equipment and material to be used for tunneling, boring and jacking operations to the Engineer for review and approval. The approval by the Engineer of any drawings or plans will not in any way be deemed to release the Contractor from full responsibility for complete and accurate performance of the Work according to the Contract Drawings and Specifications.

2. When tunneling, boring, or jacking is required under railroads, highways, streets, or other facilities, construction will not interfere with the operation of the railroad, street, highway, or other facility and will not weaken or damage any embankment or structure. No water shall be introduced into any tunneling, boring or jacking excavation that lies within City, State or Rail Road right-of-way. A boring that uses a bentonite slurry may be allowed at the discretion of the Engineer and the owner of the right-of-way.

3. The Contractor will be responsible for protection of utilities and sewers against damage by his work. If any utility above or near the tunnel is endangered or has been damaged because of the construction operations, the utility owner will be notified immediately and will be given access to the area to carry out all necessary repairs to such utilities. If any sewers

are damaged, it will be the responsibility of the Contractor to make the necessary repairs. If any public or private property is endangered or has been damaged due to tunneling, boring, or jacking operations, it will be repaired at the Contractor's expense. All cost and expense to the Contractor of carrying out the above requirements will be considered included in his bid prices for the completed sewer installation.

4. Access pits will be of sufficient size to provide ample working space for the jacking or boring equipment, reaction blocks, bracing, liner plates, spoil removal, and 2 sections of pipe. Provisions will be made for the erection of guide rails in the bottom of the pit where applicable. If drainage is to be discharged from the jacking pit, a collection sump will be provided. Wherever end trenches are cut in the sides of the embankment or beyond it, such work will be sheeted securely and braced satisfactorily to prevent earth caving.

5. The Contractor will furnish and operate all necessary pumping equipment of ample capacity and arrange to keep tunnels and shafts free of water during construction and to dispose of water satisfactorily. During placement of concrete, drainage and pumping will be arranged so concrete is placed in dry conditions. No water will flow over the concrete until it has set and will not be damaged.

B. Tunneling

1. The Contractor will carry out the work of tunneling so there will be no cave-in or heaving of earth or other material into the tunnel excavation. If there should be any fall or movement of earth into the tunnel, the Contractor will proceed with the work with all necessary precautions to insure the safety of life and of sewers, utilities and public and private property above and near the tunnel.

2. The Contractor will furnish, place, and maintain all sheeting, bracing, lining or casing required to support the tunnel until the pipe and its bedding, jointing, encasement, and backfilling have been completed. All liners will remain in place.

3. Care will be used in trimming the surfaces of the excavated section and in placing the liners or sheeting and bracing so that the required minimum clearance between the outside of the pipe and the final position of the liners, sheeting and bracing in the tunnel will be attained without any deviation in sewer alignment. Sheeting or lining must be placed and held tightly against the trimmed earth surface of the excavated section so that there will be no voids between the earth and the lining or sheeting.

4. No part of the lining, bracing, or flanges of steel liner plates will project closer to the outside of the pipe or pipe bells than the clearance limits shown on the Plans, or a minimum of two inches, if not shown on the Plans.
5. If timber is used for lining and bracing instead of steel liner plates, invert struts will be placed at the required intervals but in such manner that the pipe and its bedding will be supported entirely by the original earth floor of the tunnel and not on timber lining or bracing. All timbers, when placed for the support of the roof and sides of the tunnel, will be properly fitted and wedged in place. Timber sets in tunnels will be abutting. All voids behind timbers will be filled with blocking or other suitable material.

6. Timbering will be designed and placed to allow the filling of voids. All excavated material not required for backfilling abandoned shafts will be removed from the site and disposed of by the Contractor at his expense.

7. Shafts will be constructed at the location shown on the Plans. Temporary construction shafts will be of adequate size and properly constructed and equipped to meet all safety requirements. All shafts will be barricaded, lighted, fenced, and properly guarded from the beginning of the excavation until the completion of the construction requiring the shaft.

8. Provision will be made at all shafts so that plumb lines suspended on the centerline of the sewer at each end of the shaft will hang freely from the surface.

9. A ladder meeting OSHA requirements will be provided in each shaft and will be kept in safe, good repair, clean and clear of debris.

10. Cavities between the surfaces of excavation and the tunnel liner plates or sheeting will be completely filled with a uniform sand cement grout consisting of 1 part portland cement and 7 parts sand and the minimum amount of water necessary for proper placement. Grout will be placed under pressure through grout holes in the steel liner plates or sheeting. The grout holes will be located and the grout placed in such sequence to insure the complete filling of all cavities and to transfer the load from the undisturbed material to the tunnel lining or sheeting uniformly.

11. After the tunnel section is excavated, lined, and braced, the pipe will be placed on and supported by steel rails or other approved supports. The supporting system will assure line and grade and will allow space below the pipe for concrete grout. Care will be used to avoid damage to the pipe and the liner plates.

12. The space between the pipe and the tunnel will be completely grouted with a mixture of sand and portland cement, mixed in the proportions of 1 part cement to 7 parts sand by volume and a minimum amount of water necessary for proper placement whether placed under pressure or by hand.

13. Temporary shafts will be completely abandoned. Unless otherwise specified in the Plans or Contract Documents all sheeting, bracing, and similar items may be removed unless the Contractor requests and receives authorization from the Engineer to leave it in place. No payment will be made for items left in place at the Contractor's option. If the Plans or the Engineer requires leaving the sheeting, bracing, and similar items in place, measurement will be made as provided in Specification Section 02530.5 and payment will be made as provided in Specification Section 02530.6.

C. Boring

1. When required by the Plans, sewers will be installed in bored holes. The holes will be

bored from the downstream end, unless site conditions dictate otherwise and the Engineer approves.

2. The boring machine to be used will be in good condition and capable of drilling the bore hole within the required limits of accuracy. A smooth liner of sufficient strength will be forced into the bored hole to give a tight fit against the earth sides of the bore hole and still provide a uniform clearance of at least two inches around the pipe flange to permit pressure grouting. The liner pipe will be carefully inspected to insure that the carrier pipe can be properly placed.

3. All carrier pipe shall be mechanical joint or restrained joint pipe. Manholes at the ends of a section of bored pipe will not be constructed until the bored section is completed.

4. The following procedures will be used for carrier pipe 18 inches and larger in diameter. The assembled pipe will be placed in the bored hole with approved, non-metallic, casing spacers attached. Casing spacers will be attached in accordance with the manufacturer's recommendations and with a casing spacer installed within 6 inches of each end of the bore. The assembled pipe will be placed in the bored hole only by such method that will keep the joints in compression. Any method that disjoints the pipe while being placed will not be permitted.

5. The ends of the bore shall be sealed with an approved, flexible end seal. The end seals shall be attached in accordance with the manufacturer's recommendations using stainless steel hardware.

6. When unforeseen obstructions or conditions require abandonment of a partially completed bore hole, and the starting of a new hole, the Contractor will grout the abandoned bore hole solid. The Contractor will receive no compensation for any expenses incurred by any unsuccessful attempt.

D. Jacking

1. The Contractor will furnish for the Engineer's review, a plan showing his proposed method of jacking, including the design for the jacking head, jacking support or back stop, arrangement and position of jacks, pipe guides, and similar items in the assembled position. The review of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.

2. Heavy duty jacks suitable for forcing the pipe through the embankment will be provided by the Contractor. In operating jacks even pressure will be applied to all jacks used. A suitable jacking head and bracing between jacks and jacking head will be provided so that pressure will be applied to the pipe uniformly around the circumference of the pipe. A suitable jacking frame or backstop capable of resisting the jacking forces will be provided. The pipe to be jacked will be set on guides, properly braced together to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly will be placed to line up with the direction and grade of the pipe. The Contractor may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with the inside angles or lugs to keep the cutting edge from slipping back onto pipe.

3. The pipe will be jacked from the downstream end. Manholes at the ends of a section of jacked pipe will not be constructed until jacked section is completed.

4. Any pipe damaged in jacking operations will be removed and replaced by the Contractor at his own expense. Embankment material will be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment

with jacks, into the space thus provided.

5. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, will conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe.

6. The distance that the excavation will extend beyond the end of the pipe depends on the character of the material, but it will not exceed 2 feet in any case. This distance will be decreased if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

7. A cushion material will be placed in the joints between each pipe section adequate to distribute the jacking forces around the entire periphery of the pipe uniformly.

8. When jacking of pipe is begun, the operation will be carried on without interruption, as much as practicable, to prevent the pipe from becoming firmly set in the embankment.

9. The pits or trenches excavated to allow jacking operations will be backfilled immediately after the jacking of the pipe has been completed according to Specification Section 02530 Paragraph 3.11.

E. Sewer Pipe in Jacked Liner

1. When required by the Plans or Contract Documents, a sewer pipe will be installed by jacking a pipe as a liner and inserting a carrier pipe of required size, type, and class. When using jacking for liners, the steel liner will be welded steel, 35,000 psi yield strength, and of the diameter and wall thickness required on the Plans and Specifications. The Contractor will provide, at his own expense, thicker walled lines if necessary to withstand the forces of jacking. In any case, the Contractor will retain full responsibility for the adequacy of this jacking operation, equipment and material.

3.13 FINAL GRADING

A. Final grading around sanitary sewer facilities shall conform to the elevation of adjacent undisturbed ground or as shown on the Drawings. Sufficient grading shall be done to provide adequate drainage.

3.14 CLEANING

A. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing material into the pipelines. As the work progresses, the interior of the sewer shall be cleaned of all dirt, jointing material and extraneous material. On small pipe where cleaning after laying may be difficult, a squeegee shall be kept in the pipeline and pulled forward past each joint immediately after its completion. Before final inspection the Subcontractor shall remove all debris and foreign material.

3.15 TRAFFIC CONTROL

A. All traffic control shall be installed and maintained in accordance Section 01551 – Traffic Control for Work Zones. At a minimum, the Subcontractor must have two trucks with flashing yellow lights on the work site. Traffic cones must also be placed downstream of the construction site to divert cars into the adjacent lane(s) per MUTCD requirements. On roads with a heavy traffic volume, a flagman may also be needed to assist with traffic

control. At the end of each working period, the Subcontractor shall plate all open excavations to maintain traffic flow.

3.16 FALL PROTECTION

A. Subcontractor shall install and maintain all fall protection measures in accordance with the SARP10 Loss Control Manual. The Subcontractor shall construct a controlled access zone around the manhole being adjusted. At a minimum, the fall protection zone shall include traffic cones encircled with pennant tape. The controlled access zone must have one point of access with an entrance log.

3.17 PROTECTION OF DOWNSTREAM FACILITIES

A. The Subcontractor must take all steps necessary to assure that no material is allowed to fall into the line during his installation process. The Subcontractor shall bear all cost of repairs resulting from any damages to downstream facilities resulting from failure to abide by this stipulation.

3.18 WASTEWATER SPILLS

A. Should the Subcontractor spill any wastewater, such that the sewage either immediately or ultimately enters the waters of the State of Tennessee, then the Subcontractor shall be completely responsible for any fines or penalties imposed on the Purchaser or the Subcontractor by the USEPA or the State of Tennessee.

PART 4- FINAL TESTING AND ACCEPTANCE

4.01 VISUAL INSPECTION

A. All work will be subject to visual inspection for faults or defects and any such deviation or omission will be corrected at once.

B. A PACP CCTV inspection in accordance with Section 00003 shall be submitted after pipe replacement is competed.

4.02 LEAKAGE TESTS

A. On sewers with no house connections, leakage tests shall be performed on the full length of all sewer lines and manholes in the presence of the Purchaser before acceptance. On all other sewers, an infiltration test shall be performed. The cost of all testing will be included in the unit price for the item being tested.

B. Air Leakage Test for 8-24 inch Diameter Pipe

1. Upon completion of construction, or earlier if the Purchaser deems advisable, the Subcontractor shall provide the necessary equipment and labor to perform low pressure air tests according to ASTM F1417. This test shall be performed in the presence of the Purchaser and shall be for all types of gravity sewer pipe. This test shall also include service lines from manholes.

2. The pressure test gauge will meet the following minimum specifications:

a.	Size (diameter)	4 ½ inches
b.	Pressure Range	0-15 PSI
c.	Figure Intervals	1 PSI Increments

d.	Minor Subdivisions	0.05 PSI
e.	Pressure Tube	Bourdon Tube or diaphragm
f.	Accuracy	Plus or minus 0.25% of Maximum scale reading
g.	Dial	White coated aluminum with black lettering, 270° arc and mirror edges
h.	Pipe Connection	Low male ½ inch NPT

3. Calibration data shall be supplied with all pressure test gauges. Certification of pressure test gauges shall be required from the gauge manufacturer. This certification and calibration data shall be available to the Purchaser whenever air tests are done.

4. Air leakage tests shall be performed on each reach of sewer pipe between manholes after completion of the installation of pipe and appurtenances and the backfill of sewer trenches. The test time shall be determined from the following table. If air tests fail to meet the following requirements, the Subcontractor shall repeat tests as necessary after all leaks and defects have been repaired. Before acceptance, the same sewer reach shall pass the low pressure air test.

Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated[1]

Pipe Diameter (in.)	Minimum Time (min:sec)	Test Time for Length of Sewer Tested (min)
8	7:34	1.52 X L(ft)/60
10	9:26	2.374 X L(ft)/60
12	11:20	3.418 X L(ft)/60
15	14:10	5.342 X L(ft)/60
18	17:00	7.692 X L(ft)/60
21	19:50	10.47 X L(ft)/60
24	22:40	13.674 X L(ft)/60

1. Establish the test time for the sewer length from the formula or the minimum time, whichever is greater.

C. Infiltration Test

1. Infiltration tests may be required for the complete line or any portion of it. Failure of any part of the line to pass an infiltration test shall be sufficient reason to require additional work by the Subcontractor to reduce the infiltration in such portions of the line tested. The passing of an infiltration test shall in no way relieve the Subcontractor of any responsibility to repair visible leaks found during the visual inspection.

2. Maximum allowable infiltration shall be 0 gallons per mile per inch of diameter of sewer per 24-hour day at a time. The joints shall be tight, and visible leakage in the joints of leakage greater than that specified above shall be repaired at the Subcontractor's expense by any means necessary.

4.03 DEFLECTION TEST - SEMIRIGID AND FLEXIBLE PIPE

A. All polyvinyl chloride (PVC) pipe and glass fiber reinforced polymer mortar pipe shall be tested for deflection. All testing shall take place after backfill has been in place at least 30 days. All lines shall be thoroughly cleaned before testing to assure accuracy.

B. Tests shall be run using a rigid ball or nine arm mandrel having a diameter of 95% of the inside diameter of the pipe for PVC and 96% of the inside diameter of the pipe for glass fiber reinforced polymer mortar pipe. The mandrel will be pulled freely by hand through the pipe from manhole to manhole. No pipe deflection will exceed 5% for PVC and 4% for glass fiber reinforced polymer mortar pipe. Any section failing the test shall be repaired by re-bedding or pipe replacement and retested to the satisfaction of the Purchaser.

C. The cost of this service shall be included in the unit price bid for the pipe.

4.04 FINAL ACCEPTANCE

A. When all work required by the Contract has been completed, the Subcontractor shall submit to the Purchaser written certification from a registered land surveyor that the centerline of each structure is within 2.0 feet of the centerline of the sewer easement or the location designated on the Drawings. After receiving the surveyor's certification from the Subcontractor, the Purchaser will make a final inspection of the Work, including any tests for operation. After completion of this inspection, the Purchaser will, if all things are satisfactory to him, issue to the Subcontractor a Certificate of Completion certifying that the Work required by the Contract has been completed according to the Contract Drawings and Specifications. However, the Certificate will not operate to release the Subcontractor or his sureties from any guarantees under the Contract or the Performance Bond. Upon receipt of the Certificate of Completion the Subcontractor will clean the premises and see that they are in an orderly condition.

PART 5- MEASUREMENT

5.01 LOCATE AND EXPOSE MAINLINE TERMINUS

A. Locate and expose mainline terminus shall be measured per each.

5.02 UNDERCUT BACKFILL

A. Undercut backfill will be measured by the ton of limestone in place.

5.03 SEWER PIPE

A. Sewer pipe length will be measured per linear foot along the centerline of the pipe from center of manhole to center of manhole. When there are special structures, sewer pipe will be measured from inside face to inside face for the various sizes, types, classes or wall thicknesses.

B. Sewer pipe length measurement will include the length of wyes as measured along the primary axis for all sizes of sewer pipe.

5.04 SERVICE CONNECTION REMOVAL AND REPLACEMENT

A. Service connection removal and replacement for construction of sewer facilities will be measured per each. Service Connections damaged by the Subcontractor that do not require removal and replacement for construction of sewer facilities will not be measured for payment.

5.05 PAVEMENT BACKFILL

A. Pit run gravel or other acceptable material used for backfill under pavements or other areas directed by the Purchaser will be measured by the cubic yard in the following manner. Cubic yards of Pavement Backfill equals the linear feet of sewer pipe installed directly below pavement as measured along the centerline of the pipe multiplied by the trench payline width in feet multiplied by the depth of pavement backfill material in feet divided by 27. The trench payline width is defined as the outside diameter of the sewer pipe plus 2 feet. The depth of pavement backfill is defined as the distance from 6 inches above the top of the sewer pipe to the subgrade elevation of the pavement.

5.06 BYPASS PUMPING

A. Bypass pumping will be measured as a per each pipe segment relayed.

5.07 TRAFFIC CONTROL

A. Traffic control will be measured as specified in Section 01551 – Traffic Control for Construction Work Zones.

5.08 INVERTED SIPHONS

A. Inverted siphons constructed according to Plans and Specifications will be measured per lump sum for each siphon complete in place.

5.09 HYDROEXCAVATION/HAND DIGGING

A. Hydroexcavation and/or hand digging of the trench perimeter will be measured per linear foot of sewer pipe replaced.

5.10 EXCAVATION

A. All work for excavation, blasting, drainage of trenches and dewatering, backfilling of excavation, compaction, grading, protection of existing utilities, disposal of excess material, and all other similar items included in this section of the Specifications but not covered by a Pay Item herein will be considered obligations of the Subcontractor under other Pay Items of the Contract.

5.09 PIPE WYES

A. Pipe wyes on sewer lines will not be measured for payment, but are incidental to the cost of furnishing and installing sewer pipe.

5.10 STEEL CASING

A. Measurement shall be along the centerline of the installed steel casing pipe. Measurement shall not be made of incidental work, including sheeting, shoring, grout, excavation, backfill, dewatering, or other work related to installing the steel casing pipe complete and in place.

PART 6 - PAYMENT

6.01 LOCATE AND EXPOSE MAINLINE TERMINUS

A. Locate and expose mainline terminus will be paid for at the contract unit price per each. This item will include but not be limited to all means necessary for locating and excavating the terminus of the sewer when no manhole exists. This item will not include any pay items related to the installation of a new manhole.

6.02 UNDERCUT BACKFILL

A. Accepted quantities of undercut backfill will be paid for at the contract unit price per ton of limestone furnished and placed, which will be full compensation for undercut excavation, special protection, protection of existing utilities, and backfilling to bottom of facility subgrade elevations, complete in place.

6.03 SEWER PIPE

B. The accepted quantities of all sewer pipe will be paid for at the contract unit price per linear foot furnished and laid for the various sizes, types, classes, or wall thicknesses of pipe, which will be full compensation for material and material testing, excavation, special protection, protection of existing utilities, maintenance of sewage flow, proper pipe embedment, laying, jointing, cleaning and inspection, conducting acceptance tests, installation of pipe wyes, connection to manholes, adapters and couplings, stoppers, and removal and/or abandonment of existing pipe within the limits of excavation and backfilling outside pavement areas.

6.04 SERVICE CONNECTION REMOVAL AND REPLACEMENT

A. Accepted quantities of building connections removed and replaced will be paid for at the contract unit price per each for various types of building connections, which will be full compensation of excavation, removal of old service line and appurtenances, furnishing and construction of new service lines, connection fitting to main sewer, PVC 4-inch stack pipe, double sweep cleanout, PVC cap with screw plug, 6-inch by 4-inch PVC reducer, and connection to the existing private lateral and appurtenances to remain, backfilling, testing and inspection, complete in place.

6.05 PAVEMENT BACKFILL

A. Accepted quantities of pit run gravel or other acceptable material used for backfill under pavements or other areas designated by the Purchaser will be paid for at the contract unit price per cubic yard furnished and placed, which will be full compensation for furnishing, placing and compacting the selected material.

6.06 BYPASS PUMPING

A. Bypass pumping will be paid at the appropriate contract each per segment replaced. This item includes all materials and labor necessary to properly comply with the bypass pumping requirements listed in the specification.

6.07 TRAFFIC CONTROL

A. Traffic Control will be paid as specified in Section 01551 – Traffic Control for Construction Work Zones. Traffic control does not apply to segments being replaced in alleys or other locations where traffic is not impacted.

6.08 HYDROEXCAVATION/HAND DIGGING

A. Hydroexcavation and/or hand digging of the trench perimeter will be paid per linear foot of pipe installed where one of these methods is used. Payment shall include all material and labor required to complete the item as specified.

6.10 STEEL CASING

A. The accepted quantities of all still casing pipe will paid for at the contract unit price per linear foot furnished and laid for the various sizes, types, classes, or wall thicknesses of pipe, which will be full compensation for installation, labor, pipe, materials, equipment, tools and incidentals necessary to complete the work.

PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02530-6.01	LOCATE AND EXPOSE MAINLINE TERMINUS	Each
02530-6.02	UNDERCUT BACKFILL	Ton
02530-6.03	**SEWER PIPE**	Linear Foot
02530-6.03.06.10	10” DUCTILE IRON PIPE, CLASS 50	Linear Foot
02530-6.03.15.08.01	8” POLYVINYL CHLORIDE (PVC) 0’ - 6’ DEEP	Linear Foot
02530-6.03.15.15.01	15” POLYVINYL CHLORIDE (PVC) 0’ - 6’ DEEP	Linear Foot
02530-6.03.15.15.02	15” POLYVINYL CHLORIDE (PVC) 6.1’ – 12’ DEEP	Linear Foot
02530-6.03.15.24.01	24” POLYVINYL CHLORIDE (PVC) 0’ - 6’ DEEP	Linear Foot
02530-6.03.15.24.02	24” POLYVINYL CHLORIDE (PVC) 6.1’ - 12’ DEEP	Linear Foot
02530-6.03.15.30.01	30” POLYVINYL CHLORIDE (PVC) 6.1’ - 12’ DEEP	Linear Foot
02530-6.04	SERVICE CONNECTION REMOVAL AND REPLACEMENT	Each
02530-6.05	PAVEMENT BACKFILL	Cubic Yard
02530-6.06	BYPASS PUMPING	Lump Sum
02530-6.08	HYDROEXCAVATION/HAND DIGGING	Linear Foot
02530-6.10	STEEL CASING	Linear Foot

END OF SECTION 02530

Group 3 Relay Rehab Project - Manhole Bid Schedule

MH ID	Diameter (in.)	Repair Method 1	Repair Method 2	Manhole Height (ft)	Height Above Grade (ft)
FS021567.01	40	Structurally Repair MH	None	8.4	0.5
FS022664.01	48	Repair Bench/Channel	Cement Coating: Entire MH	10.8	0.0
WS010292	48	Cement Coating: Entire MH	None	8.8	0.0
WS013771	48	Cement Coating: Entire MH	None	7.9	0.0
WS013934	48	Cement Coating: Entire MH	None	8.7	0.0
FS021444	48	Install New Manhole	None	9.0	0
FS022619.01	48	Install New Manhole	None	9.0	0
WS013048	48	Install New Manhole	None	10.0	0
WS010610	48	Install New Manhole	None	15.0	0
WS012850.01	48	Install New Manhole	None	12.0	0
WS013021	48	Install New Manhole	None	11.0	0
WS013035	48	Install New Manhole	None	10.0	0
WS013038	48	Install New Manhole	None	5.0	0
WS014005	48	Install New Manhole	None	12.0	0
WS013893	48	Install New Manhole	None	9.0	0

Group 3 Relay Rehab Project - Pipe Bid Schedule

Pipe ID	Sheet	US MH [Approx. Depth (ft)]	DS MH [Approx. Depth (ft)]	Diameter (in.)	Material	Approx. Repair Length (ft)	Approx. Repair Depth (ft)	Approx. # of Taps	Repair Method	Notes
FS020173.06S	A2	FS020173.06 [3.4]	FS020173.05 [3.2]	8		159.6	3.3	2	Mainline Relay	
FS022665S-2	B3	FS022665 [Not Inspected]	FS022664.01 [10.8]	8		305.8	10.8	17	Mainline Relay	
FS022640S	B5	FS022640 [7.9]	FS022639 [10.7]	8		357.9	9.3	16	Mainline Relay	
WS010303S	B6	WS010303 [4.4]	WS010302.01 [4.4]	6		261.8	4.3	12	Mainline Relay	
WS010307S	B6	WS010307 [Not Inspected]	WS010292 [8.8]	8		359.0	8.8	1	Mainline Relay	
FS022653S	C4	FS022653 [6.1]	FS022525 [4.5]	8		397.6	5.6	20	Mainline Relay	
FS022595.01S	E5	FS022595.01 [6.8]	FS022595 [7.2]	6		285.7	7.0	9	Mainline Relay	
FS021443.01S	F3	FS021443.01 [8.9]	FS021312.02 [Not Inspected]	6		170.8	8.9	0	Mainline Relay	
FS021444S	F3	FS021444 [Dead End]	FS021443.01 [8.9]	6		431.4	8.9	4	Mainline Relay	
FS022619.01S	F4	FS022619.01 [Not Inspected]	FS022619 [8.3]	6		150.8	8.4	8	Mainline Relay	
FS022633S	G5	FS022633 [4.6]	FS022593 [7.4]	6		216.2	6.0	6	Mainline Relay	
FS021374S	H4	FS021374 [4.9]	FS021354 [5.1]	6		340.5	5.0	2	Mainline Relay	
FS022626.01S	H5	FS022626.01 [Dead End]	FS022626 [6.4]	6		187.4	6.5	4	Mainline Relay	
FS021278S	I1	FS021278 [7]	FS021284.01 [7.5]	6		105.5	7.3	10	Mainline Relay	
FS021279S	I1	FS021279 [6.5]	FS021278 [7]	6		259.6	6.8	24	Mainline Relay	
FS021655.01S	I5	FS021655.01 [11.2]	FS021655 [14.3]	6		320.2	12.9	13	Mainline Relay	
FS021653S	I6	FS021653 [17.1]	FS021231 [Not Inspected]	8		229.9	15.6	0	Mainline Relay	
FS021656.01S	I6	FS021656.01 [Not Inspected]	FS021656 [9.3]	6		540.4	6.8	1	Mainline Relay	
WS013047S	J10	WS013047 [7]	WS012930 [8.8]	6		539.3	7.8	13	Mainline Relay	

WS013048S	J10	WS013048 [Dead End]	WS013047 [7]	6		108.8	6.9	1	Mainline Relay	
WS012836S	J13	WS012836 [12.9]	WS012835 [11.5]	6		461.1	12.2	4	Mainline Relay	
WS010609S	J8	WS010609 [6.6]	WS010605 [8.9]	6		194.9	8.0	2	Mainline Relay	
WS010610S	J8	WS010610 [Dead End]	WS010609 [6.6]	6		450.6	6.9	3	Mainline Relay	
WS012850.01S	J9	WS012850.01 [Dead End]	WS012850 [12.1]	6		122.1	12.1	4	Mainline Relay	
~~WS012396S~~	~~K15~~	~~WS012396~~ ~~[15.4]~~	~~WS012395~~ ~~[12.7]~~	~~6~~		~~144.3~~	~~13.5~~	~~5~~	~~Mainline~~ ~~Relay~~	
WS013110.01S	L10	WS013110.01 [8.5]	WS013110 [Not Inspected]	6		373.4	7.7	13	Mainline Relay	
WS013057S	L11	WS013057 [11.6]	WS012951.01 [8.8]	8		599.7	10.3	20	Mainline Relay	
FS021567.01S	L2	FS021567.01 [8.4]	FS021567 [7.8]	6		207.5	8.3	17	Mainline Relay	
FS021574S	L3	FS021574 [9.9]	FS021573 [9.3]	8		185.1	9.8	0	Mainline Relay	
WS013021S	L9	WS013021 [Dead End]	WS013020 [8.3]	6		421.1	8.4	17	Mainline Relay	
FS021549.02S	M1	FS021549.02 [Not Inspected]	FS021549.01 [Not Inspected]	12		71.5	0.0	1	Mainline Relay	
WS013029S	M10	WS013029 [4.8]	WS013028 [Not Inspected]	6		322.5	6.2	8	Mainline Relay	
WS013030S	M11	WS013030 [8.4]	WS013029 [4.8]	6		481.5	6.6	19	Mainline Relay	
WS013035S	M12	WS013035 [Dead End]	WS012952 [8.3]	6		693.6	8.4	1	Mainline Relay	
WS013038S	M12	WS013038 [Dead End]	WS012956 [7.3]	6		213.5	7.4	2	Mainline Relay	
FS021921S	M4	FS021921 [Not Inspected]	FS021716 [10.6]	6		298.5	10.6	2	Mainline Relay	
WS010583S	M8	WS010583 [9.5]	WS010582 [6.5]	8		543.7	8.0	23	Mainline Relay	
WS013715S	M8	WS013715 [6.1]	WS013714 [6.3]	6		242.9	6.1	9	Mainline Relay	
WS013017S	M9	WS013017 [3.9]	WS013016 [6.8]	6		178.4	5.5	6	Mainline Relay	
WS013847S	M9	WS013847 [2.2]	WS013846 [9.8]	8		578.1	6.5	9	Mainline Relay	

WS013713S	N8	WS013713 [6.4]	WS013712 [7.6]	6		295.0	6.9	11	Mainline Relay	
WS013714S	N8	WS013714 [6.3]	WS013713 [6.4]	6		455.0	6.4	14	Mainline Relay	
WS013728S	N8	WS013728 [4.7]	WS013725 [7]	6		157.4	5.8	2	Mainline Relay	
WS013014.01S	N9	WS013014.01 [8.9]	WS013014 [4]	6		546.8	6.5	10	Mainline Relay	
WS012982S	O10	WS012982 [4.4]	WS012981 [8.3]	6		363.0	6.2	8	Mainline Relay	
WS013129S	O10	WS013129 [4.4]	WS013128 [9.2]	6		506.1	7.0	4	Mainline Relay	
WS013134S	O10	WS013134 [3.9]	WS012999 [8.3]	6		450.0	6.2	8	Mainline Relay	
WS013827S	O8	WS013827 [5.2]	WS013610.02 [7.2]	6		622.2	6.3	20	Mainline Relay	
WS013132S	O9	WS013132 [7.6]	WS013131 [7.8]	6		500.6	7.9	15	Mainline Relay	
WS013749S	O9	WS013749 [5]	WS013748 [6.7]	6		294.9	5.8	10	Mainline Relay	
WS013119.01S	P11	WS013119.01 [2.7]	WS013119 [5.2]	6		147.8	3.8	2	Mainline Relay	
WS012989S	Q10	WS012989 [8.6]	WS012988 [9.2]	6		397.6	9.0	4	Mainline Relay	
WS013987S	S9	WS013987 [4.5]	WS013986 [6.9]	6		343.6	5.8	7	Mainline Relay	
WS014005S	S9	WS014005 [Dead End]	WS013623.01 [7.3]	6		497.0	7.2	16	Mainline Relay	
WS013883S	U10	WS013883 [4]	WS013882 [2.5]	6		392.0	3.3	3	Mainline Relay	
WS013893S	U10	WS013893 [Dead End]	WS013883 [4]	8		379.0	6.0	13	Mainline Relay	
WS013934S	U8	WS013934 [8.7]	WS013771 [7.9]	6		224.0	8.3	1	Mainline Relay	
WS013970.02S	V9	WS013970.02 [10]	WS013970.01 [5.8]	6		279.5	7.8	11	Mainline Relay	
WS013976.01S	V9	WS013976.01 [10.1]	WS013976 [4.8]	6		257.0	7.5	16	Mainline Relay	