



**REQUEST FOR BID
FOR
Group 1 Relay**

Bid No. 196548.71.0401

February 7, 2018



City of Memphis, Tennessee

Black & Veatch and Overland Contracting Inc. (OCI), a subsidiary of Black & Veatch, are the Program Manager and Construction Manager respectively, for the SARP10 Program for the City of Memphis.

Overland Contracting Inc.
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00170 - Request for Bid

00170.1 Introduction

Sealed bids will be received at the Office of the City of Memphis Environmental Administration, Room 620, City Hall, 125 N. Main, Memphis, TN 38103, until **3:00 p.m. local time, March 29, 2018** for furnishing the City of Memphis with the following: FOR THE DIVISION OF: PUBLIC WORKS FOR THE CONSTRUCTION OF: SARP10 Program **Group 1 Relay**

The Sealed Bid envelope must be labeled with the project name, bidder's name, license bidder number, license expiration date, license classification. The Sealed Bid envelope must contain one (1) hardcopy of the bid and one (1) electronic CD copy of the bid.

Sealed Bids sent through the mail or other such delivery service shall be sent in such a manner so as to allow the opening of the "Mailing Container" and still have intact the sealed Bid. On the Mailing Container the sender shall state the words that a **"SEALED RESPONSE IS ENCLOSED"** and the Bid number.

Subcontractors intending to bid on this project must follow the instructions for Registration as stated in the Advertisement Legal Notice Request for Bid No. **196548.71.0401** (dated February 7, 2018). Registration information must be submitted by **March 9, 2018**.

00170.2 Program Overview

The Program consists of the management of the capital program needed to bring the City's wastewater and sewer system into compliance with federal and state regulations per the City of Memphis Wastewater Collection and Transmission System (WCTS) Condition Assessment and Rehabilitation Program Consent Decree signed on September 21, 2012, including the procurement of studies, design and construction services associated with the City of Memphis SARP10 Program.

00170.3 Scope of Work

The Scope of Work for this bid generally consists of digging and replacing approximately 19,000 linear feet of 8" diameter gravity sewer pipes in Priority Rehab Area outlined in the Consent Decree. In most cases the work will include, but is not limited to, replacing the existing 6" or 8" sewer segment with a new 8" PVC segment, reinstating all laterals, and rehabilitating certain associated manholes. Other related work will include providing traffic control and restoring any disturbed area. The project will involve work in both improved and unimproved areas primarily on residential streets. Another contractor will be performing a separate rehabilitation contract in the same area while this contract is being completed so coordination between the two will be necessary.

00170.4 Bid Guarantee Requirements

Guarantee Requirements:

(a) Bidder will not withdraw bid for one hundred eighty (180) calendar days after opening of bids without Purchaser's written consent.

(b) If bid is accepted, bidder will enter into formal Subcontract with Purchaser, within five (5) calendar days after receipt of Subcontract documents for execution.

(c) If bid is accepted, bidder will execute required 100% Performance/Payment Bond in accordance with Article 00571.4 and will obtain required insurance coverage in accordance with Article 00572.21 within ten (10) calendar days after receipt of Subcontract.

(d) All bids will require a bidder's bond or certified or cashier check made payable to the Purchaser on a solvent bank in the amount of 5% of the bid. Said instrument to remain in effect and will be returned only after the Subcontract has been fully executed and secured. Additionally, the successful bidder shall execute a performance bond in an amount equal to 100% of the Subcontract sum as security for the faithful performance of the Subcontract and for the payment of labor and material furnished and



incorporated into the Work. The only acceptable form of instrument for this bid bond is bound herein, Article 00672.7.

Bidder shall be liable to the Purchaser for full amount of proposal guarantee as representing damage to the Purchaser on account of default of bidder if:

- (a) Bid is withdrawn within one hundred eighty (180) calendar days after receipt of bids without approval by Purchaser.
- (b) Bidder fails to enter into contract with Purchaser and execute required Performance Bond and provide required insurance coverage within ten (10) calendar days subsequent to notice of award of the Subcontract.

**Firms desiring to submit a Bid should carefully review these instructions.
Compliance with all requirements will be solely the responsibility of the Respondent.**

00170.5 Request for Bid Definitions

Terms used in this Request for Bid documents are defined and have the meanings assigned to them as follows. The term "OC!", "Purchaser" or "Program Manager" means Overland Contracting Inc. The term "Respondent", "Firm", "Company", "Subcontractor" or "Bidder" means one who submits a Response for the purpose stated in this Solicitation Request for Bid documents. The terms "BID", "Response" or "Respondent's Response" mean all submittal documents provided by the Respondent as required by this Request for Bid. The terms "Request for Bid" or "Bid Documents" mean the documents included in this Request for Bid.

Every effort has been made to use industry-accepted terminology in this Request for Bid. Any statement in this document, which uses words such as "must", "shall", "should", "provide for" or "have/provide the capability of/for", means that compliance with the intent of the statement is mandatory and that failure by the Respondent to satisfy that intent may be cause for the Response to be rejected.

00170.6 Disadvantaged Business Enterprise (DBE) Goals

This section shall set forth the respondent's DBE Participation Plan that must be submitted and include: (1) the level and dollar amount of participation your firm anticipates to achieve in the performance of the Subcontract resulting from this RFB; (2) the type of Work to be performed by the DBE firm(s) participating; and (3) the names of the DBE firms the Respondent plans to utilize in the performance of the Subcontract resulting from this RFB.

SARP10 DBE Participation Goal: **15%**
(Vendors from the City of Memphis EBO list only)

00170.7 Clarification of Bid

Purchaser reserves the right to obtain clarification of any point in a Response or to obtain additional information as necessary to properly evaluate a particular Response. Failure to respond to such request for additional information or clarification in a timely manner may result in rejection of the Response.

00170.8 Not Used

00170.9 Responsiveness

Respondents should respond to all requirements of the Bid to the maximum extent possible and are required to clearly identify any limitations or exceptions to the requirements.

00170.10 Examination of Request for Bid Documents

Before submitting a Response, each Respondent must:



- Study and carefully correlate the Respondent's observations and responses with the Bid Documents.
- Notify Purchaser of all conflicts, errors and discrepancies, if any; in the Bid Document submitted.
- Review the Loss Control Manual.

Respondents by and through the submission of their Response, agree that they shall be held responsible for having therefore familiarized themselves with the nature and extent of the requirements in the Bid Documents.

00170.11 Interpretations and Addenda

If any prospective Firm is in doubt as to the true meaning of any part of the Requirements For Preparing and Submitting Bid Submittal for the requested services, they may submit a written request (verbal requests will not be accepted) for an interpretation before the Last Date for Bidder Questions; as stated in 00170.16. The person submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by addendum transmitted to each party receiving a set of such documents. Purchaser will not be responsible for any other explanations or interpretations of the proposed documents. Any requests not submitted within this time period will be deemed waived.

SUBMIT ALL QUESTIONS BY E-MAIL TO:

Attn: Scott McAmis

scott_mcamis@gspnet.com

Cc: Ginny Dorsey

DorseyV@bv.com

Cc: Brad Davis, PE

DavisBJ@bv.com

(Reference: SARP10 Program **Group 1 Relay**, BID No. 196548.71.0401)

All requests or questions should be clearly marked and must be received by Last Date for Bidder Questions, as stated in 00170.16. A response will be returned via addendum to all Firms along with the original question(s).

There shall be no communication between the Firm, their employees or subcontractors concerning this Bid to anyone within Black & Veatch, OCI, Allen & Hoshall, Allworld Project Management, Gresham Smith and Partners, Integrated Circles Technologies, Tamco, Carter-Malone Group, Rohadfox Construction Control Services Corporation, or City of Memphis employee or any such person's spouse, child, parent, brother, sister, dependent or person assuming a relationship being the substantially equivalent of the above except through Brad Davis. **Failure to comply with this requirement will be grounds for disqualification.**

00170.12 Modification or Withdrawal of Bid Submittals

Responses may be modified or withdrawn by an appropriate document duly executed (in the same manner that a Response must be executed) and delivered to the place where Responses are to be submitted at any time prior to the submission deadline. A request for withdrawal or a modification must be in writing and signed by an authorized person. Evidence of such authority must accompany the request for withdrawal or modification. Withdrawal of a Response will not prejudice the rights of a Responder to submit a new Response prior to the Response deadline. After expiration of the period for receiving Responses, only Purchaser may request clarifications or additional information.

00170.13 Rejection of Responses

To the extent permitted by applicable local, state and federal laws and regulations, Purchaser reserves the right to reject any and all Responses, to waive any and all informalities not involving price, time, or changes in the Work with the successful Respondent, and the right to disregard all non-conforming, non-responsive, unbalanced or conditional Responses. Also, Purchaser reserves the right to reject a Response, in its sole discretion, if the City of Memphis believes that it would not be in its best interest to make an award to that Respondent.



Purchaser reserves the right to reject any Response if the evidence submitted by the Responder or if the investigation of such Respondent fails to satisfy Purchaser that such Respondent is properly qualified to carry out the obligations and to complete the Work contemplated therein. All Responses will be rejected if there is reason to believe that collusion exists among Respondents. Responses will be considered irregular and may be rejected if they show serious omissions, alterations in form, additions not called for, conditions or unauthorized alterations, or irregularities of any kind.

00170.14 Other Items

This Bid does not commit Purchaser to enter into a Subcontract, nor does it obligate Purchaser to pay for any costs incurred in the preparation and submission of Responses or in anticipation of a Subcontract. Costs of preparing the Bid in response to this request are solely the responsibility of the Respondent.

By responding to this solicitation, the respondent attests that no employee of Black & Veatch, OCI, Allen & Hoshall, Allworld Project Management, Gresham Smith and Partners, Integrated Circles Technologies, Carter-Malone Group, Rohadfox Construction Control Services Corporation, or City of Memphis employee or any such person's spouse, child, parent, brother, sister, dependent or person assuming a relationship being the substantially equivalent of the above, has an existing or pending, direct or indirect, financial interest in the respondent's business.

No Respondents to this solicitation shall discriminate against any employee or applicant for employment because of race, religion, color, sex, age, or national origin.

00170.15 Selection Process

Purchaser intends to select one Firm based on price and successful completion and approval of the OCI Registration process. There is a local contractor preference of 5%. For evaluation purposes the 5% will be applied to the Total Estimated Unit Price Value.

00170.16 Selection Schedule

The following schedule will be adhered to during the selection process. It is subject to change at the sole discretion of OCI.

Event	Completed By
Advertising Date	February 7, 2018
Pre-Bid Meeting	February 15, 2018 1:00 pm local time
Registration Information submitted per 196548.71.0401 Advertisement	March 9, 2018
Last Date for Bidder Questions	March 9, 2018
Issue Addendum for answers to questions	March 15, 2018
Receive all Bids	March 29, 2018 by 3:00 pm local time
Public Opening	March 29, 2018 immediately following receipt of bids
Public Notice of Intent to Award	April 5, 2018
Preconstruction Meeting with Subcontractor	April 19, 2018
Tentative Notice to Proceed	April 26, 2018

00170.17 Mandatory Pre-Bid Meeting

A mandatory pre-bid meeting will be held at **1:00 PM** (local time) at **2714 Union Avenue Extended, 5th Floor Training Room, Memphis, TN 38112** on **February 15, 2018**. Bidders are required to attend at their own cost.



00270 - Instructions to Bidders

00270.1 Bidder's Compliance with Request for Bid

Provide the information requested and any supporting information necessary to permit a complete analysis of your bid. You acknowledge that preparation and submission of a bid will be at your sole cost and that you will treat this RFB and any resulting discussions as confidential. If you do not agree to treat this RFB and associated discussions as confidential, return the complete RFB to Purchaser and delete or destroy any copies you made.

00270.2 General Bid Parameters

Provide the information requested in Section 00270 and Section 00370 in the appropriate fields of Section 00370. Complete each line of Section 00370 in its entirety and submit it with your bid in accordance with Section 00170. Do not alter Section 00370 forms in any way or deviate from the terminology used or the unit of measure indicated when completing Section 00370. Submit Section 00370 forms in their original core application software, with no embedded programming and no permissive encoding restricting access to the data provided.

00270.2.1 Bidder's Contact Information

Include contact information for your representative in Article 00370.2.1. Your representative must have the appropriate expertise and authority to negotiate on behalf of your company.

00270.2.2 Addenda to Request for Bid

In Article 00370.2.2, list all addenda received from Purchaser and indicate "Yes" to show your receipt of and incorporation of the listed addenda into the proposal. Address any exceptions or clarifications to addenda in accordance with Article 00270.6.

00270.3 Bid Pricing

You must include numerical values in the applicable fields of Table 00370.3.1. Non-numerical values, such as "included" or "not applicable," are not acceptable. Purchaser will evaluate fields left blank or filled with a zero as scope included in your bid at no cost.

00270.3.1 Unit Pricing

Provide the unit prices to perform the Work in accordance with this RFB in Table 00370.3.1. A unit price is the total amount to be billed to Purchaser for a specific unit of work. Unit pricing includes all costs, overhead, profit and mark-up associated with delivering the complete unit.

00270.4 Supplemental Bid Information

00270.4.1 Company Status

In Article 00370.4.1, indicate the type of your organization's legal entity and the state and country in which it is organized.

00270.4.2 Contractor License

If you are not licensed to perform the Work, indicate "No" in Article 00370.4.2. If you indicate "No," declare an exception in accordance with Article 00270.6.

00270.4.3 Not Used

00270.4.4 Bid Validity Period

Indicate "Yes" in Article 00370.4.4 if your proposal is valid for one hundred eighty calendar days after the Proposal Due Date (the "Proposal Validity Period"). If you indicate "No" in Article 00370.4.4, provide the number of calendar days that your proposal is valid in Article 00370.4.4 and declare an exception in accordance with Article 00270.6. Purchaser may reject your proposal without prior notice if your proposal is not valid for the full Bid Validity Period.



00270.4.5 Firm Non-Escalatable Pricing

Indicate "Yes" in Article 00370.4.5 if the proposal pricing is firm and not subject to escalation. If you indicate "No," declare an exception in accordance with Article 00270.6 and include the terms of escalation in your exception.

00270.4.6 Taxes

Tax requirements are identified in Article 00571.6. Indicate "Included" in Article 00370.4.6 if your proposal includes the tax requirements. If you indicate "Excluded" in Article 00370.4.6, declare an exception in accordance with Article 00270.6.

00270.4.7 Work at Jobsite

Identify the type of craft labor. If you plan to subcontract any of the Work, indicate "Yes" in the appropriate section of Article 00370.4.7 and complete Table 00370.4.7.

00270.5 Schedule Compliance

Indicate "Yes" in Article 00370.5 if you can meet the schedule dates included in Table 00370.5. If you indicate "No," submit an alternative summary level schedule with your proposal.

00270.6 Compliance with Request for Bid

00270.6.1 Declared Exceptions to RFB Requirements

An exception is any variation from an express RFB requirement. Declare all exceptions, whether commercial or technical in nature, in Table 00370.6.1. Provide specific exceptions and accurately reference the article number to which each exception applies. Exceptions of a general nature or that refer to your standard specifications or terms are not acceptable and may result in Purchaser rejecting your bid without prior notice.

00270.6.2 Declared Clarifications to RFB Requirements

A clarification is the means by which you offer to meet an RFB requirement if the RFB does not identify the specific means by which the RFB requirement must be met. Declare any clarifications, whether commercial or technical in nature, in Table 00370.6.2. Reference the article number to which each clarification applies.

00270.7 Bid Attachments

List any supplemental documents included in your bid in Article 00370.7.

00270.8 Declarations

Indicate "Yes" in Article 00370.8 to confirm you have familiarized yourself with the conditions affecting the Work. If you indicate "No," declare an exception in accordance with Article 00270.6.

00270.9 Nondiscrimination

All entities contracting with the Purchaser agree to abide by and to take affirmative action when necessary to ensure compliance with the nondiscrimination clauses set out below, and agree to show proof of non-discrimination upon request and to post in conspicuous places available to all associate agents and their employees. In the event of non-compliance with nondiscrimination clauses, or with provisions of Executive Orders 11141 (age), 11246, 11375 (women), 12086 (Vietnam veterans), 11478 (federal employees), 11625 (minority business) 11701 (veterans), Title 41, Chapter 60 (handicapped) and specifically the handicapped affirmative action clause in Section 60-741.6.9 of OFCCP Rules, and any and all other federal laws prohibiting discrimination, contracts may be canceled, terminated, or suspended in whole or in part by the Purchaser.

The Bidder shall execute the specified Nondiscrimination Certificate (see Section 00672.3) agreeing that, if awarded the Subcontract, he/she shall not discriminate against any Sub-subcontractor, employee, or applicant for employment on the grounds of race, color, national origin or sex, in accordance with the

citations listed in the above paragraph; and shall require the execution of such a certificate for each Sub-subcontractor prior to award of any subcontract with the further requirement that each subcontractor shall include identical requirements in any lower tier subcontracts which might in turn be made. FAILURE TO EXECUTE AND SUBMIT SUCH CERTIFICATE WITH THE BID MAY CAUSE THE BID TO BE REJECTED AS NON-CONFORMING. The successful Bidder and all Sub-subcontractors under the general contract shall maintain copies of their payrolls and all subcontracts for each weekly payroll period for the life of the construction and for a period of **SEVEN (7) YEARS** after final release and payment is made by the Purchaser to the contractor.

00270.10 Equal Business Opportunity Program (EBO)

The Bidder must complete and return the Equal Business Opportunity Program Compliance Form included in Section 00672.4 of this RFB.

00370 – Commercial Bid Form (9 pages)



00370 - Commercial 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.

00370.1 Bid Submitted by	Bidder Response Column
Company Name	
Mailing Address/Number, Street	
Mailing Address/State, Zip Code	
Country	
Taxpayer ID Number (or EIN)	
Bidder's Bid Date	
Bidder's Bid No.	

00370.2 General Bid Parameters
Bidder is providing the information defined by the articles comprising Section 00270, INSTRUCTIONS TO BIDDERS, in the corresponding fields of this Section 00370, COMMERCIAL BID FORM.

00370.2.1 Bidder's Contact Information	Bidder Response Column
Bidder's Representative Name	
Title	
Mailing Address/Number, Street	
Mailing Address/City	
Mailing Address/State, Zip Code	
Delivery Address/Number, Street	
Delivery Address/State, Zip Code	
Country	
Email Address	
Phone Number () - ()	
Mobile Phone Number () - ()	
Fax Number () - ()	

Business Interruption Plan
 Confirm that Bidder maintains a Business Interruption/Disaster Recovery Plan that documents how Bidder will respond to disaster or pandemic to help minimize impact - **Yes/No**
 If Yes, plan should be submitted with RFB.

00370.2.2 Addenda to Request for Bid	Bidder Response Column
Bidder acknowledges receipt and inclusion of the following Addenda to the RFB - Yes/No	
	Received and Incorporated
Addenda Number	Date Issued

00370.3 Bid Pricing Information

00370.3.1 Bid Prices	See Attached Pricing Table(s) [Bidder to List Tables Used]
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00370.4 Supplemental Bid Information
 Bidder provides the following information to supplement the Bidder's bid pricing.

00370.4.1 Company Status	Bidder Response Column
Bidder's company status is: (i.e. partnership, individual owned, joint venture, corporation, etc.)	
in State of	
in Country of	

00370.4.2 Contractor License	Bidder Response Column
Bidder certifies that it is licensed, as required, to engage in the RFB Work scope in the State/Province/Country the RFB Work is to be performed. - Yes/No	
1st License Title	
in State/Province of	
License Number	
2nd License Title	
in State/Province of	
License Number	

00370.4.3 Not Used	
00370.4.4 Bid Validity Duration	Bidder Response Column
Bidder's bid is valid for acceptance by the Purchaser for a period of 180 days from the bid due date. - Yes/No	
If no, Bidder's bid is valid for indicated days from bid due date. - No. Days	
00370.4.5 Firm Non-Escalatable Pricing	Bidder Response Column
All of Bidder's prices herein bid are firm and are non-escalatable. - Yes/No	
If No, explanation is included as an Exception.	
00370.4.6 Taxes	Bidder Response Column
Bidder's prices included herein are in accordance with Article 00571.6 Taxes. - Yes/No	
If No, explanation is included as an Exception.	
00370.4.7 Work at Jobsite	Bidder Response Column
Bidder's source of craft labor to be utilized in the performance of the Work is - Open-Shop/Merit-shop/Union-shop	
If applicable, identify the local union(s) used for hiring craft labor: 1st Local Union Name	
Address/Number, Street	
Address/City, State, Zip Code	
Phone	
Email	
2nd Local Union Name	
Address/Number, Street	
Address/City, State, Zip Code	
Phone	
Email	
Bidder has accounted for all Jobsite existing and controlling conditions and limitations which may affect the Work performance and the Bidder's Bid. - Yes/No If No, explanation is included in Exception.	
Bidder proposes that it will perform all the Work at the Jobsite with its own forces. - Yes/No	
Bidder has indicated proposed sub-subcontracted Work in attached Table 00370.4.7. - Yes/No	
Bidder has provided proposed Small Business/Minority/Disadvantaged Entrepreneur Participation Plan with its bid. - Yes/No	
00370.5 Schedule Compliance	
Bidder agrees to meet the schedule dates indicated in the RFB documents: - Yes/No If No, explanation is included in Exception.	
If No, Bidder has completed and submitted an attached alternative summary level schedule: - Yes/No	
00370.6 Compliance with Request for Bid	
NOTE: A bid based on Bidder's standard terms and conditions will not be considered. The bid must address specific exceptions, if any, to Purchaser's terms and conditions.	
Bidder certifies that its bid complies with all RFB commercial and technical requirements without exception and clarification. - Yes/No	
00370.6.1 Exceptions	Bidder Response Column
Bidder certifies that its bid complies with all RFB commercial and technical requirements except for the following:	
Bid is based on acceptance of all commercial requirements of this RFB. - Yes/No	
If No, all Commercial Exceptions have been accurately defined and identified as "Commercial Exceptions" on the Purchaser provided and Bidder attached Exceptions Form: - Yes/No	
Bid is based on acceptance of all technical requirements of this RFB. - Yes/No	
If No, all Technical Exceptions have been accurately defined and identified as "Technical Exceptions" on the Purchaser provided and Bidder attached Exceptions Form. - Yes/No	
00370.6.2 Clarifications	Bidder Response Column
Bidder certifies that its bid complies with all RFB commercial and technical requirements without clarification. - Yes/No	
If No, all Commercial Clarifications have been accurately defined and identified as "Commercial Clarifications" on the Purchaser provided and Bidder attached Clarification Form. - Yes/No	
If No, all Technical Clarification have been accurately defined and identified as "Technical Clarifications" on the Purchaser provided and Bidder attached Clarification Form. - Yes/No	

00370.7 Bid Attachments	
In addition to this Commercial Bid Form and Tables indicated herein, the Bidder's Bid contains supplemental information and details attached to this bid consisting of the following:	Bidder Response Column
(Attachment 1)	
(Attachment 2)	
(Attachment 3)	
(Attachment 4)	
(Attachment 5) (Add additional lines as needed)	

00370.8 Declarations	
The Bidder declares that it has familiarized itself with the conditions affecting the Work. The Bidder also declares that only the persons or firms interested in the bid as principal or principals are named herein; that no other persons or firms have any interest in this bid or in the Subcontract to be entered into; that this bid is made without connection with any person, company, or party likewise submitting a bid; and that it is in all respects for and in good faith, without collusion or fraud. - Yes/No	
If written notice of acceptance of this bid is delivered to the Bidder within "Bid Validity" days after the date set for receipt of bid, or any time thereafter before the bid validity expires, the Bidder will, within 5 days after receipt of a formal Subcontract for signature, exercise and deliver to Purchaser a signed Subcontract in the form provided by the Purchaser in accordance with the documents provided herein. - Yes/No	

Bidder Authorized Signature:

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					Bidder Response	
Item Number	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Extension Price	
71.0401 Group 1 Relay						
Pipe Replacement						
02530-4.01.A	Locate & Expose Mainline Terminus	Each	17		\$ -	
02530-4.01.B-1.1	8" Polyvinyl Chloride (PVC) Pipe (0'-6' Depth)	Linear Ft	5,769		\$ -	
02530-4.01.B-1.2	8" Polyvinyl Chloride (PVC) Pipe (6.1'-10' Depth)	Linear Ft	7,959		\$ -	
02530-4.01.B-1.3	8" Polyvinyl Chloride (PVC) Pipe (10.1'-14' Depth)	Linear Ft	4,139		\$ -	
02530-4.01.B-1.4	8" Polyvinyl Chloride (PVC) Pipe (14.1'-20' Depth)	Linear Ft	1,175		\$ -	
02530-4.01.C	Service Lateral Removal & Replacement for Pipe Replacement	Each	192		\$ -	
02530-4.01.D	Pavement Backfill for Pipe Replacement	Cubic Yds	25,000		\$ -	
02530-4.01.E	Undercut Backfill	Cubic Yds	1,000		\$ -	
02530-4.01.F	Bypass Pumping	Each	40		\$ -	
02530-4.01.G	Traffic Control	Crew Day	450		\$ -	
02530-4.01.H	Hydroexcavating/Hand Digging	Linear Ft	19,000		\$ -	
Manhole Replacement / Installation						
02531-4.01.B	Precast Manhole Installation	Vertical Ft	100		\$ -	
02531-4.01.C	Pavement Backfill for Manholes	Cubic Yds	40		\$ -	
Manhole Rehabilitation						
02533-4.01.A	Manhole Rehabilitation - Cementitious Coating	Vertical Ft	150		\$ -	
02533-4.01.B-1	Invert & Bench Replacement	Each	11		\$ -	
02533-4.01.D-2	Sewer Manhole Inside Drop Construction (5'-10')	Each	2		\$ -	
Post-Rehabilitation PACP Inspection						
02541-4.01.A	Post Rehab CCTV Inspection For All Diameters	Linear Ft	20,000		\$ -	
Post-Rehabilitation MACP Inspection						
02544-4.01.A	GPS Coordinates of Manhole Cover	Each	33		\$ -	
02544-4.01.C-1	Post Rehab MACP Level 2 Manhole Inspections	Each	33		\$ -	
Site Preparation and Restoration						
02630-4.01.A	Removal & Replacement of Vegetated/Turfed Areas	Square Yd	1,500		\$ -	
Pavement and Incidentals						
02950-4.01.A-1	Asphaltic Concrete Pavement Removal & Replacement	Square Yd	13,000		\$ -	
02950-4.01.A-2	Concrete Pavement Removal & Replacement	Square Yd	3,000		\$ -	
02950-4.01.A-3	Temporary Cold Patch Asphalt Removal & Replacement	Square Yd	1,000		\$ -	
02950-4.01.B	Concrete Sidewalk Removal & Replacement	Square Ft	20,000		\$ -	
02950-4.01.C	Concrete Curb & Gutter Removal & Replacement	Linear Ft	4,000		\$ -	
02950-4.01.D	Gravel Driveway & Gravel Area Removal & Replacement With Crushed Stone	Ton	400		\$ -	
Miscellaneous						
	100% Performance and Payment Bonds	Lot	1		\$ -	
Total Estimated Unit Price Value					\$ -	

Table 00370.6.1 - Exceptions 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)

00370.6.1 Exceptions

The Bidder's specific Exceptions herein itemized and included with the bid represent an exhaustive list of any and all explicit variations or deviations from the requirements of the RFB documents. Bidder confirms that otherwise, it is the intent of Bidder's bid that the Work will be performed in strict accordance with the requirements of the RFB documents.

00370.6.1.1 Commercial Exceptions

Count	Reference Article	Stated Commercial Exception
CE1		
CE2		
CE3		
CE4		
CE5		
CE6		
CE7		
CE8		
CE9		

00370.6.1.2 Technical Exceptions

Count	Reference	Stated Technical Exceptions
TE1		
TE2		
TE3		
TE4		
TE5		
TE6		
TE7		
TE8		
TE9		
TE10		
TE11		
TE12		
TE13		
TE14		
TE15		
TE16		
TE17		
TE18		
TE19		
TE20		

Table 00370.6.2 - Clarifications 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)

00370.6.2 Clarifications

All of Bidder's Clarifications herein itemized and included with the bid **do not** constitute explicit variation or deviation from performance of the Work by the Bidder in strict accordance with the requirements of RFB documents.

00370.6.2.1 Commercial Clarifications

Count	Reference Article	Stated Commercial Clarification
CC1		
CC2		
CC3		
CC4		
CC5		
CC6		
CC7		
CC8		
CC9		

00370.6.2.2 Technical Clarifications

Count	Reference	Stated Technical Clarification
TC1		
TC2		
TC3		
TC4		
TC5		
TC6		
TC7		
TC8		
TC9		
TC10		
TC11		
TC12		
TC13		
TC14		
TC15		
TC16		
TC17		
TC18		
TC19		
TC20		

00370.7 Schedule Compliance

State any exceptions in 00370.6.1.

00370.7.1 Construction Milestone Completion Dates and Applicable Liquidated Damages

Item	Milestone Description	Construction Milestone Completion Date	*LDs Apply?	Bidder Complies? (Yes/No)
1	Completion of all Work as described in the Notice to Proceed	365 days after receiving the Notice to Proceed from Purchaser	Yes	

*LD indicates that completion of the Work after the "Construction Milestone Completion Date" is subject to liquidated damages per applicable Articles of Section 00571.

*Note Subcontractor performance will directly impact future procurements for the SARP10 Program, schedule is critical and must be maintained.

00370.8 Schedule of Submittals							Bidder Agrees? Yes/No
Effective Date: TBD							
The following are post-award Subcontract submittals. This list is not all-inclusive. The RFB documents contain submittal requirements that are not included in this list. It will, however, remain the successful Bidder's responsibility to comply with submittal requirements whether or not the submittal is included in the following list:							
If Bidder does not agree, state an exception in 00370.6.1.							
Item	Reference Section	Submittal Item	Submittal Dates				
			Calendar Days		Event	Due Date	
00370.8.1 Commercial Submittals							
C01	None	Executed Subcontract in the form provided by the Purchaser	5	After	Receipt of Subcontract for Signature		
C02	00571	Payment Estimate Breakdown	10	After	Effective Date and Prior to First Payment with monthly updates		
C03	00571	Security Instruments	10	After	Effective Date		
C04	00572	Lien Waivers and Report of Disadvantaged Business Enterprise Participation Form		With	Each Invoice		
C05	00572	Final Lien Waivers from Subcontractor, Sub-subcontractors, Sub-subcontractors' subcontractors, Report of Disadvantaged Business Enterprise Participation Form		With	Final Invoice		
C06	00571	Final Payment Invoice and Report of Disadvantaged Business Enterprise Participation Form	45	After	Issuance of the Notice Of Final Completion and Acceptance		
C07	00572	Contractor Licenses	14	Before	Mobilization Onsite		
C08	00572	Written Notice and Supporting Documentation, of all Claims	5	After	Occurrence of Event Giving Rise to the Claim		
C09	00572	Insurance Certificates for Purchaser Approval		Prior to	Mobilization		
C10	00572	Initial Issue Subcontractor's Work Execution Schedule	30	After	Effective Date		
C11	00571	Subcontractor Actual Man-hours Expended and Quantities Installed	Weekly	After	Mobilization Onsite		
C12	00575	Subcontractor's Daily Report	Daily	After	Mobilization Onsite		
C13	00575	Signed Daily Reports		Daily	After Mobilization Onsite		
C14	00575	Weekly Coordination Meeting Agenda Input	Weekly	Prior to	Weekly Coordination Meeting		
C15	00575	Subcontractor's Safety, Health and Accident Prevention Program		Prior to	Mobilization Onsite		
C16	00575	Subcontractor's Hazardous Waste Project Health and Safety Plan		Prior to	Mobilization Onsite		
C17	00575	Safety and Health Representative Resume		Prior to	Assignment and Mobilization		
C18	00575	Verification of meeting Hazardous Waste Requirements of 29CFR1910.120	5	Prior to	Mobilization Onsite		
C19	00575	Hazardous Materials Documentation		With	Each Hazmat Shipment		
C20	00575	Safety and Health Records	Monthly	After	Mobilization Onsite		
C21	00575	Evidence that Jobsite Personnel have Passed Drug Testing	10	Prior to	Mobilization Onsite		
C22	Loss Control Manual	Fall Protection Plan	5	Prior to	Starting Work Operations		
C23	Loss Control Manual	Chemical Hazard Communication Plan, as applicable	5	Prior to	Mobilization Onsite		
C24	Loss Control Manual	Substance Abuse Program	5	Prior to	Mobilization Onsite		
C25	00672.3	Certificate of Nondiscrimination for Subcontractor and Sub-subcontractors		With	Bid		
C26	00672.4	Equal Business Opportunity Program Compliance Form for Subcontractor and Sub-subcontractors		With	Bid		
C27	00170.4	Bid Bond		With	Bid		

00571 - Supplementary Terms and Conditions

00571.1 Notices and Correspondence

The parties agree to send all notices arising out of or related to this Subcontract by one of the following methods: (a) personal delivery; (b) certified mail with return receipt; (c) nationally recognized overnight mail or courier service, with delivery receipt requested; or (d) email. The parties may send routine correspondence by email or first class mail, each without confirmation of receipt. The parties agree to address notices and correspondence as indicated in this article. Subcontractor agrees that delivery of a notice or of correspondence by Purchaser to Subcontractor's at the jobsite constitutes personal delivery.

Electronic Technical Correspondence

Addressed to Purchaser:

To: Brad Davis
DavisBJ@bv.com
Cc: Gary Older
OlderGS@bv.com

Addressed to Subcontractor:

To: [[name]]
[[email address]]
Cc: [[name]]
[[email address]]

Non-Electronic Technical Correspondence

Addressed to Purchaser:

Overland Contracting Inc.
845 Crossover Lane, Suite 120
Memphis, TN 38117
Attention: Brad Davis
196548.71.0401

Addressed to Subcontractor:

[[subcontractor entity]]
[[street address]]
[[city, state, zip code]]
Attention: [[name]]
196548.71.0401

Electronic Commercial Correspondence (excluding invoices)

Addressed to Purchaser:

To: Ginny Dorsey
Dorsey@bv.com

Addressed to Subcontractor:

To: [[name]]
[[email address]]
Cc: [[name]]
[[email address]]

Non-Electronic Commercial Correspondence (excluding invoices)

Addressed to Purchaser:

Overland Contracting Inc.
8400 Ward Parkway
Kansas City, MO 64114
Attention: Ginny Dorsey
196548.71.0401

Addressed to Subcontractor:

[[subcontractor entity]]
[[street address]]
[[city, state, zip code]]
Attention: [[name]]
196548.71.0401



Electronic Invoices

Subcontractor will submit invoices via email to sarp10invoices@bv.com. Subcontractor shall utilize the AIA form, available upon request. Invoices will be reviewed, and either approved or returned to Subcontractor for correction. The Black & Veatch Project Manager will forward invoices to Black & Veatch Accounts Payable, once they are approved.

All Subcontractor Invoice Submittals:

To: Overland Contracting Inc.

sarp10invoices@bv.com

Attention: BVAP

196548.71.0401

00571.2 Not Used

00571.3 Payment Terms

The following payment terms shall apply in addition to the corresponding provisions contained in Article 00572.4 Invoicing and Payment.

The Parties will meet each month at an agreed time in order to determine the quantity of materials used and man-hours expended during the invoice period. The Parties will use the field progress measurement system to calculate that month's payment total by adding the Subcontract unit price totals based on actual Work completed.

00571.4 Security Instruments

Subcontractor shall give Purchaser separate performance and payment bonds in the format of AIA Document 312 - 2010 Performance Bond and Payment Bond, each in the amount of the Subcontract Price. Subcontractor shall submit the bonds to Purchaser by the due date specified in the Article titled "Schedule of Submittals and Applicable Liquidated Damages". The bonding company must be licensed to bond in the state in which the Project is located and must be rated "A" or better by A.M. Best and included in the Department of the Treasury's Listing of Approved Sureties (Department Circular 570).

00571.5 Liquidated Damages

00571.5.1 General

Subcontractor's failure to meet the requirements identified in this Article 00571.5 will cause Purchaser to incur harm that will be very difficult to ascertain with certainty. The Parties therefore agree the liquidated damages specified in this Article 00571.5 represent a reasonable estimate of Purchaser's harm and are not intended as a penalty. Subcontractor's obligation to pay liquidated damages for breach of one specified requirement, does not relieve Subcontractor of its obligation to pay liquidated damages for breach of another specified requirement. Subcontractor's payment of liquidated damages for breach of the specified requirement is Purchaser's sole and exclusive remedy with regard to Subcontractor's breach of that requirement, except for any other express remedies stated in the Subcontract. If Purchaser terminates the Subcontract for cause, liquidated damages will cease to accrue after the termination date and Subcontractor's remaining liability will be calculated in accordance with Article 00572.17.

00571.5.2 Not Used

00571.5.3 Construction Milestone Dates

Each construction milestone subject to liquidated damages for late completion is listed in the article titled "Construction Milestone Completion Dates and Applicable Liquidated Damages". If all portions of the Work comprising the construction milestone do not meet the Subcontract requirements on the construction milestone completion date, liquidated damages will accrue for each failure as shown below.

Beginning on the first calendar day after the specified construction milestone completion date for each construction milestone and continuing until the construction milestone is completed, delay liquidated damages will be assessed at the rate of five hundred (\$500) dollars per calendar day.

00571.6 Taxes

Subcontractor shall pay all payroll and other related employment compensation taxes for Subcontractor's employees, federal, state and other taxes which may be assessed on Subcontractor's income from the Project, engineering and business license costs (collectively, the "Subcontractor Taxes"). Subcontractor shall administer and pay all sales, use, gross receipts and excise taxes (collectively, the "Project Taxes"). Subcontract price includes Subcontractor Taxes and all Project Taxes. Purchaser will not be responsible for any additional charges related to tax that were not included as part of the Subcontract Price. Where applicable, Purchaser shall furnish to Subcontractor a certificate complying with state and local governmental laws, regulations and ordinances identifying any components of the Work to be considered exempt from the Project Taxes. Subcontractor shall cooperate with Purchaser to establish appropriate procedures and minimize the amount of such taxes to the extent reasonable and practical. Subcontractor is responsible for all property taxes on the construction equipment; Owner is responsible for property taxes on all other items incorporated into the project. Subcontractor shall notify Purchaser, and Purchaser shall have the right to review prior to Subcontractor's response to such document, of any correspondence with a federal or local taxing authority as it relates to sales and use, gross receipts, or excise taxes.

00572 - General Terms and Conditions

00572.1 Definitions

The terms below have the following definitions when used in this Subcontract:

"Applicable Laws" means all laws, statutes, regulations, codes, rules, treaties, ordinances, judgments, permits, decrees, approvals, interpretations, injunctions, writs, orders, or other legal requirements of a governmental body entitled to exercise any administrative, executive, judicial, legislative, police, regulatory or taxing power and having jurisdiction over the jobsite or performance of the Work.

"Claims" means claims, actions, suits, liabilities, demands, damages, losses, costs, expenses (including reasonable attorneys' fees), impacts to price, impacts to schedule, awards, fines and judgments, of every kind and nature.

"Consent Decree" means the negotiated plan between Owner, Department of Justice, Environmental Protection Agency, Tennessee department of Environment and Conservation, and the Tennessee Clean Water Network that requires Owner to develop and implement plans to improve its wastewater systems.

"Final Completion" means: (a) the Work is complete and complies with the requirements of this Subcontract; and (b) Subcontractor has fulfilled all of its obligations under this Subcontract except obligations that survive completion of the Work.

"Indemnified Parties" means Owner and its officials, Purchaser, Purchaser's engineer, and the parent companies, related companies, affiliated companies, subsidiaries, successors, and assigns of each, including the shareholders, officers, directors, partners, employees, and agents of each of the above firms. "Indemnified Parties" does not include Subcontractor or any Sub-subcontractor.

"Notice to Proceed" means to written notice provided by Purchaser to Subcontractor releasing Subcontractor to proceed with all or part of the Work.

"Owner" means the City of Memphis, Tennessee.

"Program Manager" means Black & Veatch Corporation or Overland Contracting Inc. (OCI).

"Purchaser" means the party so identified in the Subcontract Agreement.

"SARP10 Program Office" 845 Crossover Lane, Suite 120, Memphis, TN 38117.

"Subcontract" means the agreement between Purchaser and Subcontractor consisting of: (a) the Subcontract Agreement; (b) the documents listed in the Subcontract Agreement; (c) written Subcontract revisions; (d) attachments, appendices and exhibits to the Subcontract documents; (e) documents expressly incorporated by reference into the Subcontract; and (e) any requirements that can be reasonably inferred from any of the foregoing.

"Subcontract Agreement" means the Subcontract form executed by Purchaser and Subcontractor.

"Subcontractor" means the party so identified in the Subcontract Agreement.

"Sub-subcontractor" means any party, at any tier, having an agreement with Subcontractor or with a Sub-subcontractor, to perform a portion of the Work.

"Work" means that which Subcontractor is to perform or provide under this Subcontract.

00572.2 Interpretation

00572.2.1 This Subcontract is the complete and final agreement between the parties relating to the Work. All prior or contemporaneous negotiations and agreements relating to the Work are superseded by this Subcontract. Exceptions or terms submitted by Subcontractor in the course of accepting this Subcontract are void.

00572.2.2 Provisions of this Subcontract that contemplate performance or obligations subsequent to completion or termination of the Work or contain waivers or limitations of liability will survive such completion or termination. Termination of the Work will not affect the rights and obligations that arose before termination.

00572.2.3 If any provision of this Subcontract is held to be unenforceable, the remaining provisions of this Subcontract will remain in effect.

00572.3 Subcontractor's Status

Subcontractor is an independent contractor in the performance of the Work. Subcontractor is solely responsible for the means, methods, sequences, procedures, and safety precautions used or adopted by Subcontractor and any Sub-subcontractor in the performance of the Work. Except as provided in Article 00574.2 and 00574.3, Subcontractor has sole authority and responsibility to employ, manage, discharge, and otherwise control its employees.

00572.4 Invoicing and Payment

00572.4.1 Subcontractor shall submit invoices to Purchaser with all documentation required to be submitted with the invoice. Each invoice must be itemized by the Subcontract line number. Each invoice must also clearly show the Subcontract number, the invoice number, the billing period (if applicable), the invoiced amount, retention (if applicable), and the net amount due. The final invoice must contain a copy of Purchaser's notice of Final Completion.

00572.4.2 Subcontractor agrees to provide additional itemization of the Subcontract price as Purchaser reasonably requests. If payment to Subcontractor will be on a time and material basis or a unit price basis, or if Subcontractor files a Claim under Article 00572.13, Subcontractor shall furnish Purchaser complete breakdowns and supporting information in the detail required by Purchaser to verify the accuracy of the invoiced or claimed amounts. Purchaser or Purchaser's designee may audit the aforementioned records at Purchaser's expense.

00572.4.3 Purchaser will withhold five percent retention from all invoices except the final invoice. Payment by Purchaser does not: (a) constitute approval or acceptance of any portion of the Work; (b) waive any of Purchaser's rights; or (c) relieve Subcontractor from responsibility or liability arising out of or related to this Subcontract. Acceptance by Subcontractor of final payment constitutes a release and waiver of all Claims by Subcontractor against Indemnified Parties.

00572.4.4 Purchaser may withhold or set-off amounts due under this Subcontract on account of Claims arising out of or related to Subcontractor's breach or reasonably anticipated breach of this Subcontract.

00572.4.5 Once Work that has undergone specified QA/QC is submitted, reviewed and approved by the Program Manager, the Subcontractor's invoice will be submitted along with the Program Manager's next invoice to the Owner. The Program Manager's invoice is typically submitted during the second week of each month for work performed during the previous month. Typical payment from the Owner to the Program Manager is anticipated to be forty five (45) calendar days upon Owner's acceptance of invoice, and the Program Manager will cause the Purchaser to pay the Service Contractor within two weeks of Program Manager's receipt of payment from the Owner.

00572.5 Schedule

Performance of the Work as scheduled under this Subcontract is of the essence. Subcontractor shall give Purchaser written notice of any delay or anticipated delay within three calendar days after the occurrence of the event giving rise to the delay. Subcontractor's notice must identify the cause of the delay or the anticipated delay and the actions Subcontractor is undertaking to recover from or avoid the delay.

00572.6 Waivers of Lien

As a condition precedent to payment, Subcontractor shall furnish a lien waiver in the form of Article 00672.1 with each invoice except the final invoice. As a condition precedent to payment of the final invoice, Subcontractor shall furnish a lien waiver in the form of Article 00672.2 with the final invoice. If a lien is filed and Subcontractor does not remove or bond around the lien within seven calendar days after receipt of written notice from Purchaser or Owner, Purchaser or Owner may remove the lien. Subcontractor shall reimburse Purchaser or Owner, as applicable, for all costs and expenses incurred by Purchaser or Owner in removing the lien, including reasonable attorneys' fees and court costs.

00572.7 Assignment and Subcontracting

00572.7.1 Subcontractor may not assign all or part of this Subcontract voluntarily, by operation of law, or otherwise, nor may Subcontractor assign any of the money payable under this Subcontract, without obtaining Purchaser's prior written consent.

00572.7.2 Except for the supply of expendable materials and minor components or the supply of a portion of the Work for which a Sub-subcontractor is named in this Subcontract, Subcontractor may not subcontract the Work without first obtaining Purchaser's written consent. In addition, Subcontractor must obtain a safety prequalification for any Sub-subcontractor that will be performing any portion of the Work at the Jobsite, as outlined in Article 00575.9. If Subcontractor subcontracts any portion of the Work, Subcontractor remains responsible for complying with the Subcontract requirements and is liable to Purchaser for the acts and omissions of Sub-subcontractors, including their failure to comply with the requirements of this Subcontract or fulfill the obligations imposed on Subcontractor by this Subcontract, as if the acts and omissions were those of Subcontractor. Purchaser has the right to contact Sub-subcontractors to discuss their progress of the Work.

00572.8 Passage of Title, Risk of Loss, and Delivery

Subcontractor warrants that the Work (excluding Subcontractor-furnished items that are not intended to become a permanent part of the project) will be free of all liens, claims, charges, security interests, encumbrances or defects in title. Title to the Work (excluding Subcontractor-furnished items that are not intended to become a permanent part of the project) will pass to Purchaser upon the earlier of Subcontractor's receipt of payment or delivery of the Work to the jobsite. Subcontractor retains the risk of loss of the Work until Purchaser issues the notice of Final Completion. The terms of delivery have the meanings assigned them in the 2010 edition of the Incoterms published by the International Chamber of Commerce, except as modified in this Subcontract.

00572.9 Final Completion

Subcontractor shall notify Purchaser in writing when Subcontractor believes the Work meets the requirements for Final Completion. Purchaser will inspect the Work within ten calendar days after Purchaser's receipt of Subcontractor's notice. If Purchaser identifies any defective or non-conforming Work, Subcontractor shall correct that Work in accordance with Article 00572.10. Purchaser will issue a notice that Final Completion has been achieved when the Work meets the requirements for Final Completion. Purchaser's issuance of the notice of Final Completion does not relieve Subcontractor of its obligations under this Subcontract.

00572.10 Warranty

00572.10.1 Subcontractor warrants to Purchaser and Owner that the Work: (a) will be new when delivered to the jobsite; (b) will be free from defects in design, material, and workmanship; (c) will comply with Applicable Laws; (d) will comply with the requirements of this Subcontract; and (e) will be fit for the purposes specified. Subcontractor also warrants to Purchaser and Owner that elements of the Work for which this Subcontract does not establish express standards of quality and fitness will comply with good industry practices for the specific application. Subcontractor agrees that Owner may directly enforce the warranties of this Article 00572.10.1.

00572.10.2 Subcontractor shall correct any breach of this warranty within five calendar days after Purchaser gives Subcontractor written notice of the breach. The cost of warranty work and removal or replacement of other work will be at Subcontractor's expense. Subcontractor shall work diligently and without interruption to correct the breach. In the case of emergency where, in the reasonable judgment of Purchaser, delay could result in serious loss or damage to persons or property, Purchaser may correct the defect or nonconformity at Subcontractor's expense.

00572.10.3 The warranty for the Work extends until one year after Final Completion. The warranty applies to all repairs and replacements to the same extent the warranty applies to the original Work. The warranty period for repaired Work or replacements will be extended for a period of one year after the repair or replacement is complete or until the original warranty period expires, whichever occurs later.

00572.10.4 This project is being implemented to provide services to the City of Memphis, through the City's Program Manager, for implementation of the Consent Decree executed on September 20, 2012, civil action number 2:10-cv-02083-SHM-dkv (CD). The City negotiated the Consent Decree with the United States Environmental Protection Agency and the Tennessee Department of Environment and Conservation to implement an assessment and rehabilitation program of the City's wastewater collection and transmission system. Per section II, paragraph 5 of the Consent Decree all contractors performing work required by the Consent Decree must be notified by the City that a copy of the Consent Decree is posted on the City's webpage. This article provides the required notification. The Consent Decree may be reviewed by accessing the City's webpage at:

<http://www.memphistn.gov/Government/PublicWorks/ConsentDecree.aspx>

This page provides a link to the Consent Decree and associated documents. An explanation of each document is also provided. Click on any link to access. Alternatively, the Consent Decree is available at:

<http://www.sarp10.com/consent-decree>

00572.10.5 Subcontractor acknowledges that Owner's failure to achieve 100 percent compliance with the Consent Decree requirements may result in the imposition of penalties, costs, and other damages imposed against the Owner and Purchaser. To the extent caused by Subcontractor's failure to perform the Work in accordance with this Subcontract or to the extent caused by the negligence of Subcontractor or any Sub-subcontractor, Subcontractor agrees to pay penalties and costs incurred by Owner and Purchaser under the Consent Decree.

00572.11 Compliance with Laws

00572.11.1 Subcontractor shall comply with all Applicable Laws in effect during its performance of Work, including but not limited to the City of Memphis Prevailing Wage Ordinance, the Fair Labor Standards Act, Occupational Safety and Health Administration (OSHA), and the Americans with Disabilities Act (ADA). Subcontractor shall obtain all licenses, permits, and inspections applicable to the Work except for licenses, permits, and inspections identified in this Subcontract as Purchaser's or Owner's responsibility. Subcontractor shall also comply with the USA's Foreign Corrupt Practices Act.

00572.11.2 Purchaser and Subcontractor shall abide by the requirements of 41 CFR §§ 60-1.4(a), 60-4.3(a), 60-300.5(a) and 60-741.5(a). These regulations prohibit discrimination against qualified individuals based on their status as protected veterans or individuals with disabilities, and prohibit discrimination against all individuals based on their race, color, religion, sex, or national origin. Moreover, these regulations require that covered prime contractors and subcontractors take affirmative action to employ and advance in employment individuals without regard to race, color, religion, sex, national origin, protected veteran status or disability.

00572.11.3 Neither party shall engage in any conduct or activity in the performance of this Subcontract that constitutes a conflict of interest under Applicable Laws.

00572.11.4 Not Used

00572.12 Business Practices

00572.12.1 Subcontractor shall uphold the good name and reputation of Purchaser and shall not take any action which is intended to or which causes damage to or discredits Purchaser. Subcontractor shall not:

- (a) Offer to give or agree to give any director, officer, employee or agent of any potential client a gift or consideration of any kind as an inducement or reward for: (i) doing or declining to do, or for having done or declined to do, any action in relation to obtaining or executing any contract or (ii) for showing or declining to show any favor or disfavor to any person in relation to any possible project; or
- (b) Induce or attempt to induce any officer, servant, or agent of any private or public body to depart from his or her duties to his or her client or, in the case of any officer, servant or agent of a public body, his or her duties to the applicable public body, the applicable body politic, or both.

00572.12.2 Subcontractor shall not engage or employ, on a full, part-time or any other basis during the term of the Prime Agreement and for a period of one year after the termination or expiration, any professional or technical personnel who are or have been at any time during the term of the Prime Agreement in the employ of Owner with the explicit written consent of Owner.

00572.12.3 Nondiscrimination:

- (a) Subcontractor certifies and agrees that all persons employed by it, its affiliates, subsidiaries, or holding companies are and will be treated equally without regard to or because of race, creed, color, religion, ancestry, national origin, sexual orientation, sex, age, condition of physical or mental handicap, marital status, or political affiliation, in compliance with all Applicable Laws. Subcontractor shall certify, at Purchaser's request that it is in full compliance with all applicable EEO rules and laws.
- (b) Purchaser and Owner reserve the right to investigate any claims of illegal discrimination by Subcontractor and in the event a finding of discrimination is made and upon written notification thereof, Subcontractor shall take all necessary steps to cure and rectify such action to the reasonable satisfaction of Purchaser and Owner. Subcontractor's failure or refusal to do so shall be cause for termination of this Subcontract in accordance with the terms of this Subcontract.

00572.12.4 Purchaser is an affirmative action employer. Accordingly, the parties hereby incorporate by reference the requirements of Executive Order 11246, as amended, and the applicable regulations contained in 41 C.F.R. Parts 60-1 through 60-60; 29 U.S.C. Section 793 and the applicable regulations contained in 41 C.F.R. Part 60-741; 38 U.S.C. Section 4212 and the applicable regulations contained in 41 C.F.R. Part 60-250 and/or 60-300; and 29 C.F.R. Part 471, Appendix A to Subpart A.

00572.12.5 Subcontractor represents and warrants that it has a code of conduct or other set of compliance requirements that is at least as broad as Purchaser's Code of Conduct for Global Business Relationships (hereinafter "Code of Conduct"), or that it will comply with Purchaser's Code of Conduct in all dealings that affect Purchaser. The Code of Conduct and its amendments are expressly incorporated herein by reference and full text of the same can be found at:

<https://www.bv.com/sites/default/files/reports-studies/Code-of-Conduct-for-Global-Business-Relationships>

00572.13 Claims

Subcontractor must give written notice, with appropriate supporting documentation, of all Claims for extra compensation or additional time for performance of the Work within three calendar days after occurrence of the event giving rise to the Claim. Subcontractor acknowledges that failure of Subcontractor to give Purchaser notice and appropriate supporting documentation within the required time frame constitutes a waiver of all Claims arising out of or related to the event.

00572.14 Subcontract Revisions and Work Authorizations

00572.14.1 Purchaser may make additions, deletions, reductions in scope, or other changes to the Work. If a proposed change will cause a material increase or decrease in Subcontractor's cost or time for performance, Subcontractor shall so notify Purchaser in writing, accompanied by supporting documentation, within three calendar days after Subcontractor's receipt of Purchaser's notice of change. If Purchaser agrees with Subcontractor's notice, the parties will negotiate an equitable adjustment to the Subcontract price, to the schedule, or both, in accordance with the Subcontractor's fee for overhead and profit as listed in Article 00572.14.2 below. These adjustments will be reflected in a written Subcontract revision.

00572.14.2 The Subcontractor's fee for overhead and profit shall be determined as follows:

- For costs incurred for labor the maximum fee shall be fifteen percent to the Subcontractor or the Sub-subcontractor performing the Work.
- For costs incurred for materials and equipment the maximum fee shall be five percent to the Subcontractor or the Sub-subcontractor providing the materials and equipment. If applicable, the Subcontractor may receive an additional fee of five percent on labor or materials and equipment performed or provided by a Sub-subcontractor, as long as the total combined fee does not exceed fifteen percent.

00572.14.3 A written Subcontract revision is required before Subcontractor is entitled to payment for the Work performed under the Work authorization. Subcontractor will bear the expense of performing any change not supported by a written Work authorization or written Subcontract revision. Purchaser will not be liable to Subcontractor for Claims arising from a decrease in the Work. No change is effective without a written Work authorization or a written Subcontract revision issued by Purchaser.

00572.15 Non-Disclosure

Subcontractor shall not make any news releases, authorize or participate in any interview concerning this Subcontract, or issue other advertising pertaining to the project or this Subcontract without the prior written approval of Purchaser. Subcontractor shall treat all information provided by Purchaser as confidential and only disclose such information as necessary to perform the Work, and will require the employees, agents, and Subcontractors who need to know to adhere to the terms of this provision.

00572.16 Suspension of Work

Purchaser may, at any time and in its sole discretion, suspend performance of all or part of the Work by written notice to Subcontractor. If the suspension is unrelated to Subcontractor's failure to comply with this Subcontract, Purchaser will adjust the schedule to reflect the reasonable delay due to the suspension and will reimburse Subcontractor for the reasonable and direct additional costs incurred by Subcontractor due solely to the suspension. Subcontractor shall promptly resume performance of all or part of the suspended Work in accordance with Purchaser's written authorization to resume the Work.

00572.17 Termination for Cause

If Subcontractor defaults in any obligation under this Subcontract and does not cure the default within ten calendar days after receipt of Purchaser's written notice identifying the default, Purchaser may terminate all or part of the Work.

00572.18 Termination Without Cause

Purchaser may, at any time and in its sole discretion, terminate all or part of the Work. Subject to Subcontractor's compliance with this Subcontract, Subcontractor will recover from Purchaser, as the complete and final settlement for the terminated Work and all related Claims, a sum equal to Subcontractor's direct cost for the terminated Work satisfactorily performed as of the effective date of termination, plus an allowance for reasonable overhead and profit on such direct cost.

00572.19 Purchaser's Remedies

If Subcontractor by its action or inaction indicates that it is unable or unwilling to proceed with the Work in accordance with the schedule or if Purchaser intends to perform any corrective work under Article 00572.10, Purchaser may, upon written notice to Subcontractor, accomplish the Work in question by the most expeditious means available and back-charge Subcontractor for the costs incurred. Subcontractor shall pay all direct costs incurred by Purchaser under this Article 00572.19, including engineering (charged at \$100/hour), labor, material, transportation, insurance, subcontracts, tools, and equipment. Subcontractor shall also pay twenty-five percent of the direct costs incurred by Purchaser under this Article 00572.19 for Purchaser's overhead and general and administrative costs.

00572.20 Indemnity

00572.20.1 SUBCONTRACTOR AGREES TO DEFEND, INDEMNIFY, AND HOLD HARMLESS THE INDEMNIFIED PARTIES AGAINST ANY CLAIM, LOSS, DAMAGE, EXPENSE, OR LIABILITY (INCLUDING ATTORNEYS' FEES AND COSTS OF ANY SUCCESSFUL ENFORCEMENT OF THIS INDEMNITY ARTICLE) ARISING OUT OF THE PERFORMANCE OR NON-PERFORMANCE BY SUBCONTRACTOR OR ITS SUB-SUBCONTRACTORS, OR THEIR OFFICERS, EMPLOYEES, OR AGENTS.

00572.20.2 Providing that Purchaser is not in breach of its obligation to make payments to Subcontractor for the Work, Subcontractor shall indemnify, defend and hold harmless the Indemnified Parties from any claims or mechanic's liens brought against the Indemnified Parties or against the Project as a result of the failure of Subcontractor, or those for whose acts it is responsible, to pay for any services, materials, labor, equipment, taxes or other items or obligations furnished or incurred for or in connection with the Work. Within three (3) days of receiving written notice from Purchaser that such a claim or mechanic's lien has been filed, Subcontractor shall commence to take the steps necessary to discharge said claim or lien, including, if necessary, the furnishing of a mechanic's lien bond. If Subcontractor fails to do so, Purchaser will have the right to discharge the claim or lien and hold Subcontractor liable for costs and expenses incurred, including attorneys' fees.

00572.20.3 Subcontractor will immediately notify Purchaser of any claim or suit made or filed against Subcontractor or its Sub-subcontractors in which Purchaser or Owner is named as a co-defendant.

00572.21 Insurance Requirements

00572.21.1 Subcontractor shall, at its sole cost, maintain insurance as required by this Subcontract and shall impose the obligations of this Article 00572.21.1 on all Sub-subcontractors. Subcontractor shall give Purchaser ACORD insurance certificates evidencing the required coverage by the due date identified in article titled "Schedule of Submittals" and as Purchaser may request from time to time. Subcontractor shall ensure the policies:

- (a) Contain a provision or endorsement that the coverage will not be cancelled, materially changed, or renewal refused unless the insurer gives at least thirty calendar days prior written notice to Purchaser.
- (b) Remain in effect through the warranty period if coverage is occurrence-based and remain in effect at least one year after expiration of the warranty period if coverage is claims-based.
- (c) Are primary with respect to insurance covering Indemnified Parties as additional insureds. All insurance carried by Indemnified Parties will be excess insurance.
- (d) Contain a waiver of all rights of subrogation by the insurance carriers in favor of Indemnified Parties.
- (e) Comply with all Applicable Laws of the jurisdiction in which any part of the Work is to be performed including, but not limited to, admitted and compulsory coverage.
- (f) Are rated "A-" or better by A.M. Best's "Insurance Guide and Ratings."

00572.21.2 Subcontractor shall maintain broad form commercial general liability insurance protecting Subcontractor, and Indemnified Parties as additional insureds (using endorsements CG 20 10 and CG 20 37 or their equivalent), against claims arising out of bodily injury or property damage arising from the Work. The policy must include a cross-liability or severability of interest clause, a per project aggregate endorsement, and coverage for personal injury liability, contractual liability, products and completed operations (covering lawsuits brought in the USA and the country of the jobsite), explosion, building collapse, and damage to underground property. The policy must include coverage for riggers liability if applicable to the Work. Subcontractor shall maintain policy limits of at least one million dollars for each occurrence.

00572.21.3 Subcontractor shall maintain worker's compensation insurance protecting Subcontractor against all claims under applicable worker's compensation laws, including, but not limited to, the United States Longshoremen's and Harbor Worker's Act and the Jones Act. If Subcontractor is required to maintain worker's compensation insurance in the USA, the worker's compensation insurance must contain an "all states" or "other states" endorsement. For Work performed in the USA, Subcontractor shall also maintain employer's liability insurance protecting Subcontractor against claims for injury, disease or death of employees which are not covered by the worker's compensation insurance. Subcontractor shall maintain worker's compensation policy limits as required by statute and, if applicable to this Subcontract, employer's liability policy limits of at least one million dollars for each occurrence.

00572.21.4 Subcontractor shall maintain comprehensive automobile liability insurance protecting Subcontractor, and Indemnified Parties as additional insureds, against all claims for injuries to members of the public and damage to property of others arising from the use of motor vehicles, whether owned, non-owned, or hired. Subcontractor shall maintain policy limits of at least one million dollars for each occurrence.

00572.21.5 Subcontractor shall maintain umbrella liability insurance that follows the form of the commercial general liability insurance, the employer's liability insurance and the automobile liability insurance. The umbrella liability insurance must protect Subcontractor, and Indemnified Parties as additional insureds, against claims in excess of the limits of the commercial general liability insurance, the employer's liability insurance, and the automobile liability insurance. Subcontractor shall maintain policy limits of at least four million dollars for each occurrence.

00572.21.6 Subcontractor is responsible for maintaining any and all property insurance on their own equipment and shall require all Sub-subcontractors to do likewise.

00572.22 Audit

Purchaser reserves the right to audit the records of Subcontractor. Accordingly, Subcontractor shall make and keep as the same accrue, full and complete records and books of accounts of revenue and

income, and costs and expenses that specifically relate to performance under this Subcontract. Records and books of account, together with any or all memoranda pertaining thereto that may be kept, maintained, or possessed by Subcontractor, shall be opened to examination during regular business hours by Purchaser or its representatives for the purposes of inspecting, auditing, verifying, or copying the same or making extracts therefrom. Subcontractor shall make and keep said records and books of account for a period of seven (7) years after the completion of the contract obligations of the final payment under the Subcontract, whichever is later.

00572.23 Governing Law and Disputes

Claims and disputes arising out of or relating to this Subcontract will be governed by the law of the State of Missouri, USA, excluding provisions that would apply the law of another jurisdiction. Pending resolution of any claim or dispute and without prejudice to Subcontractor's rights, Subcontractor shall continue to perform as directed by Purchaser.

00572.24 Hazardous Conditions

00572.24.1 Subcontractor is not responsible for any Hazardous Conditions encountered in the performance of the Work at the Jobsite. Upon encountering any Hazardous Conditions, Subcontractor will stop services immediately in the affected area and duly notify Purchaser. For purposes of this Subcontract, Hazardous Conditions is defined as any materials, wastes, substances and chemicals deemed to be hazardous under any Applicable Law or the handling, storage, remediation, or disposal of which are regulated by Applicable Laws and applies to any hazardous or toxic substance, material, or condition present at the locations in which the Work is performed which was not brought onto such site or sites by Service Contractor for the exclusive benefit of Subcontractor.

00572.24.2 Subcontractor shall be obligated to resume the Work at the affected areas only after Owner's expert provides it with written certification that (i) the Hazardous Conditions have been removed or rendered harmless and (ii) all necessary approvals have been obtained from all Governmental Authority having jurisdiction over the location.

00572.24.3 Subcontractor will be entitled, to an adjustment in its compensation and all times for performance of the Work to the extent Subcontractor cost or time of performance have been adversely impacted by the presence of Hazardous Conditions, subject to submission of appropriate documentation by Subcontractor and Subcontractor's duty to mitigate.

00572.25 Force Majeure

00572.25.1 If Subcontractor is delayed in the performance of the Work due to acts, omissions, conditions, events, or circumstances beyond its control, the times for performance shall be reasonably extended by on a not less than day for day basis. By way of example and not of limitation, events that will entitle Subcontractor to an extension of the times for performance include without limitation acts or omissions of Owner or Purchaser, or anyone under Owner's control (including separate contractors), Hazardous Conditions, wars, terrorism, civil unrest, actions and inactions of delay of Governmental Authorities, floods, labor disputes and unrest, unusual delay in transportation, epidemics, earthquakes, tsunami, adverse weather conditions, and acts of God.

00572.25.2 In addition to Subcontractor's right to a time extension for those events set forth above, Subcontractor shall also be entitled to an appropriate increase in the compensation due to the impacts or delays arising from such events. Subcontractor will file all claims in accordance with Article 00572.13.

00574 – Jobsite Operations Terms and Conditions

00574.1 Subcontractor Scope of Work

Except as expressly provided in this Subcontract, Subcontractor shall furnish all materials, tools, equipment, vehicles, supplies, services, labor and supervision required to perform the Work. Unless otherwise stated in this Subcontract, the Work includes unloading, off transport, hauling, receiving, storing, maintaining, protecting, erecting, installing, cleaning, adjusting, and all other work required to make the Work ready for use.

00574.2 Safety Requirements

00574.2.1 Subcontractor shall conduct all operations under this Subcontract in a manner that avoids the risk of bodily harm and damage to property. At a minimum, Subcontractor shall comply with the requirements of this Article 00574.2, Section 00575, the Loss Control Manual, and Owner's safety requirements. Subcontractor's failure to comply with the requirements of this Article 00574.2, Section 00575, the Loss Control Manual, or Owner's safety requirements constitutes a material breach of this Subcontract.

00574.2.2 When at the jobsite, Subcontractor shall continuously inspect all Work and conduct surveys of all Work areas to identify any unsafe condition and shall immediately take adequate precautions against any unsafe condition identified. Subcontractor is solely and exclusively responsible for the discovery and correction of such conditions. Subcontractor agrees that nothing contained in this Article 00574.2, Section 00575, the Loss Control Manual, or Owner's safety requirements shifts responsibility for bodily harm or damage to property sustained resulting from violation of those provisions from Subcontractor to Owner or Purchaser. Subcontractor remains solely and exclusively responsible for compliance with all safety requirements.

00574.2.3 Subcontractor shall immediately correct any unsafe condition identified by Purchaser. If, in Purchaser's sole discretion, Subcontractor has not taken sufficient precautions for the avoidance of bodily harm and damage to property, or in response to Purchaser's identification of an unsafe condition, Purchaser may stop the Work at Subcontractor's expense or implement suitable precautions at Subcontractor's expense, or both. Purchaser's right to stop the Work and to implement suitable precautions does not impose on Purchaser a duty to exercise those rights and does not relieve Subcontractor of responsibility for damage resulting from violation of this Article 00574.2, Section 00575, the Loss Control Manual, or Owner's safety requirements.

00574.2.4 Compliance with this Article 00574.2, Section 00575, the Loss Control Manual, and Owner's safety requirements is the minimum standard required of Subcontractor. Subcontractor is responsible for examining all Work-related requirements and determining whether additional or more stringent health and safety provisions are required or appropriate for the Work. Subcontractor shall notify Purchaser promptly in writing if a charge of noncompliance with this Article 00574.2, Section 00575, the Loss Control Manual or Owner's safety requirements has been filed against Subcontractor or a Sub-subcontractor in connection with the performance of the Work.

00574.3 Labor

Subcontractor shall designate a supervisor at the jobsite who has the authority to act on behalf of and to bind Subcontractor in all matters relating to or arising out of this Subcontract. The supervisor must be fluent in English. Subcontractor agrees to replace, at no cost to Purchaser, any Sub-subcontractor or any personnel of Subcontractor or Sub-subcontractor who Purchaser reasonably requests be replaced.

00574.4 Protection and Restoration of Property

Typical Work days consist of a Monday through Friday schedule with a 7am start at the earliest, and a 6pm finish at the latest. Saturday Work may be permitted as necessary. Sunday Work will not be permitted, unless deemed by the Program Manager to be of a critical or emergency nature. No Work is



permitted on Memorial Day, Independence Day, Labor Day, Thanksgiving Thursday and Friday, Christmas Eve, Christmas and New Year's Day, during the Subcontract duration.

For weekend operations, requests must be submitted in writing by Thursdays at NOON.

In cases where the Program Manager does not have the resources available to observe Saturday, Sunday, and/or night work, the request will be denied and no time extension or impact will be considered.

Night Work, when deemed necessary by the Program Manager; will be permitted as requested (48-hour advance notice required). Noise attenuated equipment for night work is required when working in residential neighborhoods.

00574.5 Protection and Restoration of Property

00574.5.1 Subcontractor shall, at its expense, protect the Work, the environment, and all other property from hazards arising out of or relating to the Work and from natural elements. Subcontractor shall, at its expense, promptly repair or remove and replace any damage or loss and, to the extent practicable, restore property affected by the Work to its original condition, as determined by Purchaser. Subcontractor is solely responsible for protection of the Work until Final Completion.

00574.5.2 At the completion of the Work, Subcontractor shall remove all Subcontractor-furnished items that are not intended to become a permanent part of the project from the jobsite and shall remove and deposit in Subcontractor-furnished waste facilities all scrap, trash, waste materials, and debris resulting from the Work. Subcontractor shall thoroughly remove all accumulations of dust, scraps, waste, oil, grease, weld spatter, insulation, paint, and other foreign substances resulting from performance of the Work and shall restore all surfaces affected by those substances.

00575 - Safety, Health and Accident Prevention

00575.1 Project Safety and Health Program

Purchaser will implement and coordinate the overall Project Safety and Health Program as defined in the Loss Control Manual which is available for inspection at <http://www.sarp10.com/facts/>.

00575.2 Safety, Health, and Accident Prevention Program

00575.2.1 Subcontractor shall implement and maintain a written Safety, Health and Accident Prevention Program specifically applicable to the Work. Subcontractor's Safety, Health and Accident Prevention Program must meet the requirements of Applicable Laws and adhere to the Project Safety and Health Program, if implemented by Purchaser. Subcontractor shall submit Subcontractor's Safety, Health and Accident Prevention Program for Purchaser's review at least thirty calendar days before starting Work at the jobsite. Purchaser's review does not relieve Subcontractor of Subcontractor's sole responsibility for safety and health in relation to the Work, nor does Purchaser's review limit Subcontractor's obligation to undertake any action necessary to establish and maintain safe working conditions relating to the Work at the jobsite.

00575.2.2 Purchaser may monitor Subcontractor's safety and health performance and may require changes to Subcontractor's Safety, Health and Accident Prevention Program during the performance of the Work. Purchaser's monitoring and requirement of changes does not relieve Subcontractor of Subcontractor's sole responsibility for safety and health in relation to the Work, nor does Purchaser's monitoring and requirement of changes limit Subcontractor's obligation to undertake any action necessary to establish and maintain safe working conditions relating to the Work at the jobsite.

00575.3 Hazardous Waste Project Health and Safety Plan

00575.3.1 Subcontractor understands that the Work involves hazardous substances or hazardous wastes. Subcontractor shall comply with all Applicable Laws, Owner's facility rules and regulations, and applicable guidance documents. Subcontractor shall prepare and implement a jobsite-specific Hazardous Waste Project Health and Safety Plan, based on Subcontractor's Safety, Health and Accident Prevention Program and all written programs required by Applicable Laws. Subcontractor is responsible for the completeness and accuracy of Subcontractor's Hazardous Waste Project Health and Safety Plan. Subcontractor shall submit Subcontractor's Hazardous Waste Project Health and Safety Plan to Purchaser at least thirty calendar days before starting Work at the jobsite and shall maintain a copy at the jobsite for review by Purchaser, Owner, and regulatory personnel.

00575.3.2 Before starting Work at the jobsite, Subcontractor shall submit written verification that:

- (a) personnel assigned to the Work have received forty hour health and safety training that meets the requirements of 29 CFR 1910.120(e) or 1926.65(e);
- (b) the assigned field supervisor has completed eight hours of supervisor training that meets the requirements of 29 CFR 1910.120(e)(4) or 1926.65(e)(4); and
- (c) personnel assigned to the Work are participating in a medical surveillance program that meets the requirements of 29 CFR 1910.120(f) or 1926.65(f).

00575.4 Protective Clothing, Equipment and Instrumentation

Subcontractor agrees to furnish special protective clothing, respiratory protective equipment, and monitoring instrumentation as required by Applicable Laws, the project's safety-related plans and programs, and Purchaser's and Owner's rules and regulations. Subcontractor shall ensure that personnel performing Work at the jobsite properly use the clothing, equipment, and instrumentation. Subcontractor shall furnish and maintain all safety equipment, including but not limited to, barriers, signs, warning lights, and guards necessary for adequate protection of persons and property.



00575.5 Safety and Health Representative

The Subcontractor shall identify a qualified person to be its representative for Environmental, Safety, Health & Security matter and make this person available as needed and requested by the Purchaser. The representative must have authority to correct unsafe conditions and to stop Work in the area of an unsafe condition. In addition, the representative shall routinely visit the jobsite.

00575.6 Safety and Health Goal

Subcontractor shall endeavor to attain the project's safety goal of zero injuries. Subcontractor shall maintain accurate accident and injury reports and shall furnish Purchaser a monthly summary of injuries and man-hours lost due to injuries by the third of each month. Subcontractor accident rates must be calculated monthly in accordance with the Bureau of Labor Statistics incident rate, frequency rate, and days away from work rate methods. If Subcontractor or Sub-subcontractor accident rates exceed the project's safety goal, Subcontractor shall take immediate corrective action, which may include, but is not limited to:

- (a) Submittal of a written corrective action plan to Purchaser by Service Contractor;
- (b) Additions or modifications to Service Contractor's Safety, Health and Accident Prevention Program;
- (c) Removal from the jobsite of any Service Contractor or Subcontractor personnel not implementing or following the necessary safety and health measures; and
- (d) Increasing the amount of Service Contractor safety and health training.

00575.7 Drug Prevention Program

As part of the Work, Subcontractor shall assist Purchaser in administering the project requirements for a drug detection and prevention program. Subcontractor agrees that all costs for drug testing and alcohol testing are included in the Subcontract price. Subcontractor must provide evidence to Purchaser that all personnel assigned to the Work at the jobsite have passed the drug test within three calendar days of completion of the test. The drug detection and prevention program will include, but will not be limited to, the following: (a) a pre-jobsite assignment test; and (b) post-jobsite assignment tests, such as reasonable suspicion tests, post-accident tests, and unannounced random drug tests of ten percent of the workforce on a monthly basis.

00575.8 Fall Protection

The OSHA Fall Protection Standard 29 CFR 1926 Subpart M shall be strictly adhered to by the Subcontractor. Fall protection is required for all of Subcontractor's Work operations one hundred percent of the time, whether climbing, traveling, or working. NO WORK OPERATION is exempt from the six (6) foot fall protection requirement.

Prior to starting work operations requiring fall protection, Subcontractor shall submit to Purchaser a fall protection plan. The fall protection plan shall include, but not be limited to, the following:

- Name of qualified person in charge of operation.
- Description of work operation.
- List of fall exposures.
- Description of fall protection methods used to eliminate fall exposures.
- Training and enforcement methods used to ensure employee compliance with the plan.

Fall protection body harnesses, lanyards, and lifelines shall be used in accordance with OSHA Standard 1926 Subpart 502D, with the following exceptions:



- Full body harnesses shall be used in lieu of safety belts.
- Only lanyards with shock absorbers and locking type snap hooks shall be used.
- At least two lanyards shall be used to provide one hundred percent fall protection when moving around obstructions, connection points, or other similar items.

Fall protection guardrail systems shall comply with OSHA Standard 1926 Subpart 502(b) except manila, plastic, or synthetic rope shall not be used as guardrails.

00575.9 Sub-subcontractor Safety Prequalification

Prior to any Sub-subcontractor performing Work on the Jobsite the Sub-subcontractor must obtain a Sub-subcontractor safety prequalification from Purchaser. In order to obtain the safety prequalification, Subcontractor or its Sub-subcontractor shall submit to Purchaser evidence that the Sub-subcontract has an Experience Modification Rating or equivalent rating of 1.0 or less and that incident rates (Recordable Incident Rate, Loss Time Incident Rate, and Days Away/Restricted or Job Transfer rate) are below the national average during the last three years. In addition, Subcontractor or Sub-subcontractor must submit sufficient information to allow Purchaser to evaluate any Occupational Safety and Health Administration (OSHA) violations received by Sub-subcontractor within the last three years and any other documentation Purchaser may reasonably require. Purchaser's safety manager will review the submission and provide a safety prequalification if Purchaser, in its sole discretion, determines the Sub-subcontractor meets Purchaser's safety requirements. Subcontractor or its Sub-subcontractor must submit the requirements prior to Sub-subcontractor first mobilizing to the Jobsite.

00575.10 Confined Spaces

All employees entering confined spaces and all attendants for such entries including supervisors shall receive confined space entry training and emergency rescue training at a minimum of once per year.

00575.11 Third Party Medical Triage

Subcontractor shall retain the services of a third party medical triage company that meets the following criteria:

- Must employ medical doctors that understand occupational medicine and the rules set forth by OSHA for first aid treatment of work-related injuries and illnesses
- Ability to provide virtual real-time consultation with medical doctors for injury triage, with injured worker
- Available 24 hours a day, 7 days per week, and 365 days per year

Subcontractor shall require retention of identical services for each subcontractor, with the further requirement that each lower tier subcontractor shall include identical requirements in any lower tier subcontracts, which might in turn be made.

00672 - General Conditions Attachments

00672.1 Partial Waiver and Release of Lien Rights

**AFFIDAVIT AND PARTIAL WAIVER OF CLAIMS AND LIENS
AND RELEASE OF RIGHTS FOR SUBCONTRACTORS**

The undersigned, who is the _____ (designate title) of _____ which is the _____ (designate whether subcontractor, supplier or otherwise) for the _____ (designate the type of work, supplies or services rendered) on the improvements constructed on the premises hereafter identified, declares that his contract with _____ (General Contractor) is in the total amount of \$ _____, which includes extras and all change orders to the date hereof.

The undersigned further states that as of _____ (date) the total value of work completed and material stored is \$ _____. Of this amount \$ _____ has been received (the receipt and sufficiency of which is hereby acknowledged by the undersigned including \$ _____ in payment of Payment Application or Invoice Number _____). A total of \$ _____ is being held as retainage.

In consideration of the amounts and sums received, the undersigned does hereby waive and release to the **City of Memphis (Owner)** and to _____ (General Contractor) any and all claims and liens and rights to liens upon the premises described below and upon improvements now thereon, and upon the monies or other considerations (due as of the date of the aforesaid payment application or invoices from the **City of Memphis (Owner)** or _____ (General Contractor) or from any other person, firm or corporation), said claims and liens and rights to liens being on account of labor, services, materials, fixtures or apparatus heretofore furnished by or at the request of the undersigned. The premises as to which said claims and liens and rights to liens are hereby released are identified as follows:

Project Name: Group 1 Relay

Address of Project:

City: _____ **County:** Shelby **State:** TN **Zip Code:** _____

The undersigned further represents and warrants that he is duly authorized and empowered to sign and execute this waiver on his own behalf and on behalf of the company or business for which he is signing; that he has properly performed all work and furnished all the materials of the specified quality per plans and specifications and in a good and workmanlike manner through the date of said payment application or invoice; that he has paid for all the labor, materials, equipment, and services that he has used or supplied to the above premises through the date of said payment application or invoice; that he has no other outstanding and unpaid payment applications, invoices, retentions, holdbacks, chargebacks or unbilled work or materials against _____ (General Contractor) as of the date of the aforementioned payment application; and that any materials which have been supplied or incorporated into the above premises were either taken from his fully-paid or open stock or were fully paid for and supplied as stated on the payment application or invoice.

The undersigned further agrees to reimburse and does hold harmless and fully indemnify the **City of Memphis (Owner)** and _____ (General Contractor) for any losses or expenses should any such claims, lien or right to a lien be asserted (by the undersigned or by any laborer, materialman or subcontractor of the undersigned), including, without implied limitation, attorneys' fees incurred in the defense thereof.



The undersigned further accepts and acknowledges the receipt of the aforesaid sums in full accord and satisfaction for the aforementioned claims with full knowledge that the contractors, **City of Memphis (Owner)** and _____ (General Contractor), their successors and assigns, are relying thereon; and furthermore, the undersigned agrees to perform, now and in the future, each and every covenant and provision of this written contract or supplier's agreement (as the case may be) as modified or changed in writing with _____ (General Contractor) or any subcontractor of _____ (General Contractor) hereby acknowledging that said contract or supplier's agreement is now in full force and effect.

In addition, for and in consideration of the amounts and sums received, the undersigned hereby waives, releases and relinquishes any and all claims, rights or causes of action whatsoever arising out of or in the course of the work performed on the above-mentioned project, contract or event transpiring prior to the date hereof, excepting the right to receive payment for work performed and properly completed and retainage, if any, after the date of the above-mentioned payment application or invoices.

Signed and delivered the _____ day of _____, 20_____.

Company _____

By: _____
(Printed Name)

(Signature)

Title: _____

Before me, the undersigned Notary Public in and for the said County and State, personally appeared _____, and acknowledged execution of the foregoing affidavit as his voluntary act and deed and further stated that the facts recited are true of his personal knowledge.

My Commission Expires: _____

Notary Public

Residence County/State: _____

00672.2 Final Waiver and Release of Lien Rights

**AFFIDAVIT AND FINAL WAIVER OF CLAIMS AND LIENS
AND RELEASE OF RIGHTS FOR SUBCONTRACTORS**

The undersigned, who is the _____ (designate title) of _____ which is the _____ (designate whether subcontractor, supplier or otherwise) for the _____ (designate the type of work, supplies or services rendered) on the improvements constructed on the premises hereafter identified, declares that his contract with _____ (General Contractor) is in the total amount of \$ _____, which includes extras and all change orders to the date hereof.

The undersigned further states that as of _____ (date) all work on said project has been performed and completed in accordance with the plans and specifications for the project, and said work has been accomplished in accordance with the terms and conditions of his subcontract and those documents which, by reference, are a part of said subcontract. The total value of work completed and material stored is \$ _____. Of this amount \$ _____ has been received (the receipt and sufficiency of which is hereby acknowledged by the undersigned including \$ _____ in payment of Payment Application or Invoice Number _____. A total of \$ _____ is being held as retainage.

In consideration of the amounts and sums received, the undersigned does hereby waive and release to the **City of Memphis (Owner)** and to _____ (General Contractor) any and all claims and liens and rights to liens upon the premises described below and upon improvements now thereon, and upon the monies or other considerations (due as of the date of the aforesaid payment application or invoices from the **City of Memphis (Owner)** or _____ (General Contractor) or from any other person, firm or corporation), said claims and liens and rights to liens being on account of labor, services, materials, fixtures or apparatus heretofore furnished by or at the request of the undersigned. The premises as to which said claims and liens and rights to liens are hereby released are identified as follows:

Project Name: Group 1 Relay

Address of Project:

City: _____ **County:** Shelby **State:** TN **Zip Code:** _____

The undersigned further represents and warrants that he is duly authorized and empowered to sign and execute this waiver on his own behalf and on behalf of the company or business for which he is signing; that he has properly performed all work and furnished all the materials of the specified quality per plans and specifications and in a good and workmanlike manner as required by the contract; that he has paid for all the labor, materials, equipment, and services that he has used or supplied to the above premises as required by the contract; that he has no other outstanding and unpaid payment applications, invoices, retentions, holdbacks, chargebacks or unbilled work or materials against _____ (General Contractor); and that any materials which have been supplied or incorporated into the above premises were either taken from his fully-paid or open stock or were fully paid for and supplied as stated on the payment application or invoice.

The undersigned further agrees to reimburse and does hold harmless and fully indemnify the **City of Memphis (Owner)** and _____ (General Contractor) for any losses or expenses should any such claims, lien or right to a lien be asserted (by the undersigned or by any laborer, materialman or subcontractor of the undersigned), including, without implied limitation, attorneys' fees incurred in the defense thereof.



The undersigned further accepts and acknowledges the receipt of the aforesaid sums in full accord and satisfaction for the aforementioned claims with full knowledge that the contractors, **City of Memphis (Owner)** and _____ (General Contractor), their successors and assigns, are relying thereon; and furthermore, the undersigned agrees to perform, now and in the future, each and every covenant and provision of this written contract or supplier's agreement (as the case may be) as modified or changed in writing with _____ (General Contractor) or any subcontractor of _____ (General Contractor) hereby acknowledging that said contract or supplier's agreement is now in full force and effect.

In addition, for and in consideration of the amounts and sums received, the undersigned hereby waives, releases and relinquishes any and all claims, rights or causes of action whatsoever arising out of or in the course of the work performed on the above-mentioned project, contract or event transpiring prior to the date hereof, except retainage, if any, after the date of the above-mentioned payment application or invoices.

Signed and delivered the _____ day of _____, 20_____.

Company _____

By: _____
(Printed Name)

(Signature)

Title: _____

Before me, the undersigned Notary Public in and for the said County and State, personally appeared _____, and acknowledged execution of the foregoing affidavit as his voluntary act and deed and further stated that the facts recited are true of his personal knowledge.

My Commission Expires: _____

Notary Public

Residence County/State: _____

00672.3 Certificate of Nondiscrimination

As Bidder, Contractor, or Subcontractor on Purchaser's Contract, **Group 1 Relay**

The undersigned states that it does not discriminate against any subcontractor, employee, or applicant for employment on the grounds of race, color, national origin or sex and, if awarded a contract for this project, agrees in performance of work:

1. Not to discriminate against any subcontractor, employee, or applicant for employment on the grounds of race, color, national original or sex;
2. To maintain payrolls of laborers and mechanics employed on this contract until seven (7) years after final release and final payment by the City;
3. To require a similar certificate to be executed by each subcontractor at the time a subcontract is executed under the contract with the requirement that such subcontractor agrees to require a similar certificate of requirement on any lower tiers of subcontracts.
4. To conform to federal law, state statutes, executive orders, and local ordinances identified and listed under Non-discrimination.

Service Contractor's Name

Date

Signature

Printed or Typed Name and Title

**THIS FORM MUST BE SUBMITTED WITH THE PROPOSAL OR
THE PROPOSAL MAY BE CONSIDERED NON-CONFORMING.**



00672.4 Equal Business Opportunity Program

This form must be submitted with Bidder's bid. Failure to execute and submit this document with Bidder's bid may cause the Bid to be rejected as non-conforming. In addition, each Sub-Subcontractor must execute the form.

This Subcontract will be subject to the requirements of the City of Memphis Ordinance #5384 which establishes the Equal Business Opportunity ("EBO") Program. It is up to the Respondent to ensure that all requirements of this ordinance are met. The Ordinance may be accessed on the City's website at www.memphistn.gov under "Office of Contract Compliance". The intent of the EBO Program is to increase the participation of locally owned minority and women owned business enterprises ("M/WBE").

SARP10 DBE Participation Goal:

MBE/WBE minimum **15%**

(Vendors from the City of Memphis EBO list only)

Participation Plan

The Participation Plan must include: (1) level and dollar amount of participation your firm anticipates to achieve in the performance of contract resulting from this RFB; (2) the type of work to be performed by the M/WBE participation; and (3) the names of the M/WBE and/or DBE firm(s) the Respondent plans to utilize in the performance of the contract resulting from this RFB.

Eligible M/WBE and/or DBE Firms

To qualify as a M/WBE firm, per the requirements of City of Memphis Ordinance #5384, a firm must be included on the City's EBO list of certified M/WBE firms.

A list of the City's eligible M/WBE firms may be requested from Purchaser as a guide only. If a Bidder desires to utilize an M/WBE firm not included on the list, it is the Bidder's responsibility to confirm that the desired firm is certified by the City of Memphis. Such confirmation must be obtained from the City's Contract Compliance Office, in writing, before the bid/response due date. Requests for verification must be submitted to the City's Contract Compliance Office listed below:

Joann Massey
City of Memphis, Contract Compliance Office
125 North Main Street, Suite 546
Memphis, TN 38103
Phone: (901) 576-6210 - Fax: (901) 576-6560
Email: joann.massey@memphistn.gov

MINORITY/WOMEN BUSINESS ENTERPRISE COMPLIANCE FORM

SUBCONTRACT TITLE: **GROUP 1 RELAY**

Project M/WBE/DBE Goals: DBE participation **15%**

The following sections must be completed by Bidder. A certified subcontractor or supplier is defined as a firm from the list of certified firms provided with this specification.

Bidder's Name

Section A - If the Bidder is a certified firm, so indicate here with a check mark.

_____ MBE _____ WBE _____ DBE

Section B - Identify below those certified firms that will be employed as subcontractors or suppliers on this Project. By submitting this Proposal, the Bidder commits to the use of the firms listed below.

- \$ = Show the dollar value of the subcontract to be awarded to this firm
- % = Show the percentage this subcontract is of your base Proposal
- M/WBE = Show by inserting an M or W whether the subcontractor is an MBE or WBE

\$	%	M/WBE	DBE	CERTIFIED SUBCONTRACTOR NAME, ADDRESS, TEL #
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

\$ _____ % _____ = **Total M/WBE and/or DBE**

THIS FORM MUST BE SUBMITTED WITH THE PROPOSAL OR THE PROPOSAL MAY BE CONSIDERED NON-CONFORMING



00672.5 Report of Disadvantaged Business Enterprise Participation Form (1 page)



00672.6 Not Used



00672.7 Bid Bond

Know all men by these presents, that we, the undersigned,
_____ as

Principal, and _____ as surety,

Hereby held and firmly bound unto _____ as Owner on
the sum of _____ for the payment of which, well
and truly to be made, We hereby jointly and severally bind ourselves, our heirs, executors, administrators,
successors and assigns.

Signed this _____ day of _____, 2018.

This condition of the above obligation is such that whereas the principal has submitted to the Purchaser a
certain bid, attached hereto and hereby made a part of hereof to enter into a contract in writing for the
construction of:

SARP 10 Program 196548.71.0401 Group 1 Relay

Now therefore,

- A) If said bid shall be rejected, or in the alternative,
- B) If said bid shall be accepted and the principal shall execute and deliver a contract in the form of
contract attached hereto (properly completed in accordance with said bid), required insurance
certificates, and shall furnish a Bond for the payment of all persons performing labor or
furnishing materials in connection therewith, and shall in all other respects perform the
agreement created by the acceptance of said Bond,

Then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly
understood and agreed that the liability of the surety for any and all claims hereunder shall, in no event,
exceed the amount of this obligation as herein stated.

The surety, for value received, hereby stipulates and agrees that the obligations of said surety and its
bond shall be in no way impaired or affected by any extension of the time within which the Purchaser may
accept such bid; and said surety does hereby waive notice of any such extension.

In witness whereof, the principal and the surety hereunto set their hands and seals, and such of them as
are corporations have caused their corporate seals to be hereto affixed and these presents to be signed
by their proper officers, the day and year set forth above.

CONTRACTOR

SURETY

Contractor's Company Name

Surety Name

Signature (principal)

By: _____
Attorney in Fact - Signature

Printed or Typed Name and Title

Printed or Typed Name and Title



00672.8 Schedule Impact Due to Weather

Program Manager will determine Contractor’s entitlement to an extension of the Contract Time as a result of weather delays, based on the data included in Tables 1 and 2. Extensions of time will be granted at the discretion of the Program Manager for circumstances not covered by the flow chart. The following rules apply to any analysis for weather related delays to this Project. Weather delay days may be awarded if the first two rules are met. Additional days may be awarded if conditions in Rule 3 are met for unusually heavy precipitation independent of Rules 1 and 2.

Rule 1: The average monthly precipitation amount must have been exceeded.

If the total amount of actual precipitation in a month exceeds the average for that month shown in Table 1, the first test has been met. Go to rule number 2. (Precipitation is defined as the quantity of water deposited by rain, hail, sleet, or snow.)

Rule 2: The number of days in a month with actual precipitation greater than the threshold amount shown in Table 2 has been exceeded.

The numbers of days with actual precipitation greater than the threshold amounts shown in Table 2 are eligible for award as weather delays days. Additional days may be awarded for unusually heavy precipitation independent of meeting the rules above.

Rule 3: Unusually heavy precipitation has occurred.

Precipitation greater than one inch in a single day may be justification for an additional day, time extension for each precipitation day. This rule may be applied singly but not in addition with any other rule.

**National Weather Service Data for
Memphis International Airport – Years 2008-2017**

Table 1

Average Precipitation by Month (In Inches)											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
3.56	3.62	6.51	5.95	6.53	3.95	4.59	3.96	3.18	3.69	4.07	5.54

Table 2

Average Number of Days with Precipitation Greater than 0.25 Inches											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4	4	6	6	6	4	4	4	3	4	4	5

Any weather-related extension of Contract time shall be non-compensable. Efficiencies gained as a result of favorable weather within a calendar month, where the number of days of normally anticipated weather days is less than expected, shall contribute to the project float and shall not affect the Contract Times. Application for a weather related extension of time shall be submitted to the Program Manager, and shall state the extension requested and be supported by the relevant weather data.



00672.9 SARP10 Safety Guidelines

Black & Veatch Memphis SARP10 Safety Guidelines

Anyone working for the SARP10 Program must comply with these basic safety requirements, except where their individual employer's safety requirements are more stringent. It is the employer's responsibility to ensure that their employees are informed of the Project safety policies and that they work in compliance with the Program safety policies.

Black & Veatch is committed to the safety and health of all employees, subcontractors, vendors and visitors. In our effort to minimize hazards and provide the safest worksite possible, we expect all workers on the Program to know and practice the following safe work rules as a minimum. The following rules are not all inclusive nor intended to be a substitute for or in lieu of any other contractual requirements or Applicable Laws.

Noncompliance with the Rules We Live By will result in removal from the Program.

Rules We Live By

- **Confined Spaces** - DO NOT ENTER ANY CONFINED SPACE UNLESS TRAINED TO DO SO. Breaking the plane of the confined space in any way is considered an entry.
- **Fall Protection** - 100% fall protection is required when working on unprotected surfaces at or above 6 feet. An open manhole is a fall exposure and must be protected.
- **Lock Out Tag Out (LOTO)** - Lock Out Tag Out process must be in place when work includes exposure to hazardous potential energy.
- **Trench and Excavation** - All trenches 5' or greater must be protected by a trench box, shoring, sloping or other protective system.
- **Drugs and Alcohol**- No employees under the influence of drugs or alcohol will be permitted to work on the Program.

PPE Requirements

- Safety glasses with side shields, ANSI Z87.1 approved are mandatory on the worksite.
- Hard hats, ANSI Z89.1 approved, with no modifications or deformities are mandatory on the worksite.
- Good quality, over the ankle, work boots with safety toes (steel toe) are required. Sneakers of any kind are prohibited.
- High visibility work vests with reflective markings shall be worn in all construction areas. Must be ANSI Class II specification as and be fluorescent (orange or lime green).
- You are the person most responsible for your safety. Observe and obey all signs and barricades.

General Safety and Health Requirements

- 100% fall protection is required when working on unprotected surfaces at or above 6 feet. Full body harnesses and shock absorbing lanyards with double locking hooks are the only acceptable method of personnel fall protection.
- DO NOT use the top two steps of a step ladder or the top three steps of a straight ladder. Use the 3 point rule (both feet/one hand or two hands/one foot) when using ladders.
- When on site, be aware of moving vehicles and equipment. Before traveling in front of or behind pieces of equipment make eye contact with the operator and wait for an indication to proceed.
- DO NOT cross a red barricade without permission from the owner of that barricade.
- Immediately correct safety hazards if within your authority. If you cannot make the correction report it to your supervisor. Unresolved hazards or conditions not corrected by the previous methods must be brought to the attention of the Site Project Manager.
- Immediately report injuries, fires, spills, near misses, accidents or unsafe conditions or practices to the Safety Department.
- Pay attention to barricades, signs and announcements.



00770 – Loss Control Manual

The Loss Control Manual is available for viewing on the SARP10 website:

<http://www.sarp10.com/facts/>

Contact Riley Thompson, Safety Manager for additional information:

ThompsonLR@bv.com

(901) 495-2649



Technical Specifications (160 pages)

Note: Specifications and Drawings are provided here. Maps will be available as a separate link on the SARP10 website, along with this RFB. <http://www.sarp10.com/projects/>



Group 1 Rehab Project - Mainline Relay 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
FS022731S	NI03	FS022731 [7.2]	FS022730 [4.2]	6	Victrified Clay Pipe	804	5.9	1	Mainline Relay	
WS010363.20S	NK02	WS010363.20 [Dead End]	WS010363.11 [4.5]	8	Concrete Pipe (non- reinforced)	10	4.4	0	Mainline Relay	
FS021699S	NN02	FS021699 [11.2]	FS021698 [-.1]	6	Victrified Clay Pipe	315	15.1	1	Mainline Relay	
WS010566S	NN02	WS010566 [Dead End]	WS010504 [8.4]	6	Polyvinyl Chloride	469	8.4	4	Mainline Relay	
WS010549S	NN03	WS010549 [Cleanout]	WS010548 [5.2]	6	Victrified Clay Pipe	324	5.1	2	Mainline Relay	
WS010640S	NN03	WS010640 [4.0]	WS010548 [5.2]	6	Victrified Clay Pipe	493	4.6	13	Mainline Relay	
WS010538S	NQ02	WS010538 [3.0]	WS010537 [11.0]	6	Polyvinyl Chloride	544	7.0	0	Mainline Relay	
WS010570S	NQ02	WS010570 [5.3]	WS010534 [8.4]	6	Victrified Clay Pipe	534	6.9	1	Mainline Relay	
FS045221S	SA17	FS045221 [Dead End]	FS045128 [8.3]	6	Victrified Clay Pipe	576	8.6	1	Mainline Relay	
FS045257.01S	SC16	FS045257.01 [-.1]	FS045257 [9.2]	6	Victrified Clay Pipe	217	9.3	5	Mainline Relay	
FS045536S	SC16	FS045536 [9.8]	FS045257 [9.2]	6	Victrified Clay Pipe	338	9.7	0	Mainline Relay	
FS045448S	SC17	FS045448 [-.1]	FS045445 [7.8]	6	Victrified Clay Pipe	233	8.0	6	Mainline Relay	
FS045449S	SC17	FS045449 [2.4]	FS045442 [13.7]	6	Victrified Clay Pipe	604	8.0	11	Mainline Relay	
FS045621S	SC17	FS045621 [Dead End]	FS045444 [16.7]	6	Polyvinyl Chloride	123	17.1	0	Mainline Relay	
FS045208S	SC18	FS045208 [10.6]	FS045133.01 [5.9]	6	Victrified Clay Pipe	389	8.3	1	Mainline Relay	
FS045209S	SC18	FS045209 [5.7]	FS045208 [10.6]	8	Victrified Clay Pipe	224	8.1	8	Mainline Relay	
NN021334S	SD16	NN021334 [13.8]	NN021333 [-.1]	6	Victrified Clay Pipe	517	14.4	1	Mainline Relay	
NN021422S	SD17	NN021422 [11.4]	NN021421 [9.4]	6	Victrified Clay Pipe	483	10.5	0	Mainline Relay	
NN021447S	SE16	NN021447 [Dead End]	NN021435 [6.2]	6	Victrified Clay Pipe	426	6.5	1	Mainline Relay	
NN021424S	SE17	NN021424 [3.6]	NN021411 [4.1]	6	Victrified Clay Pipe	338	3.9	0	Mainline Relay	
NN021449S	SE17	NN021449 [Dead End]	NN021413 [7.9]	6	Victrified Clay Pipe	327	10.3	0	Mainline Relay	

Group 1 Rehab Project - Mainline Relay 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
FS045632S	SE18	FS045632 [Dead End] [6.2]	FS045631 [6.2]	6	Victrified Clay Pipe	354	6.3	11	Mainline Relay	
NN021442S	SF17	NN021442 [Dead End] [5.0]	NN021406 [5.0]	6	Victrified Clay Pipe	532	5.1	3	Mainline Relay	
FS045372S	SF18	FS045372 [Dead End] [4.5]	FS045371 [4.5]	6	Victrified Clay Pipe	586	4.5	22	Mainline Relay	
NN020741S	SF19	NN020741 [5.3]	NN020740 [4.5]	6	Victrified Clay Pipe	241	4.7	1	Mainline Relay	
NN021071S	SF19	NN021071 [10.6]	NN021070 [9.7]	6	Victrified Clay Pipe	600	10.0	14	Mainline Relay	
NN021072S	SF19	NN021072 [7.3]	NN020740 [4.5]	8	Victrified Clay Pipe	617	5.9	0	Mainline Relay	
NN020715S	SG16	NN020715 [Dead End] [7.8]	NN020714 [7.8]	6	Victrified Clay Pipe	112	7.8	0	Mainline Relay	
NN020712S	SG17	NN020712 [6.6]	NN020711 [14.0]	6	Victrified Clay Pipe	361	10.3	1	Mainline Relay	
NN020780S	SI19	NN020780 [Dead End] [7.5]	NN020779 [7.5]	6	Victrified Clay Pipe	338	7.1	1	Mainline Relay	
NN020783S	SI19	NN020783 [8.5]	NN020782 [10.4]	6	Victrified Clay Pipe	321	9.5	3	Mainline Relay	
NN021007S	SI19	NN021007 [5.6]	NN020598 [11.9]	6	Victrified Clay Pipe	347	8.7	14	Mainline Relay	
NN020570.01S	SI16	NN020570.01 [7.8]	NN020570 [5.3]	6	Victrified Clay Pipe	179	4.8	0	Mainline Relay	
NN023273S	SI09	NN023273 [3.5]	NN023124 [5.5]	6	Victrified Clay Pipe	165	4.5	0	Mainline Relay	
NN022542S	SI12	NN022542 [10.2]	NN022404 [9.1]	8	Concrete Pipe (non- reinforced)	271	9.7	1	Mainline Relay	
NN022618S	SI12	NN022618 [7.9]	NN022576 [8.4]	8	Concrete Pipe (non- reinforced)	251	8.2	8	Mainline Relay	
NN023182S	SM08	NN023182 [7.2]	NN023145 [8.0]	8	Reinforced Concrete Pipe	301	7.6	0	Mainline Relay	
NN020188S-2	SN13	NN020188 [11.7]	NN020153 [16.2]	8	Concrete Pipe (non- reinforced)	26	13.3	0	Mainline Relay	
NN010745S	SO01	NN010745 [---]	NN010732 [14.1]	6	Victrified Clay Pipe	213	14.0	1	Mainline Relay	
NN010725S	SO02	NN010725 [Dead End] [5.5]	NN010733 [4.8]	6	Victrified Clay Pipe	686	5.0	0	Mainline Relay	
NN022435S	SO13	NN022435 [5.5]	NN022434 [10.7]	8	Concrete Pipe (non- reinforced)	390	7.9	0	Mainline Relay	
NN010736S	SM01	NN010736 [---]	NN010731 [12.6]	6	Victrified Clay Pipe	226	12.7	1	Mainline Relay	
NN010727S	SM02	NN010727 [---]	NN010726 [13.7]	6	Victrified Clay Pipe	292	13.7	7	Mainline Relay	

Group 1 Rehab Project - Mainline Relay 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
NN010728.04S	SR02	NN010728.04 [Dead End]	NN010728.03 [6.0]	6	Victrified Clay Pipe	154	7.6	0	Mainline Relay	
NN010728S	SR02	NN010728 [7.5]	NN010727 [-.]	6	Victrified Clay Pipe	202	7.6	2	Mainline Relay	
NN010767S	SR02	NN010767 [Dead End]	NN010766 [1.8]	6	Victrified Clay Pipe	73	1.6	0	Mainline Relay	
NN010227S	SS01	NN010227 [Dead End]	NN010226 [5.6]	6	Victrified Clay Pipe	282	5.8	1	Mainline Relay	
NN024062S	SS07	NN024062 [Dead End]	NN024061 [5.5]	6	Victrified Clay Pipe	531	5.5	0	Mainline Relay	
NN010739S	ST01	NN010739 [Dead End]	NN010718 [12.0]	6	Victrified Clay Pipe	588	12.0	3	Mainline Relay	
NN010748S	ST02	NN010748 [7.0]	NN010752 [-.]	6	Victrified Clay Pipe	120	7.0	4	Mainline Relay	
NN010752S	ST02	NN010752 [-.]	NN010718 [12.0]	6	Victrified Clay Pipe	596	12.0	0	Mainline Relay	
NN023658S	ST03	NN023658 [8.0]	NN023657 [8.3]	6	Victrified Clay Pipe	81	8.2	0	Mainline Relay	
NN023793S	ST04	NN023793 [9.0]	NN023541 [13.7]	8	Reinforced Concrete Pipe	514	11.4	2	Mainline Relay	
NN023675S	ST05	NN023675 [8.0]	NN023674 [4.2]	6	Victrified Clay Pipe	367	6.1	0	Mainline Relay	
NN023759S	ST05	NN023759 [3.1]	NN023674 [4.2]	6	Victrified Clay Pipe	290	3.6	9	Mainline Relay	
NN023760S	ST05	NN023760 [Dead End]	NN023759 [3.1]	6	Victrified Clay Pipe	497	3.1	16	Mainline Relay	

Group 1 Rehab Project - Manhole Bid Schedule - Relay Contract

MH ID	Sheet	Diameter (in.)	Repair Method 1	Repair Method 2	Manhole Height (ft)	Notes
FS021699	NN02	48	Cement Coating: Entire MH	None	11.2	
WS010566	NN02	48	Install New Manhole	None	7.0	
WS010549	NN03	48	Install New Manhole	None	5.0	
WS010538	NP02	48	Cement Coating: Entire MH	None	3.0	
WS010570	NP02	48	Repair Bench/Channel	None	5.3	
FS045221	SA18	48	Install New Manhole	None	8.0	
FS045442	SC17	48	Cement Coating: Entire MH	None	13.7	
FS045444	SC17	48	Cement Coating: Entire MH	Install Inside Drop	16.7	Install Drop = 10 ft
FS045208	SC18	48	Cement Coating: Entire MH	None	10.6	
FS045209	SC18	48	Repair Bench/Channel	Cement Coating: Entire MH	5.7	
NN021334	SD16	48	Install Inside Drop	None	14.0	Install Drop = 10 ft
FS045621	SD17	48	Install New Manhole	None	14.0	
NN021447	SE16	48	Install New Manhole	None	5.0	
NN021411	SE17	48	Repair Bench/Channel	None	4.1	
NN021449	SE17	48	Install New Manhole	None	8.0	
FS045632	SE18	48	Install New Manhole	None	5.0	
NN021406	SF17	48	Cement Coating: Entire MH	None	5.0	
NN020741	SF19	48	Repair Bench/Channel	None	5.3	
NN020715	SG16	48	Install New Manhole	None	7.0	
FS045372	SG18	48	Install New Manhole	None	4.0	
NN020780	SH19	48	Install New Manhole	None	7.0	
NN020783	SI19	48	Cement Coating: Entire MH	None	8.5	
NN020570	SI16	48	Cement Coating: Entire MH	None	5.3	
NN023153	SL09	48	Cement Coating: Entire MH	None	8.4	
NN022618	SL12	48	Cement Coating: Entire MH	None	7.9	
NN020153	SN13	48	Repair Bench/Channel	None	16.1	
NN020188	SN13	48	Cement Coating: Entire MH	None	11.7	
NN010733	SQ01	48	Repair Bench/Channel	None	4.8	
NN010725	SQ02	48	Install New Manhole	None	4.0	
NN010728	SR02	48	Repair Bench/Channel	Cement Coating: Entire MH	7.5	
NN010728.03	SR02	48	Repair Bench/Channel	None	6.0	
NN010766	SR02	48	Repair Bench/Channel	Cement Coating: Entire MH	1.8	
NN010767	SR02	48	Install New Manhole	None	1.0	
NN010728.04	SR04	48	Install New Manhole	None	5.0	
NN010227	SS01	48	Install New Manhole	None	4.0	
NN024061	SS07	48	Repair Bench/Channel	Cement Coating: Entire MH	5.5	
NN024062	SS07	48	Install New Manhole	None	4.0	
NN010739	ST01	48	Install New Manhole	None	10.0	
NN010748	ST02	48	Repair Bench/Channel	Cement Coating: Entire MH	7.0	
NN023541	ST04	48	Cement Coating: Entire MH	None	13.7	
NN023760	ST05	48	Install New Manhole	None	2.0	

**SECTION 01610
BASIC PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SCOPE

- A. All materials and permanently installed equipment (for example, traffic signalization equipment, sewer pumps, and other such items) furnished by the Subcontractor for the Work shall conform to the requirements of the Plans and Contract Documents, including the applicable City of Memphis Standard Construction Specifications and Design Standards.
- B. Throughout the entire Project, all units of any one item of installed equipment shall be of the same manufacture and model unless otherwise approved by the Purchaser.

PART 2 PRODUCTS

2.01 MATERIALS & EQUIPMENT

A. Equivalent Materials and Equipment

- 1. The General Conditions allows for the substitution of equivalent materials and equipment, with the written approval of the Purchaser.
- 2. Reference to a particular product by manufacturer, trade name, or catalog number establishes the quality standards of materials and equipment required for the Work. It is not intended to exclude products equivalent in quality and similar in design. Whenever any article, material, or equipment is identified by using the name of a manufacturer or vendor, the term “or approved equal” if not inserted shall be implied.
- 3. If the Subcontractor proposes to furnish materials or supplies other than those specified, he shall furnish complete descriptive data, including performance capabilities, specifications, and other data as required in the Contract General Conditions. The provisions of this substitution of materials shall not relieve the Subcontractor of the responsibility of meeting the requirements of the Plans and Contract Documents. All materials must be approved by the Purchaser before any installation will be permitted.

B. List of Major Materials and Equipment

- 1. The Subcontractor shall submit to the Purchaser for approval, with due promptness after award of Contract but in no case later than at the preconstruction conference, a list of major equipment and materials which he proposes to provide. The list shall include in sufficient detail to identify the materials, the name of the manufacturer’s model number of all material that is identified on the Plans or in the Contract Documents, including catalog literature for standard equipment and detailed scale drawings of any nonstandard or special equipment and of any proposed deviation from the Plans. A signed statement shall accompany this list stating that materials and equipment are in exact accordance with Project specifications. No charge shall be made to the Purchaser for any materials or equipment purchased, labor performed, or delay to the Work prior to approval of materials by the Purchaser.

C. Source of Supply

- 1. The source of supply for each material to be supplied by the Subcontractor shall be subject to approval by the Purchaser before delivery is started.

PART 3 EXECUTION

A. Samples and Testing

1. Representative samples of materials included for incorporation in the Work shall be submitted to the Purchaser for his examination and/or testing when so specified or requested.
2. All testing of materials shall be made in accordance with the standard methods of testing of the ASTM, AASHTO, NEMA, ITE, or other applicable standard specifications.

PART 4 MEASUREMENT & PAYMENT

4.01 PROPOSAL QUANTITIES

- A. The quantities appearing in the Proposal Sheet(s) of the Proposal are approximate and are proposed and shown for the comparison of bids and award of a Contract. The Purchaser does not guarantee or assume any responsibility that the quantities indicated on the Plans or in the Proposal will hold true and accurate in the construction of the Project. The Subcontractor shall not plead deception or misunderstanding because of variation from these quantities. Unless otherwise provided in the Contract Documents, payment to the Subcontractor will be made only for the actual quantities of Work performed and accepted, and materials and equipment furnished and placed in accordance with the Contract.

4.02 MEASUREMENT OF QUANTITIES

- A. All Work completed under the Contract will be measured by the Purchaser according to United States standard measure.
- B. The term “ton” will mean the short ton consisting of 2,000 pounds.
- C. The determination of quantities for specific items will be made as set for the in the subsection titled “Measurement” under the applicable Sections of the Standard Construction and Material
- D. Specifications hereof, or of other Specifications provided for the Work.
- E. Longitudinal and transverse measurements for surface area computations will be to the exact dimensions shown in the horizontal plane on the Plans or as ordered in writing by the Purchaser.
- F. Structures will be measured according to the lines and exact dimensions shown on the Plans or as altered to fit field conditions by direction to the Purchaser.
- G. In all cases where measurement of materials is based on certified weights, the Subcontractor shall furnish the Purchaser certified weigh bills showing the net weight of materials received in each shipment. In no instance will the Purchaser pay for materials in excess of the amounts represented by the certified weigh bills.
- H. When certified scale weights are not used for measurement, all materials which are measured or proportioned by weight shall be weighed on accurate, approved scales, by competent, qualified personnel, at locations designated by the Purchaser.
- I. Trucks used to haul material being paid for by weight shall be weighed empty at such times as the Purchaser directs, and each truck shall bear a plainly legible identification mark.

- J. Measurements for payment will be made to the nearest fractional units specified below, unless otherwise specified herein or in the Contract Documents for the project.

<u>Unit of Measurement</u>	<u>Nearest Unit</u>
Linear Foot	0.1 LF
Square Foot	0.1 SF
Square Yard	0.1 SY
Ton	0.1 Ton
Cubic Yard	0.01CY
1,000 SF Unit	0.1 Unit

END OF SECTION 01610

**SECTION 02530
SEWER PIPE REPLACEMENT**

PART 1 GENERAL

1.01 SCOPE

- A. This Work shall consist of the removal of existing sanitary sewers and the construction of replacement sanitary sewers and service connections of the kinds and dimensions shown on the Drawings, stipulated in the 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 PRODUCTS

2.01 MATERIALS

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 (8-15 inch Diameter)

1. All PVC gravity pipe and fittings 8-15 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. 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. 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.

I. 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:

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

J. Pit Run Gravel

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

Size No.	Total Percent by Dry Weight Passing Each Sieve (U.S. Standard)						
	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.

K. Non-Shrinking Grout

1. 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.

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 EXECUTION

3.01 SITE PREPARATION AND RESTORATION

A. Rights-of-Way and Easements

1. This Work shall include removing and replacing existing sanitary sewers in existing rights-of-way. To the degree that the existing sewer drawings can be provided, the existing rights-of-way and/or easements as shown on the existing City Drawings and/or rights-of-way/easement plats shall be provided by the City to the Subcontractor for construction of sanitary sewer facilities. The Subcontractor shall confine his construction activities to these areas. The Subcontractor shall be responsible for obtaining written agreements for use of private property outside City acquired rights-of-way/easements for such purposes as storage of material and equipment and access to the construction site. The Subcontractor shall immediately provide a copy of all such written agreements to the City and Purchaser upon obtaining the same.

B. Clearing of Rights-of-Way and Easements

1. The Subcontractor shall confine his clearing of rights-of-way and easements to the least area necessary for construction of facilities shown on the Drawings. The Subcontractor shall protect as many trees and shrubs within the area as possible. Where necessary for construction, the Subcontractor shall clear all live and dead vegetation and growth, pole stubs, logs, and other objectionable material. Cleared material shall be removed to within 3 inches of existing ground. This work shall be done well before excavation operations but only after erosion controls have been placed.

C. Location of Existing Obstructions

1. Locations of obstructions shown on the Drawings are approximate and are not intended

as an accurate location of such obstructions. Obstructions not shown on the Drawings but encountered by the Subcontractor shall be removed and replaced in their original state or protected by the Subcontractor at no additional cost to the Purchaser.

D. Removal of Obstructions

1. The Subcontractor shall demolish and remove all structures and structure foundations, abandoned vehicles, appliances, and rubbish within the right-of-way/easement limits necessary for the performance of the work.

E. Protection of Obstructions Outside Easement Limits

1. The Subcontractor shall protect and avoid damage to all trees, shrubs, plants, fences, structures, and all other objects outside the right-of-way/easement limits shown on the Drawings and/or Plats due to construction operations. All damage shall be repaired or restored at the Subcontractor's expense. Particular attention shall be paid to avoid damage to trees, shrubs, bushes, and private property located next to rights-of-way/easements. No trees, plants, or other objects may be removed outside such limits without written permission of the property owner.

F. Special Protection of Obstructions Inside Easement Limits

1. Wherever the underground installation of sanitary sewer facilities will go through surface improvements previously made by the City, other governmental bodies, or property owners, the Subcontractor shall be responsible for their protection and preservation. This responsibility includes the removal and storage of such improvements to allow replacement and restoration as close as possible to the undisturbed condition.

G. Disposal of Debris

1. All trees, brush, logs, snags, leaves, sawdust, bark, and refuse shall be collected and disposed of according to the City Code of Ordinances at the expense of the Subcontractor. There will be no separate pay item for disposal of debris. Debris shall be removed from the site when practical and shall not be left until the completion of the contract. Burning of debris shall not be allowed. When material is to be disposed of outside the easement, the Subcontractor shall first obtain written permission from the property owner on whose property the disposal is to be made and shall file a copy with the Purchaser. Unless otherwise provided in the Contract Documents, the Subcontractor shall arrange for disposing of such material outside the right-of-way/easement. No debris shall be deposited in wetlands.

H. Replacement of Fences

1. Any fences disturbed inside the right-of-way/easement limits shall be replaced or restored to their original or better condition. Any fences removed shall be replaced in their original location. Fences in such poor condition that they cannot be taken down and rebuilt with the same material shall be replaced with new fence material similar in original quality, size, construction, and appearance to the removed fence. Exceptions to this requirement shall be allowed if written releases are obtained from the property owners by the Subcontractor and submitted to the Purchaser.

I. Restoration of Turfed Areas

1. All areas shall be restored as nearly as practicable to their original condition. Finished lawn areas where soil has been deposited shall be cleared to the level of the existing sod and then raked and watered. Areas where sod has been damaged, destroyed, or ruts have been filled shall be re-sodded. After final restoration of the settled trench surfaces, trench areas and areas regraded as part of the construction shall be re-sodded, unless otherwise shown on the Drawings or directed by the Purchaser. Sod must be living at the time of final acceptance of the project.

J. Maintenance of Flow

1. 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.

3.02 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.
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:
 - a. 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.
 - b. 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.
 - c. 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:

- a. 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. Sheet piling and Shoring:

- a. The Subcontractor shall furnish, place, and maintain sheet piling 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 sheet piling and shoring without the Purchaser's instructions.
- b. Sheet piling shall extend below structure invert a sufficient depth to assure adequate support. In the installation of sheet piling, the use of vibratory type pile drivers (as opposed to impact type) shall be limited to sheet piling driven no greater than 5 feet below the invert. The sheeted trench width, as measured between those faces of the sheet piling 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.
- c. Sheet piling, 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 sheet piling left in place at least 2 feet below the surface and shall remove the cut off material from the excavation.

- d. 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.
 - e. 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.
3. Excess Width of Trench:
- a. 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.
4. Underpinning:
- a. 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 through Tennessee 811 prior to excavation. The Subcontractor will also be responsible for coordinating the relocation of any existing utilities with the appropriate utility owner.
- 2. Protection:
 - a. 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:
 - a. 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.

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.
7. 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.

3.03 LOCATE AND EXPOSE MAINLINE TERMINUS

- A. The Subcontractor shall, at the direction of the Purchaser, use all means necessary to locate and expose the terminus end of a sanitary sewer mainline when no upstream manhole exists. This may include but is not limited to: CCTV inspection, Sonde, and subsequent excavation of the located terminus. The area exposed shall be large enough to install a new manhole in accordance with Section 02531 Installation and Replacement of Manholes.

3.04 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:
 - a. 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:
 - a. 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:
 - a. 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:
 - a. 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.

3.05 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.
- 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.

3.06 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.

3.07 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.

E. 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.

3.08 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.

3.09 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:
 - a. 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.
 - b. 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.
 - c. 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.

2. Placement and Compaction:

a. Sanitary Sewer Trenches:

- i. 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:

- i. 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:

- a. 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:

- a. Backfill procedures specified in Specification Section 02530 Paragraph 3.08.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.

D. 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.

3.10 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. 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.

3.11 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.

3.12 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.

3.13 TRAFFIC CONTROL

- A. All traffic control shall be installed and maintained in accordance with the Manual on Uniform Traffic Control Devices (MUTCD). 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. For bidding purposes, the Subcontractor shall assume that a flagman will be needed on 30 percent of the setups. At the end of each working period, the Subcontractor shall plate all open excavations to maintain traffic flow.

3.14 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.

3.15 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.

3.16 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.

3.17 FINAL TESTING AND ACCEPTANCE

A. Visual Inspection

- 1. All work will be subject to visual inspection for faults or defects and any such deviation or omission will be corrected at once.
- 2. A PACP CCTV inspection in accordance with Section 02541 Closed Circuit Television Inspection of Sewer Mains & Connections shall be submitted after pipe replacement is completed.

B. Leakage Tests

- 1. 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.
- 2. Air Leakage Test for 8-24 inch Diameter Pipe
 - a. 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.

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

Size (diameter)	4 ½ inches
Pressure Range	0-15 PSI
Figure Intervals	1 PSI Increments
Minor	0.05 PSI
Subdivisions	
Pressure Tube	Bourdon Tube or diaphragm
Accuracy	Plus or minus 0.25% of Maximum scale reading
Dial	White coated aluminum with black lettering, 270° arc and mirror edges
Pipe Connection	Low male ½ inch NPT

- c. 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.
- d. 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.
- e. Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated¹

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

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

3. Infiltration Test

- a. 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.
- b. 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.

C. Deflection Test – Semigrd and Flexible Pipe

1. 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.
2. 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.
3. The cost of this service shall be included in the unit price bid for the pipe.

D. Final Acceptance

1. 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 4 MEASUREMENT & PAYMENT

4.01 MEASUREMENTS

A. Locate and Expose Mainline Terminus

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

B. Sewer Pipe

1. 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.
2. Sewer pipe length measurement will include the length of wyes as measured along the primary axis for all sizes of sewer pipe.

C. Service Connection Removal and Replacement

1. Service lateral removal and replacement for construction of sewer facilities will be measured per each, complete in place. Service Connections damaged by the Subcontractor that do not require removal and replacement for construction of sewer facilities will not be measured for payment.

D. Pavement Backfill

1. 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 1 foot above the top of the sewer pipe to the subgrade elevation of the pavement.

E. Undercut Backfill

1. Undercut backfill will be measured by the cubic yard of limestone in place, as approved by the Program Manager.

F. Bypass Pumping

1. Bypass pumping will be measured per each sewer segment being replaced.

G. Traffic Control

1. Traffic control will be paid per Crew Day for each sewer pipe installation. Traffic control does not apply to segments being replaced in alleys or other locations where traffic is not impacted.

H. Hydroexcavating/Hand Digging

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

I. Excavation

1. 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.

J. Pipe Wyes

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

4.02 PAYMENT

A. Locate and Expose Mainline Terminus

1. 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.

B. Sewer Pipe

1. 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. All pipeline material will be generically the same throughout the project except connecting solid wall PVC pipe service connections to truss pipe mainlines. Payment will be based on approval and acceptance of post-rehabilitation CCTV in accordance with Section 02541.

C. Service Connection Removal and Replacement

1. 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 for excavation, removal of old service line and appurtenances, furnishing and construction of new service lines, connections to existing service line and appurtenances to remain, and backfilling, complete in place.
2. All pipeline material will be generically the same throughout the project except solid wall PVC pipe service connected to truss pipe mainlines.

D. Pavement Backfill

1. 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.

E. Undercut Backfill

1. Accepted quantities of undercut backfill will be paid for at the contract unit price per cubic yard 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.

F. Bypass Pumping

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

G. Traffic Control

1. Traffic Control will be paid per Crew Day for each sewer pipe installation including all appurtenances required to comply with MUTCD Standards. Traffic control does not apply to segments being replaced in alleys or other locations where traffic is not impacted

H. Hydroexcavating/ Hand Digging

1. 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.

4.03 PAYMENT WILL BE MADE UNDER:

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
Modified By SARP10 Program

Item No.	Pay Item	Pay Unit
02530-4.01.A	LOCATE AND EXPOSE MAINLINE TERMINUS	EACH
02530-4.01.B-1.1	8" POLYVINYL CHLORIDE (PVC) SEWER PIPE (0-6' Depth)	LINEAR FOOT
02530-4.01.B-1.2	8" PVC SEWER PIPE (6.1' – 10' Depth)	LINEAR FOOT
02530-4.01.B-1.3	8" PVC SEWER PIPE (10.1' – 14')	LINEAR FOOT
02530-4.01.B-1.4	8" PVC SEWER PIPE (14.1' – 20')	LINEAR FOOT
02530-4.01.C	SERVICE CONNECTION REMOVAL AND REPLACEMENT	EACH
02530-4.01.D	PAVEMENT BACKFILL	CUBIC YARD
02530-4.01.E	UNDERCUT BACKFILL	CUBIC YARD
02530-4.01.F	BYPASS PUMPING	EACH
02530-4.01.G	TRAFFIC CONTROL	CREW DAY
02530-4.01.H	HYDROEXCAVATING/ HAND DIGGING	LINEAR FOOT

END OF SECTION 02530

**SECTION 02531
INSTALLATION AND REPLACEMENT OF MANHOLES**

PART 1 GENERAL

1.01 SCOPE

- A. This Work shall consist of the removal and replacement of existing or installation of new manholes for sanitary sewers as shown on the Drawings, stipulated in the Contract Documents, or as directed by the Purchaser. The construction shall be accomplished by these Specifications and in conformity with the details shown on the Drawings or established by the Purchaser.
- B. Where existing manholes are being replaced, the Subcontractor shall arrange the work such that sewage flow shall be maintained during the construction period with no discharge of sewage slowing into an open trench and provide necessary bypass pumping capacity to carry flow downstream of the manhole to be replaced. Additionally, the Subcontractor shall be responsible for properly removing and disposing of the existing manhole when replaced.
- C. All new manholes shall be precast concrete. The top section of the manholes shall be either flat top or eccentric cones as shown on Drawings.
- D. Cast iron frames shall be set at the required elevation and properly bonded to the flat top, eccentric cone, or grade rings with two rings of butyl mastic sealant and anchor bolts.

1.02 SUBMITTALS

- A. Unless otherwise specified all sample submittals shall be delivered to the Program Manager within two weeks of the NTP.
- B. Shop Drawings:
 - 1. Precast Manholes: Details of construction.
 - 2. Precast Base, Cones, and Top Slab Sections: Details of construction.
 - 3. Manholes Over Existing Piping:
 - a. Drawings and schedule for diverting flow.
 - b. Certificate from manufacturer of castings indicating they meet applicable requirements of these Specifications.
 - c. Precast Manhole Sections: Manufacturer's results of tests performed on representative sections to be furnished.
 - d. Certified load test data for precast manhole steps.
 - e. Plan for diversion of flow during installation of manhole over existing piping

1.03 DELIVERABLES

- A. Manhole Acceptance
 - 1. All manholes shall be subject to visual inspection by the Purchaser's Representative for faults, defects, or deviations from the Drawings and any such deviation or omission will

be corrected by the Subcontractor. All tests shall be made by the Subcontractor who will provide necessary equipment for testing in the presence of and under the supervision and instructions of the Purchaser's Representative.

B. Manhole Vacuum Testing for Precast Manholes

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

Vacuum Test Timetable			
Depth (Feet)	Manhole Diameter (Inches)		
	48"	60"	72"
4'	10 sec.	13 sec.	16 sec.
8'	20 sec.	26 sec.	32 sec.
12'	30 sec.	39 sec.	48 sec.
16'	40 sec.	52 sec.	64 sec.
20'	50 sec.	65 sec.	80 sec.
24'	60 sec.	78 sec.	96 sec.
*	5.0 sec.	6.5 sec.	8.0 sec.
*Add extra testing time "T", for each additional 2-foot depth. (The values listed above have been extrapolated for ASTM designation C924-85.			

C. Warranty and Guarantee for Precast Manholes

1. The Subcontractor shall guarantee the rehabilitated manholes for ten (10) years after acceptance by the Owner to the extent that he will repair any leaks that may appear in

them during this period because of faulty workmanship or materials furnished by him at no additional expense to the Owner.

D. Deliverables

1. The Subcontractor shall provide post-rehabilitation MACP inspections for each manhole in accordance with Specification Section 02544 – Manhole GPS & MACP Inspection.

PART 2 PRODUCTS

2.01 MATERIALS

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 shall be allowed 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. Qualification of Manufacturer

1. Manhole 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 Contractor shall be subject to the approval of the Purchaser. No material shall be delivered until the manufacturer and product have been approved by the Purchaser.

C. Mortar

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

D. Cast Iron Castings

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

E. Manhole Steps

1. Manhole steps shall not be allowed in sewer structures.

F. Butyl Mastic Sealant

1. The sealant shall be used when joining the casting frame to the precast manhole to provide a watertight structure. The sealing compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes, or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive

strength. It shall be supplied in extruded rope form of suitable cross section and in such sizes as to seal the joint space. The Subcontractor shall use two complete ropes at each joint. The sealing compound shall be protected by a suitable removable two-piece wrapper, which shall be designed so that half may be removed longitudinally without disturbing the other half in order to facilitate application of the sealing compound. The sealant shall also meet the requirements of the following table:

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

G. Precast Manholes

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

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

2. All cone sections and transition sections shall be eccentric. Barrel sections shall be custom made with openings to meet indicated pipe alignment and invert elevations.
3. The circumferential reinforcement for the manhole sections shall consist of welded wire fabric per ASTM C478.
4. Manholes shall be constructed with the minimum number of sections possible that the precaster can provide, to minimize the number of joints in the manhole. Minimum manhole section shall be 16 inches deep.
5. Each joint shall be a tongue and groove with two layers of butyl mastic sealant.
6. Pipe Connections:
 - a. Pipe connections to precast concrete manholes shall be with A-LOK cast in-place gaskets for new and replacement manholes. Grout shall not be allowed to encase A-LOK gaskets. Pipe connections for cured in place or for existing pipe shall be KOR N SEAL flexible connectors. Proper torque shall be applied to KOR-N-SEAL flexible

connectors with a torque wrench per manufacturer's specifications.

7. Channels and benches shall be factory grouted only. There shall be no field grouting of channels or benches.
8. A minimum line drop of 0.1 foot shall be provided across new manholes unless otherwise directed by the Purchaser.
9. Where the difference in invert elevation of two intersecting sewers in a manhole is 2 feet or more, a drop connection shall be installed as directed by the Purchaser.
10. Where invert elevations are not shown on the Drawings, pipes of differing sizes enter and exit manholes, all pipe crowns shall be matched to the same elevation.
11. The bottom of all precast base sections 4 feet in diameter shall extend a minimum of 6-inches beyond the outside wall of the manhole riser. The bottom of all precast base sections and cast-in-place bases 5 feet in diameter shall extend a minimum of 7-inches beyond the outside wall of the manhole riser. The bottom of all precast base sections and cast-in-place bases 6 feet and larger in diameter shall extend a minimum of 8-inches beyond the outside wall of the manhole riser.
12. For manholes four to six feet in diameter and less than twenty feet deep, precast reinforced concrete manhole base sections shall be a minimum of 8 inches thick. For all others, base sections shall be a minimum of 12 inches thick. All precast manhole base sections shall be reinforced with Number 4 steel reinforcing bars placed 6 inches on center each way and at mid depth of the slab, unless shown otherwise on the Drawings.
13. The interior of the manhole sections shall be a smooth, cylindrical surface. Lifting holes, when provided, shall be filled with expanding grout, or other approved materials.
14. All precast reinforced concrete manhole sections specified herein shall be inspected by the Purchaser's Representative. All materials that fail to conform to these Specifications will be rejected. After delivery to the Site, any materials that have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the Site by the Subcontractor at no cost to the Purchaser.

2.02 EQUIPMENT

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

PART 3 EXECUTION

3.01 SITE PREPARATION AND RESTORATION

A. Rights-of-Way and Easements

1. The Subcontractor shall confine his construction activities to City of Memphis Rights-of-Way and Easements. The Subcontractor shall be responsible for obtaining written agreements for use of private property outside City acquired rights-of-way/easements for such purposes as storage of material and equipment and access to the construction site. The Subcontractor shall immediately provide a copy of all such written agreements to the City and Purchaser upon obtaining the same.

B. Clearing of Rights-of-Way and Easements

1. The Subcontractor shall confine his clearing of rights-of-way and easements to the least area necessary for construction of facilities shown on the Drawings. The Subcontractor shall protect as many trees and shrubs within the area as possible. Where necessary for construction, the Subcontractor shall clear all live and dead vegetation and growth, pole stubs, logs, and other objectionable material. Cleared material shall be removed to within 3 inches of existing ground. This work shall be done well before excavation operations but only after erosion controls have been placed.

C. Location of Existing Obstructions

1. Locations of obstructions shown on the Drawings are approximate and are not intended as an accurate location of such obstructions. Obstructions not shown on the Drawings but encountered by the Subcontractor shall be removed and replaced in their original state or protected by the Subcontractor at no additional cost to the Purchaser.

D. Removal of Obstructions

1. The Subcontractor shall demolish and remove all structures and structure foundations, abandoned vehicles, appliances, and rubbish within the right of way/easement limits necessary for the performance of the work.

E. Protection of Obstructions Outside Easement Limits

1. The Subcontractor shall protect and avoid damage to all trees, shrubs, plants, fences, structures, and all other objects outside the right of way/easement limits shown on the Drawings and/or Plats due to construction operations. All damage shall be repaired or restored at the Subcontractor's expense. Particular attention shall be paid to avoid damage to trees, shrubs, bushes, and private property located next to rights of way/easements. No trees, plants, or other objects may be removed outside such limits without written permission of the property owner.

F. Special Protection of Obstructions Inside Easement Limits

1. Wherever the underground installation of sanitary sewer facilities will go through surface improvements previously made by the City, other governmental bodies, or property owners, the Subcontractor will be responsible for their protection and preservation. This responsibility includes the removal and storage of such improvements to allow replacement and restoration as close as possible to the undisturbed condition.

G. Disposal of Debris

1. All trees, brush, logs, snags, leaves, sawdust, bark, and refuse shall be collected and disposed of according to the City Code of Ordinances at the expense of the Subcontractor. There will be no separate pay item for disposal of debris. Debris shall be removed from the site when practical and shall not be left until the completion of the contract. Burning of debris shall not be allowed. When material is to be disposed of outside the easement, the Subcontractor shall first obtain written permission from the property owner on whose property the disposal is to be made and will file a copy with the Purchaser. Unless otherwise provided in the Contract Documents, the Subcontractor will arrange for disposing of such material outside the right of way/easement. No debris will be deposited in wetlands.

H. Replacement of Fences

1. Any fences disturbed inside the right of way/easement limits will be replaced or restored to their original or better condition. Any fences removed will be replaced in their original location. Fences in such poor condition that they cannot be taken down and rebuilt with the same material shall be replaced with new fence material similar in original quality, size, construction, and appearance to the removed fence. Exceptions to this requirement shall be allowed if written releases are obtained from the property owners by the Subcontractor and submitted to the Purchaser.

I. Restoration of Turfed Areas

1. All areas shall be restored as nearly as practicable to their original condition. Finished lawn areas where soil has been deposited shall be cleared to the level of the existing sod and then raked and watered. Areas where sod has been damaged, destroyed, or ruts have been filled shall be resodded. After final restoration of the settled trench surfaces, trench areas and areas regraded as part of the construction shall be resodded, unless otherwise shown on the Drawings or directed by the Purchaser. Sod must be living at the time of final acceptance of the project.

3.02 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 manhole installation as practical. All backfill shall be placed in uniform horizontal layers. Pushing backfill material down a ramp into excavated areas shall not be permitted. No trash shall 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 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 anytime during the 12-month warranty period the trenches or filled areas settle or sunken places appear, the Subcontractor shall be required to refill these sunken places when they are discovered with suitable material and shall 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:
 - a. Backfill for manhole 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 shall not be used.
 - b. Backfill for manhole 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.

- c. Select material shall be free from debris, organic matter, perishable compressible material and shall contain no stones or lumps larger than 6 inches. Rocks and lumps smaller than 6 inches shall 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 shall come in direct contact with the pipe. The upper 3 feet of backfill in sodded or planted areas shall be free of rocks or lumps larger than 1 inch in diameter.

2. Placement and Compaction:

- a. 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 shall 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).

C. Open Areas and Unimproved Property

1. 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 shall be free from debris, organic matter and perishable compressible material, and shall contain no stones or lumps or rock fragments larger than 6 inches. Rocks or lumps smaller than 6 inches in diameter shall 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.

3.03 REMOVAL OF EXISTING MANHOLES

- A. Existing manholes and structures to be removed shall be shown on the Drawings or as directed by the Purchaser. The City reserves the right to retain or reject salvage of any materials encountered. Unless otherwise specified, salvaged rims and covers remain the property of the City and shall be delivered by the Subcontractor to the City yard as directed by the Purchaser. All remaining materials become the property of the Subcontractor who shall be responsible for disposal.

3.04 GENERAL CONSTRUCTION REQUIREMENTS

- A. New manholes and structures shall be constructed of plain or reinforced concrete. Where the top elevation is not shown on the Drawings, the manhole or structure shall be built to conform to the elevation of the existing final grade or as ordered by the Purchaser. Completion of the manhole shall include the installation of fittings, connections to pipes, placing of castings, testing, and other construction as shown on the Drawings.

- B. Inlet and outlet pipes shall extend through the walls of manholes to allow for water tight connections with the manhole walls. The ends shall be cut off flush with the inside surface of the wall as shown on the Drawings, design standards, or otherwise directed by the Purchaser. The pipes shall intersect at the structures so the inlet pipe will be aligned in the direction of outlet pipe such that counter-flow is prevented. Water stops shall be installed around pipes as they pass through the sanitary manhole wall.
- C. Inverts shall be of Class A concrete poured to conform to the shapes shown on the Plans or otherwise directed. The inverts shall be constructed as to cause the least possible resistance to flow. The shape of the inverts shall conform uniformly to inlet and outlet pipes. A smooth and uniform finish shall be required.
- D. Dewatering
 - 1. Subcontractor shall furnish, install and operate pumps, pipes, appurtenances, and all equipment of sufficient capacity required to remove any groundwater encountered in the excavation. Subcontractor shall conduct said groundwater away from the construction site in an approved manner. Generally, dewatering is considered to be incidental to the construction of sewer manholes.
- E. Bypass Pumping
 - 1. Subcontractor shall furnish, install, and operate pumps, pipes, appurtenances, and all equipment of sufficient capacity required to maintain sewage flow around the work area. Subcontractor shall conduct said bypass pumping in an approved manner. Generally, bypass pumping is considered to be incidental to the construction of sewer manholes.
- F. Traffic Control
 - 1. All traffic control shall be installed and maintained in accordance with the Manual on Uniform Traffic Control Devices (MUTCD). 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 heavy traffic volume, a flagman may also be needed to assist with traffic control. For bidding purposes, the Subcontractor should assume that a flagman will be needed on 30 percent of the setups.

3.05 INSTALLATION – PRECAST MANHOLES

- A. Manhole Foundations
 - 1. Precast concrete manholes shall be built according to the Drawings or as directed by the Purchaser. All precast manholes shall use either a concrete slab constructed of Class A concrete on a 12-inch thick No. 67 crushed limestone foundation and will be cast integrally with the base section and the inlet and outlet pipes as shown on the Drawings or the precast manhole shall use a precast base section conforming to this Specification. The stone base shall be fully encapsulated in a geotextile fabric as indicated on the plans or as directed by the Purchaser. The Subcontractor shall dewater sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to and during placement of the foundation.
- B. Manhole Installation on Existing Lines
 - 1. For all lines 12 inches in diameter or less, a section of pipe shall be removed and a complete precast manhole installed. The existing pipes shall be joined by a flexible

coupling to pipe extensions from the manhole. Minimum 4-foot pipe extension shall be required from manhole to connect to existing pipe.

C. Manhole Diameters

1. In general, the internal diameter of manholes shall be 4 feet.
2. Manhole diameter sizing, however, is contingent upon limitations of manufacturer due to pipe sizes and pipe deflections at manhole. Subcontractor shall verify proper manhole diameter is provided based on proposed manhole pipe configuration and pipe sizes indicated. Manhole sizing shall be approved by the Purchaser.

D. Frames and Covers

1. Cast iron frames and covers shall be set at the required elevation and properly bonded to the masonry with two rings of butyl mastic sealant and anchor bolts.
2. City Standard watertight frames and covers shall be used in flood prone areas, and areas where water ponds or could pond, including traffic areas.
 - a. Where shown on the Drawings, vent stacks shall be installed in long runs of sewers, potentially with watertight frames and covers. Vents shall be designed and constructed to preclude water entering the sewer system during storm events through the vents.
3. City Standard frame and cover obtained from Universal Scaffolding shall be used in all other areas.
4. Manhole rim elevations shall be set at grade in traffic areas and finished landscaped areas (finished grade is at the top of mulch in finished landscape areas), shall be set at 3 inches above grade in non-finished landscaped areas, and to be set at 2 feet or more above finish grade in non-traffic and non-landscaped areas.
5. Wherever manholes are constructed in paved areas, the top surface of the frame and cover shall conform to the exact slope, crown, and grade of the existing adjacent pavement.

3.06 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.

3.07 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 MEASUREMENT & PAYMENT

4.01 MEASUREMENT

A. Manhole Replacement with Precast Manhole

1. Manhole replacement with precast manhole will be measured per vertical foot of manhole from the downstream invert up to the bottom of the frame casting

B. Precast Manhole Installation

1. Precast manhole installation will be measured per vertical foot of manhole from the downstream invert to the bottom of the frame casting.

C. Pavement Backfill

1. 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. The backfill will extend 12 inches around the outside of the masonry or concrete work to allow for proper placement. No payment will be made for additional backfill used outside of 12 inches unless approved prior to completion by the Purchaser.

D. Traffic Control

1. Traffic control will be measured per Crew Day for each standalone manhole installed or replaced when not associated with an adjoining sewer segment being rehabilitated.

E. Dewatering

1. Dewatering is considered to be an incidental to sewer manhole rehabilitation.

F. Bypass Pumping

1. Bypass pumping is considered to be an incidental to sewer manhole installation and replacement.

4.02 PAYMENT

A. Manhole Replacement with Precast Manhole

1. Precast Manhole replacement will be paid at the contract unit price per vertical foot, which shall be full compensation for the base, precast sections, adjusting rings, as needed, gaskets, steps, cast-in or core drilled pipe openings, pipe connectors, grout, manhole rims, frames, and covers, and vacuum testing, and removal and approved offsite disposal of materials, including manhole being replaced.

B. Precast Manhole Installation

1. Precast Manhole installation will be paid at the contract unit price per vertical foot, which shall be full compensation for the base, precast sections, adjusting rings, as needed, gaskets, steps, cast-in or core drilled pipe openings, pipe connectors, grout, manhole rims, frames, and covers, and vacuum testing, and removal and approved offsite disposal of materials.

C. Pavement Backfill

1. 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.

D. Traffic Control

1. Traffic control will be paid per Crew Day for each manhole rehabilitated including all appurtenances required to comply with MUTCD standards. Only standalone manhole installation or replacement will include a separate traffic control payment. All traffic control for manholes with adjoining sewer segment rehabilitation will be included in the traffic control for the associated pipe.

4.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02531-4.01.A	MANHOLE REPLACEMENT WITH PRECAST MANHOLE	VERTICAL FOOT
02531-4.01.B	PRECAST MANHOLE INSTALLATION	VERTICAL FOOT
02531-4.01.C	PAVEMENT BACKFILL	CUBIC YARD
02531-4.01.D	TRAFFIC CONTROL	CREW DAY

END OF SECTION 02531

**SECTION 02532
SANITARY SEWER MANHOLE ADJUSTMENT**

PART 1 GENERAL

1.01 SCOPE

- A. This Work shall consist of locating and adjusting existing sanitary sewer manhole frames and covers as necessary to conform to the existing street grades or as directed by the Purchaser in accordance with these Specifications.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mortar

1. Mortar shall be composed of the following mixtures by volume: one part Portland cement, two parts sand, hydrated lime not to exceed 10 percent of the cement used, and four parts water. All ingredients shall be proportioned by measurement and not by estimation. All hydrated lime shall be as specified by ASTM C 6.
2. The mortar shall be hand mixed or machine mixed. In the preparation of hand mixed mortar, the sand, cement and hydrated lime shall be thoroughly mixed together in a clean, tight mortar box until the mixture is of uniform color, after which water shall be added. Machine mixed mortar shall be prepared in an approved mixer and shall be mixed not less than 1 ½ minutes. Mortar shall be used within 30 minutes after mixing.

B. Brick

1. All brick shall conform to the Specifications for Concrete Building Brick, ASTM C55 for Grade A. Bricks shall conform to the following dimensions, unless otherwise approved by the Purchaser.

	Depth (Inches)	Width (Inches)	Length (Inches)
Standard Size	2 ¼	3 ¾	8
Allowable Variation	+ ¼	+ ¼	+ ½

2. All bricks shall be new and whole, of uniform standard size and with substantially straight and parallel edges and square corners. Bricks shall be tough and strong and free from injurious cracks and flaws. Bricks shall be culled after delivery, if required, and all culls shall be removed from the work site.
3. The Subcontractor may be required to furnish the Purchaser with at least five bricks of the character and make he proposes to use, at least one week before any bricks are delivered for use. All bricks shall be of the same quality as the accepted samples.

C. Portland Cement Concrete

1. Portland cement concrete for adjustment of precast or poured-in-place concrete manholes shall be in accordance with Section 03050 Portland Cement Concrete.

D. Steel Reinforcement

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1. Deformed steel reinforcing bar and welded wire fabric shall be of the grades, sizes and dimensions and at the designated spacing's and locations as shown on the plans or as directed by the Purchaser.

E. Grade Adapter Ring

1. Grade adapter rings shall be of the standard Memphis type as supplied by Universal Scaffolding. The Subcontractor shall secure and provide the Grade Adapter Ring.

F. Manhole Frame & Cover

1. Manhole Frame & Covers shall be of the standard Memphis type as supplied by Universal Scaffolding. The Subcontractor shall secure and provide the Frame and Cover.

G. Paving Materials

1. Flexible pavement (asphaltic concrete) and rigid pavement (Portland cement) shall be restored in kind using materials in accordance with Section 02950 Removal and Replacement of Pavements and Incidentals.

H. Precast Concrete Manhole Sections

1. Precast concrete manhole sections shall be as specified in the City of Memphis Standard Construction Specification Section 02531 – Installation and Replacement of Manholes.

2.02 EQUIPMENT

- A. All equipment necessary for the satisfactory performance of this work shall be on hand and available before Work will be permitted to begin.

PART 3 EXECUTION

A. Locate Manhole

1. The Subcontractor shall be provided all available field records and plan information regarding the location of manholes that are not on grade and showing. Using field measurements, metal detectors, Sonde, or other devices, the Subcontractor shall first locate the manhole cover to be raised to grade. The surface cover (asphalt, soil) shall then be removed and the manhole frame and rim exposed prior to adjustment. The differential height between the existing manhole rim and the street or easement surface shall be measured and this differential is the basis for the selection of the adjustment method and the payment.

B. Standard Adjustment Method (Adjustments >5" & <18")

1. Any manhole covers not adjusted and set at final grade by others shall be adjusted by the Subcontractor. If the cover requires lowering, the manhole rim shall be removed, sufficient upper courses of brick removed, and the rim reset at proper grade by use of cement mortar over the top course of brick remaining.
2. If the cover requires raising, and reaching the required final rim elevation at grade will exceed the allowable maximum of 5-inches using adapter rings, all existing riser rings in the frame shall be removed and defective courses of brick shall also be removed, and

the manhole shall be rebuilt to the final street or easement grade with the rim reset as described above.

C. Manhole Adjustment with Adapter Rings (Adjustments <5")

1. For manhole covers to be raised less than or equal to 5 inches and where the total collar height would not exceed 18 inches, manhole adapter rings may be used if approved by the Purchaser. Adapter rings may be added to raise the cover a maximum of 5 inches. Adapter rings shall be tack welded to the existing rim at a minimum of 4 locations.

D. Manhole Adjustments (>18")

1. For manhole covers more than 18 inches below grade, the Subcontractor shall be responsible for removing the existing cover or pavement, excavating to locate the actual depth of the existing manhole frame and cover, and raising the frame and cover in accordance with SARP10 specifications and details. If the frame and cover is between 18" and 36" below grade, the Subcontractor shall raise the frame and cover in accordance with SARP10 Detail "*Adjusting Manhole Frame & Cover 5 to 18 Inches.*" If greater than 36", the Subcontractor shall follow the SARP10 Detail "*Adjusting Manhole >18 Inches Deep.*" This shall include replacing existing brick corbels sections with precast manhole sections and/or corbels to attach to the existing manhole structure.

E. Traffic Control

1. All traffic control shall be installed and maintained in accordance with the Manual on Uniform Traffic Control Devices (MUTCD). 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. For bidding purposes, the Subcontractor should assume that a flagman will be needed on 30 percent of the setups.

F. Fall Protection

1. 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.

G. Site Preparation and Restoration

1. The Subcontractor shall prepare and restore the site in accordance with Specification Section 02630 Site Preparation & Restoration. The Subcontractor shall remove the vegetated area around a manhole as needed to adjust the manhole frame and cover. All disturbed areas shall be restored as neatly as practical to their original condition. The disturbed area shall be cleared and raked to the level of the existing turf and then watered. New sod shall be installed over the entire disturbed area. New sod shall consist of live, dense, well rooted growth of Bermuda grass, free from Johnson grass, nutgrass, and other obnoxious grasses or weeds, well suited for the intended purpose and for the soil in which it is to be planted. All sod shall be cleanly cut in strips having a reasonably uniform thickness of not less than 2 inches and cut in 10 to 12 inch squares.

H. Removal & Replacement of Pavements Incidental

1. The Subcontractor shall remove and replace pavement and incidentals in accordance with requirements of Specification Section 02950 Removal and Replacement of Pavement and Incidentals.

I. Restoration of Road Surfaces

1. Flexible pavement (asphaltic concrete) and rigid pavement (Portland cement) shall be restored in kind using materials in accordance with Section 02950 Removal and Replacement of Pavements and Incidentals.

PART 4 MEASUREMENT & PAYMENT

4.01 MEASUREMENT

A. Manhole Adjustment with Adapter Rings (Adjustments <5")

1. Manhole adjustment with adapter rings will be measured per each.

B. Standard Manhole Adjustments (Adjustments >5" and < 18")

1. Standard manhole adjustments will be measured per each.

C. Manhole Adjustments (Adjustments >18" & <36")

1. Manhole adjustments will be measured per each.

D. Manhole Adjustments (Adjustments >36")

1. Manhole adjustments will be measured per vertical foot.

E. 1.5 – inch Manhole Adjustment Ring

1. Manhole adjustment rings will be measured per each.

F. 2 – inch Manhole Adjustment Ring

1. Manhole adjustment rings will be measured per each.

G. #7 Sewer Manhole Frame & Cover

1. Manhole frames and covers will be measured per each.

H. #7 Sewer Manhole Cover Only

1. Manhole covers will be measured per each.

I. Traffic Control

1. Traffic control will be paid for per each construction area.

J. Site Preparation and Restoration

1. The area to be considered for measurement will be the limit of the construction area unless otherwise directed by the Purchaser.

2. When the Proposal Sheet(s) do(es) not contain an item for Site Preparation and Restoration, this work will be required within the construction limits and will not be paid for directly but will be considered as a subsidiary obligation of the Subcontractor under other contract items.

K. Sonde Used to Locate Manhole

1. Sonde use to locate manholes will be measured per each manhole employed.

4.02 PAYMENT

A. Manhole Adjustment with Adapter Rings (Adjustments <5")

1. The accepted quantities of manholes adjusted by the adapter ring method will be paid for at the contract unit price per each, for raising the manhole cover to final grade, which price will be full compensation for furnishing all labor and materials necessary for the complete adjustment of the cover to the satisfaction of the Purchaser.

B. Standard Manhole Adjustments (Adjustments >5" and < 18")

1. The accepted quantities of manholes adjusted will be paid for at the contract unit price per each, for raising or lowering the existing or new manhole frame and cover to final grade, which price will be full compensation for furnishing all labor and materials necessary for the complete adjustment of the frames and covers to the satisfaction of the Purchaser.

C. Manholes Adjustments (Adjustments >18" & <36")

1. The accepted quantities of manholes adjusted will be paid for at the contract unit price per each, for raising or lowering the existing or new manhole frame and cover to final grade, which price will be full compensation for furnishing all labor and materials necessary for the complete adjustment of the frames and covers to the satisfaction of the Purchaser.

D. Manhole Adjustments (Adjustments >36")

1. The accepted quantities of manholes adjusted will be paid for at the contract unit price per each, for raising or lowering the existing or new manhole frame and cover to final grade, which price will be full compensation for furnishing all labor and materials necessary for the complete adjustment of the frames and covers to the satisfaction of the Purchaser.

E. 1.5 – inch Manhole Adjustment Ring

1. Manhole adjustment rings will be paid per each. This payment shall include procurement of the manhole adjustment ring from Universal Scaffolding and delivery to the site.

F. 2 – inch Manhole Adjustment Ring

1. Manhole adjustment rings will be paid per each. This payment shall include procurement of the manhole adjustment ring from Universal Scaffolding and delivery to the site.

G. #7 Sewer Manhole Frame & Cover

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1. Manhole frames and covers will be paid per each. This payment shall include procurement of the manhole frame and cover from Universal Scaffolding and delivery to the site.

H. #7 Sewer Manhole Cover Only

1. Manhole covers will be paid per each. This payment shall include procurement of the manhole adjustment ring from Universal Scaffolding and delivery to the site.

I. Traffic Control

1. Traffic control will be paid for per each construction area including all appurtenances required to comply with MUTCD standards.

J. Site Preparation & Restoration

1. Payment will be made for Site Preparation and Restoration at the price, per each construction area which will be full compensation for removal of trees, shrubs, plants, brush, rubbish, fences, manmade obstructions including but not limited to structures, abandoned cars and appliances, building foundations, and all other obstructions as may be directed by the Purchaser; the disposal of debris, removing of obstructions, and the restoration of fences, turfed areas, and all other items will be as specified in the Plans and Contract Documents or as directed by the Purchaser.

K. Sonde Used To Locate Manhole

1. Payment will be made for use of a Sonde to successfully locate and raise a buried manhole that cannot be located after attempting other means. Sonde use must be approved in advance by the Purchaser.

4.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02532-4.01.A	MANHOLE ADJUSTMENTS WITH ADAPTER RINGS (ADJUSTMENTS <5")	EACH
02532-4.01.B	STANDARD MANHOLE ADJUSTMENT (ADJUSTMENT >5" AND <18")	EACH
02532-4.01.C	STANDARD MANHOLE ADJUSTMENT (ADJUSTMENT >18" AND <36")	EACH
02532-4.01.D	STANDARD MANHOLE ADJUSTMENT (ADJUSTMENT >36")	EACH
02532-4.01.E	1.5 – INCH MANHOLE ADJUSTMENT RING	EACH
02532-4.01.F	2 – INCH MANHOLE ADJUSTMENT RING	EACH
02532-4.01.G	#7 SEWER MANHOLE FRAME AND COVER	EACH
02532-4.01.H	#7 SEWER MANHOLE COVER ONLY	EACH
02532-4.01.I	TRAFFIC CONTROL PER CONSTRUCTION AREA	EACH
02532-4.01.J	SITE PREPARATION AND RESTORATION	EACH
02532-4.01.K	SONDE TO LOCATE MANHOLE	EACH

END OF SECTION 02532

**SECTION 02533
REHABILITATION AND REPAIR OF EXISTING MANHOLES**

PART 1 GENERAL

1.01 SCOPE

- A. This work shall consist of the repair and rehabilitation of existing sanitary sewer manholes as shown on the Drawings, stipulated in the Contract Documents, or as directed by the Purchaser. The construction will be accomplished by these Specifications and in conformity with the 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. Unless otherwise provided, the Subcontractor is required to furnish all labor, materials, equipment, and incidentals required to rehabilitate or repair manholes as noted on the Drawings or directed by the Purchaser.
- B. The Subcontractor shall accurately field measure and size each individual manhole. Each existing sewer manhole designated to be repaired or rehabilitated may have a different configuration and varying field dimensions.
- C. Each manhole to be rehabilitated shall be thoroughly cleaned of all loose or missing bricks, loose mortar, holes, etc. shall be repaired. All leaks shall be plugged with active leak-stop material prior to manhole rehabilitation. The material for stopping leaks and repairing nonleaking holes, cracks, etc. in concrete and masonry manholes shall be compatible with the coating system used for rehabilitation.
- D. The presence or absence of leakage through manhole walls noted on the manhole inspection reports and as seen in the Subcontractor's independent manhole inspections prior to bidding or construction depend on the groundwater levels and conditions at the time of the inspections. High groundwater levels in the project area typically occur in the dormant season (December through May), but will vary with rainfall in any given year and sewer location. Under certain circumstances, the groundwater currently entering the leaking sewer mains and laterals may migrate to the manholes after the sewer mains and laterals are rehabilitated or replaced. The Subcontractor shall reflect assumptions and judgments on leakage through manhole walls based on this information in the unit prices bid for lining manholes. All leakage shall be stopped prior to lining manholes. No additional payment will be made for repairing leaks not visible prior to bidding or sewer rehabilitation.
- E. When applicable, the manhole lining shall not be installed until all main sewer lining and other manhole rehabilitation work is complete.
- F. Where existing manholes are being repaired or rehabilitated, the Subcontractor shall arrange his work so that sewage flow will be maintained during the construction period with no discharge of sewage into an open trench, and no backup of sewage into the existing line. The Subcontractor shall provide necessary bypass pumping capacity to carry flow downstream of the manhole to be rehabilitated or repaired.
- G. Replacement Manholes shall conform to Specification Section 02531.
- H. Cast iron frames shall be set at the required elevation and properly bonded to the flat top, eccentric cone, or grade rings with two rings of butyl mastic sealant and anchor bolts as specified in Section 02532 Sanitary Sewer Manhole Adjustments.
- I. Definitions/Standards
 - 1. ASTM D-638: Test Method for Tensile Properties of Plastics.

2. ASTM D-695: Test Method for Compressive Properties of Rigid Plastics.
3. ASTM D-790: Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
4. ASTM D-4541: Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
5. ASTM D-412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
6. ASTM D-2240: Standard Test Method for Rubber Property Durometer Hardness
7. ASTM D-522: Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
8. ICRI03732: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

J. Quality Assurance

1. The Subcontractor shall furnish materials of quality required by the American Society for Testing and Materials (ASTM) standards and industry approved standards and specifications.
2. The Subcontractor shall provide guarantee against defective materials and workmanship in accordance with the requirements of these specifications.

K. Sequencing

1. All required interruptions of flow through manholes or any other portion of the sanitary sewer system shall be coordinated with the Owner and Purchaser, and approval must be received from the Purchaser prior to the interruption.

L. Substitutions

1. Should the Subcontractor wish to use any brand or type of material other than as specified herein, he shall so state in writing to the Purchaser naming the proposed substitution and manufacturer. This statement shall be accompanied by a certificate of compliance from an approved independent testing laboratory that the proposed substitute meets or exceeds the specified requirements and has been tested in accordance with the specified test standards. The statement shall also include documented proof that the proposed brand or type of material has a proven record of performance when used in the intended application as confirmed by actual field test or successful installations.

M. Samples

1. The Subcontractor shall apply the manhole lining system material on a sample area not less than four square feet (4 ft²) in size. When approved, the sample area shall serve as a standard of acceptance for all further work.

1.02 SUBMITTALS

- A. Unless otherwise specified, all sample submittals shall be delivered to the Purchaser within two weeks of the NTP.
- B. Product Data on the following:
 - 1. Crack and hole repair products
 - 2. Cementitious plug material
 - 3. Active leak-stop material
 - 4. Frame and cover seals
 - 5. Cementitious coating system including application requirements and chemical resistance data
 - 6. Gasket polymer properties
- C. Manufacturer's Certificate of Compliance for each type of product that product furnished meets requirements of this Section.
- D. Manufacturer's written recommendations for product handling and installation.
- E. Subcontractor shall submit to the Purchaser evidence indicating that the proposed applicators are fully qualified to perform the work, and any proposed applicator found to be not qualified shall (at the written request of the Purchaser) be removed forthwith by the Subcontractor.
- F. The Coating Manufacturer shall warranty the entire project to include any and all aspects of the surface preparation, base material installation and protective coating applications for a period of ten (10) years from the date of acceptance by the Purchaser. The warranty shall make no distinction between installation practices and material performance and shall not be prorated with respect to elapsed time for the entire warranty period. Manufacturer shall, within a reasonable period of time after receipt of written notice thereof by the Purchaser [period not to exceed sixty (60) calendar days], repair defects in materials or workmanship during said TEN (10) year period, and any damage to other work caused by such defects or repairing of same at his own expense and without cost to the Purchaser.

1.03 DELIVERABLES

- A. The Subcontractor shall provide post-rehabilitation MACP inspection for each manhole. Refer to Section 02544 Manhole GPS & MACP Inspection.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manhole Lining System
 - 1. The material applied to the surface of the manhole shall be a cementitious blend of acid resistant binders, siliceous aggregates, non-metallic fibers and other additives for constructing a coating that is impervious to the flow of water, is resistant to sulfide attack, and restores structural integrity to existing manhole walls. The product shall be Quadex QM-1S Restore, Reliner MSP by Standard Cement Materials, or approved equal, unless otherwise specified for urethane or epoxy resin coating top coat.

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2. The manhole lining system shall be spray applied or centrifugally cast lightweight structurally reinforced cement manhole coating.
3. The material applied onto the surface of brick or concrete manholes shall be a cementitious system formulated for application within a sanitary sewer environment. For concrete manholes in good structural condition, the Subcontractor shall install the lining to a minimum ½-inch thickness. For all other concrete manholes and for all brick manholes, the Subcontractor shall install the lining to a minimum 1-inch thickness. The coat of material shall be used to smooth the walls, benches, and inverts of the manhole and, as necessary, prepare the manhole for a final coat of a urethane or epoxy resin system when directed by the Purchaser. When a urethane or epoxy resin system is used, the base coat (cementitious layer) shall be 1/2-inch for epoxy systems and 1/8-inch thick for urethane systems. The Subcontractor can request to not use a base coat but must provide to the Owner and Purchaser evidence of successful installations of the product without using a base coat and its capability to properly adhere to the manhole wall and form a smooth finish on the wall, bench, and invert. In cases where the base coat is not used, the thickness of the top coating shall be increased by the base coat thickness listed above.
4. A monolithic liner shall be formed which covers all interior manhole surfaces and shall have the following minimum requirements at 28 days:
 - a. Compressive Strength (ASTM C-109) 3000 PSI
 - b. Tensile Strength (ASTM C-496) 300 PSI
 - c. Flexural Strength (ASTM C-293) (Modified) 600 PSI
 - d. Shrinkage (ASTM C-596) 0% at 90% R.H.
 - e. Bond (ASTM C-882) 130 PSI
 - f. Density, when applied 130 ± PCF
5. The Installer shall warrant and save harmless the Owner and his Purchaser against all claims for patent infringement and any loss thereof. The Subcontractor shall handle and store all material and shall dispose of all wastes in accordance with applicable regulations.
6. Each system shall be designed for application over damp (but not active running water) surfaces without degradation of the final product and the bond between the product and the manhole surfaces. Active leaks shall be stopped using a premixed fast-setting, volume-stable waterproof cement plug consisting of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents. It shall not contain chlorides, gypsum, plasters, iron particles, aluminum powder or gas-forming agents, or promote corrosion of steel it may come in contact with. Set time shall be approximately 1 minute. Ten-minute compressive strength shall be approximately 500 PSI.
7. All invert channels shall be coated with cementitious mortar to prevent infiltration and to build up the invert channel to the new sewer main invert elevations, where applicable; to fill all voids, cracks, and holes and to form a smooth flow channel. The entire channel shall be coated. The coating shall be a minimum ¼-inch to ½-inch thick.

B. Mortar

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

C. Butyl Mastic Sealant

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

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

2.02 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 EXECUTION

3.01 PRELIMINARY AND GENERAL ITEMS

A. Notification of Work

1. The Subcontractor shall notify all property owners who discharge sewage directly to the manhole being rehabilitated that their service will be discontinued while the work is completed. The Subcontractor shall notify individual property owners at least 72 hours in

advance, giving the date, start time, and estimated completion time for the work being conducted. This notification shall be coordinated with the door hanger distribution.

B. Traffic Control

1. All traffic control shall be installed and maintained in accordance with the Manual on Uniform Traffic Control Devices (MUTCD). 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 heavy traffic volume, a flagman may also be needed to assist with traffic control. For bidding purposes, the Subcontractor should assume that a flagman will be needed on 30 percent of the setups.

C. Fall Protection

1. The Subcontractor shall install and maintain all fall protection measures in accordance with OSHA standards and the SARP10 Loss Control Manual. The Subcontractor shall construct a controlled access zone around the manhole being rehabilitated, repaired or 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.

D. Cleaning/Surface Prep

1. All manholes to be rehabilitated shall be thoroughly cleaned before rehabilitation. All grease, oil, laitance, coatings, loose bricks, mortar, unsound concrete and other foreign materials shall be completely removed. Debris resulting from cleaning shall be removed from the manhole and not allowed to be carried downstream.

E. Flow Control

1. The Subcontractor shall be responsible for plugging or diverting the flow of sewage as needed for repair and coating of manhole inverts and benches.

F. Bypass of Flow

1. 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 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.
2. 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.

3. 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.
4. The Subcontractor shall be required to provide businesses with temporary service, as needed, and will be responsible for all necessary bypass pumping flows.

G. Wastewater Spills

1. 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.

3.02 MANHOLE REHABILITATION – CEMENTITIOUS COATINGS

- A. The surface prior to spraying shall be damp without noticeable water droplets or running water. Materials shall be spray applied to a minimum uniform thickness to ensure that all cracks, crevices, and voids are filled and a smooth surface remains after light troweling. The Subcontractor shall perform light troweling to compact the material into voids and to set the bond, where applicable.
- B. Application procedures shall conform to the recommendations of the protective coating manufacturer, including handling, thickness, mixing, environmental controls during application, safety, and spray equipment
- C. Existing manhole steps shall be cut and removed prior to coating. Manhole steps are not to be replaced.
- D. The first application shall have begun to take an initial set (disappearance of surface sheen which could be 15 minutes to one hour depending upon ambient conditions) before the second application to ensure a minimum total finished thickness of 1/2 inch. The final finished thickness may need to be greater than 1/2 inch in accordance with the manufacturer's recommendations to withstand groundwater pressures. A depth gauge shall be used during application, at various locations, to verify the required thickness. The surface then shall be troweled to smooth finish with care taken not to over trowel so as to bring additional water to the surface and weaken it. Manufacturer's recommendation shall be followed whenever more than 24 hours have elapsed between applications.
- E. The bench covers used to catch debris shall be removed and the bench and invert sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than 1/2 inch. The wall-bench intersection shall be rounded to a uniform radius the full circumference of the intersection.
- F. No application shall be made to frozen surfaces or if freezing is expected to occur within the manhole for 24 hours after application. If ambient temperatures are in excess of 95°F, precautions shall be taken to keep the mix temperature at time of application below 90°F, using ice if necessary.
- G. The final application shall have a minimum of four (4) hours cure time before subjected to actual flow.

3.03 INVERT AND BENCH REPLACEMENT

- A. Remove all loose grout and rubble from existing channel. Replace the invert and bench by removing the existing invert and bench and reconstructing with concrete conforming to Section 03050 Portland Cement Concrete. Work shall include aligning inflow and outflow ports in such a manner as to prevent the deposition of solids at the transition point. All inverts shall follow the grades of the pipe entering the manhole. Changes in direction of the sewer and entering branch or branches shall have a true curve of as large a radius as the size of the manhole will permit, but shall be shaped to allow easy entrance of maintenance equipment including buckets, TV camera, etc. Benches shall be constructed to the highest pipe crown elevation and sloped to drain toward the flow-through channel.
- B. Apply a minimum ½-inch finished thickness of cementitious liner material over the surface of the replaced invert and bench where cementitious coating is noted on Drawings or directed by the Purchaser. Allow the liner material to cure for a minimum of four hours before being subjected to flow.

3.04 RESET AND RESEAL MANHOLE FRAME AND COVER

- A. If the existing manhole frame is misaligned on the manhole, the Subcontractor shall remove the existing manhole frame and cover and, if they are not being reused, dispose of them as directed by the Purchaser. It shall be the responsibility of the Subcontractor, at no additional cost to the Purchaser, to repair any damage to the chimney or corbel caused by the removal of the existing manhole frame. Existing frames and covers that are to be reused shall be thoroughly cleaned before reinstallation.
- B. If the manhole frame is to be raised, the work shall be performed in conformance with Section 02532 of the City of Memphis Standard Construction Specifications modified by the SARP10 Program.
- C. The manhole frame for the cover shall be set on the manhole sidewall in a full bed of flexible butyl resin gasket material at the required elevation. In addition, the frame shall be bolted to the grade rings. Where manholes are constructed in paved areas or fill slopes, the surface of the frame and cover shall be tilted so as to conform to the exact slope, crown, and grade of the existing pavement or area adjacent thereto.
- D. Any new manhole frame and cover replacement shall result in a minimum 24 inches diameter clear opening to the manhole.

3.05 SEWER MANHOLE DROP CONSTRUCTION

- A. Inside drop structures shall be installed in existing manholes at the locations shown on the Drawings and/or as directed by the Purchaser. Drop construction shall conform to the details shown on *Sanitary Manhole Drop Construction* Detail. The Subcontractor shall cut a hole in the manhole wall to permit inserting the inlet pipe at the required flow line elevation, horizontal angle, and slope, and to allow two (2) inches space around the pipe for bedding and filling solidly with nonshrinking grout. Care shall be used to avoid unnecessary damage to the existing masonry or concrete. Drop structure construction shall be installed before cementitious coating is applied where shown on the Drawings or directed by the Purchaser.
- B. All loose material shall be removed from the cut surfaces, which shall be completely coated with grout before setting the pipe. Before inserting the pipe and flexible connector, a sufficient thickness of grout shall be placed at the bottom and sides of the opening for proper bedding of the pipe. After setting, all spaces around the pipe shall be solidly filled with grout and neatly pointed up on the inside to present a smooth joint, flush with the inner and outer wall

surface. Any necessary modifications to the existing invert shall be made to provide a smooth, plastered surface for properly channeled sewage flow from the new connection. All drop construction shall be constructed of either ductile iron pipe with push on or mechanical joints or PVC pipe. Solvent cement joints may be used on PVC for drop construction. The vertical drop construction shall have the dead weight held by suitable means until the steel support straps are secured in place and tightened. The pipe mechanical joint bolts, if used, shall not be positioned against the manhole wall. The steel support straps shall be fastened to the manhole wall with two bolts per strap set in expansion sleeves in drilled holes.

3.06 MANHOLE REHABILITATION ACCEPTANCE

- A. After the manhole rehabilitation work has been completed, the manhole shall be visually inspected by the Subcontractor in the presence of the Purchaser’s Representative, and the work shall be accepted if found satisfactory to the Purchaser’s Representative. When a cementitious coating is applied, the finished surface shall be free of blisters, “runs” or “sags” or other indications of uneven coating thickness. No evidence of visible leaks shall be allowed.
- B. Vacuum Testing will be required for all manholes that receive a cementitious coating. The vacuum testing method shall be conducted as follows:
 - 1. Subcontractor shall plug all pipe openings, taking care to securely brace the plugs and the pipe. The plugs shall be placed a minimum of 6 feet beyond the manhole wall.
 - 2. With the vacuum tester in place, the Subcontractor shall inflate the compression to affect a seal between the vacuum base and the structure. The Subcontractor shall connect the vacuum pump to the outlet port with the valve open and evacuate the manhole to 10-inches Hg (0.3 bar) for 48 inch diameter manholes and 5-inches Hg (0.15 bar) for 60-inch and greater diameter manholes.
 - 3. Subcontractor shall close vacuum inlet/outlet ball valve, disconnect the vacuum pump, and monitor the vacuum for the specified time period. If the vacuum does not drop in excess of 1-inch Hg over the specified time period, the manhole is considered acceptable and passes the test. If the manhole fails the test, The Subcontractor shall identify the leaking areas by removing the head assembly, coating the interior surfaces of the manhole with a soap and water solution, and repeating the vacuum test for approximately thirty seconds. Once the leaks have been identified, the Subcontractor shall complete all necessary repairs by sealing the leaks of the manhole to the satisfaction of the Purchaser’s Representative, and repeat test procedures until satisfactory results are obtained.

Vacuum Test Timetable			
	Manhole Diameter (Inches)		
Depth (Feet)	48”	60”	72”
4’	10 sec.	13 sec.	16 sec.
8’	20 sec.	26 sec.	32 sec.
12’	30 sec.	39 sec.	48 sec.
16’	40 sec.	52 sec.	64 sec.

Vacuum Test Timetable			
	Manhole Diameter (Inches)		
Depth (Feet)	48”	60”	72”
20’	50 sec.	65 sec.	80 sec.
24’	60 sec.	78 sec.	96 sec.
*	5.0 sec.	6.5 sec.	8.0 sec.
*Add extra testing time “T”, for each additional 2-foot depth. (The values listed above have been extrapolated for ASTM designation C924-85.			

4. The Purchaser reserves the right to reject any and all manholes that do not pass vacuum testing requirements, and replacement shall be at the Subcontractor’s expense. A significant number of leaks on a single manhole or significant number of manholes leaking shall be considered as a basis for rejection and replacement of manholes.
5. Where vacuum testing is not applicable, the Subcontractor shall be directed by the Purchaser to conduct a high-voltage holiday test.

3.07 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.

3.08 WARRANTY AND GUARANTEE FOR REHABILITATED MANHOLES

- A. The Subcontractor shall guarantee the rehabilitated manholes for ten (10) years after acceptance by the Purchaser to the extent that he will repair any leaks that may appear in them during this period because of faulty workmanship or materials furnished by him at no additional expense to the Owner. As required by 2.01.A.9, the Subcontractor shall also have written documentation that the Coating Manufacturer provides a ten (10) year warranty for all manholes receiving a cementitious coating.

PART 4 MEASUREMENT & PAYMENT

4.01 MEASUREMENTS

- A. Manhole Rehabilitation – Cementitious Coating
 1. Cementitious coating will be measured per vertical foot of manhole from the downstream invert up to the bottom of the frame casting.
- B. Invert and Bench Replacement
 1. Invert and bench replacement will be measured per each.

C. Reset and Reseal Manhole Frame and Cover

1. Manhole frame and cover rehabilitation will be measured per each.

D. Sewer Manhole Drop Construction

1. Drop construction in existing manholes will be measured per vertical foot as measured from the upper inlet pipe flowline to the flowline of drop pipe elbows at the bottom of the drop construction.

E. Sewer Manhole Drop Construction

1. Drop construction in existing manholes will be measured per vertical foot as measured from the upper inlet pipe flowline to the flowline of drop pipe elbows at the bottom of the drop construction.

F. Traffic Control

1. Traffic control will be measured per each standalone manhole being rehabilitated when not associated with an adjoining sewer segment being rehabilitated.

G. Bypass Pumping

1. Bypass pumping is considered to be an incidental to the sewer manhole rehabilitation.

H. Dewatering

1. Dewatering is considered to be an incidental to sewer manhole rehabilitation.

4.02 PAYMENTS

A. Manhole Rehabilitation - Cementitious Coating

1. Cementitious coating of manholes will be paid for at the contract unit price per vertical foot which shall be compensation for surface preparation, sprayed on lining, removal and disposal of manhole steps, and vacuum testing.

B. Invert and Bench Replacement

1. The accepted quantities of invert and bench replacement will be paid for at the contract unit price per each. It shall include all work and material to install new inverts in existing manholes, as directed by the Purchaser.

C. Reset and Reseal Manhole Frame and Cover

1. The accepted quantities for frame and cover rehabilitation will be paid for at the contract unit price per each which shall be full compensation for all labor and material necessary to complete the item as specified in these Contract Documents.

D. Sewer Manhole Drop Construction

1. The accepted quantities of sewer manhole drop construction will be paid for at the contract unit price per vertical foot, complete in place for drop construction in new

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manholes or drop construction in existing manholes, which will be full compensation for materials and materials testing, excavation, special protection, maintenance of sewage flow during construction, construction of drop pipe, pipe fitting and connections, installation of steel support straps, placement, curing, and protection of concrete from the manhole base to the top of drop construction, cleaning and inspection, and backfilling outside of pavement areas. Payment for drop construction for new manholes will be in addition to payment for standard depth manhole and extra depth construction (if required).

E. Traffic Control

1. Traffic control will be paid per Crew Day for manholes rehabilitated including all appurtenances required to comply with MUTCD standards. Only standalone manhole rehabilitation will include a separate traffic control payment. All traffic control for manholes with adjoining sewer segment rehabilitation will be included in the traffic control for the associated pipe.

4.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02533-4.01.A	MANHOLE REHABILITATION – CEMENTIOUS COATING	VF
02533-4.01.B-1	INVERT AND BENCH REPLACEMENT (48" Diameter)	EACH
02533-4.01.B-2	INVERT AND BENCH REPLACEMENT (>48" Diameter)	EACH
02533-4.01.C	RESET/RESEAL MANHOLE FRAME AND COVER	EACH
02533-4.01.D-1	SEWER MANHOLE DROP CONSTRUCTION (<5')	EACH
02533-4.01.D-2	SEWER MANHOLE DROP CONSTRUCTION (5'-10')	EACH
02533-4.01.D-3	SEWER MANHOLE DROP CONSTRUCTION (>10')	EACH
02533-4.01.E	TRAFFIC CONTROL	CREW DAY

END OF SECTION 02533

SECTION 02540
SANITARY SEWER POINT REPAIRS

PART 1 GENERAL

1.01 SCOPE

- A. This work shall consist of the construction of sanitary sewer gravity main point repairs of the kinds and dimensions shown on the Drawings, stipulated in the Contract Documents, or as directed by the Purchaser. The construction will 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 will furnish all material, equipment, tools, labor, and incidentals necessary to complete the Work.

1.02 REFERENCES

- A. City of Memphis Standard Construction Specifications.
- B. American Standard for Testing and Materials (ASTM).
- C. American National Standards Institute (ANSI).

1.03 DEFINITIONS

- A. A point repair as used in these Specifications shall mean repair of pipe segments of existing sanitary sewer mains or service lines and connections which require excavation to accurately locate a defect and make the necessary repair.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe Materials

- 1. All repairs to existing gravity sewer lines shall be made using ductile iron pipe. Ductile iron pipe for gravity sewer and service connections will conform to ASTM A 746. 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 Protecto 401 Ceramic Epoxy, or approved equal. 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. Steel retainer rings will conform to ASTM A 148 for Grade 90 60.

B. Elastomeric Couplings

- 1. Elastomeric couplings for connecting replacement pipe to existing pipe shall be Fernco Series 5000 RC Shielded Couplings with nut and bolt clamp, Mission "Flex-Seal" adjustable shielded repair coupling or approved equal.

C. Crushed Limestone

1. Crushed limestone will 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

D. Geotextile Material

1. Geotextile fabric shall meet 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	Corps of Engineers	40 (max)
U.S. Standard Sieve	CW-02215	

2.02 EQUIPMENT

- A. The Subcontractor will 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 will be on site and approved by the Purchaser before work will be permitted to begin.

PART 3 EXECUTION

3.01 SITE PREPARATION AND RESTORATION

A. Disposition of Excavated Material

1. Excavated material suitable for backfill will be stored no closer than 2 feet from the edge of the excavation. Excavated material will not obstruct crosswalks, side-walks, driveways, street intersections, nor interfere unreasonably with travel on streets. Gutters or other surface drainage facilities will not be obstructed. The Subcontractor must provide access to fire hydrants, mail boxes, sewer and conduit manholes and similar utility or municipal service facility as required. Excavated material intended for backfill will 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 will 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 will be given to the Purchaser. No surplus or excess material will be deposited in any stream channel nor anywhere that would change preconstruction surface drainage.

B. Control of Water

1. The Subcontractor will keep all excavations free of water. If the trench subgrade consists of good soil in good condition at the time of excavation, it will 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 will be provided by the Subcontractor. Dewatering of trenches, will be incidental to trench excavation. The Subcontractor will avoid producing mud in the trench bottom by his operations. If necessary or so ordered by the Purchaser, the Subcontractor will 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 will be done in a water free trench or excavation. Trenches will be kept clear of water until pipe joints, concrete and masonry have set and are resistant to water damage. The water will 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 will be kept in operation, or their flows will be satisfactorily diverted and provided for during construction. Any facilities disturbed during construction will be restored to the satisfaction of the Purchaser.

C. Excavation Around Obstructions

1. The Subcontractor will cautiously excavate test holes to find the limits of under-ground 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 by machinery would endanger trees, structures, or utilities that otherwise might be saved by hand excavation.
3. Hydroexcavation:
 - a. In order to protect existing utilities, the Subcontractor 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 point 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.

D. Special Protection

1. Treacherous Ground:
 - a. When running sand, quicksand, or other treacherous ground is encountered, the work will be carried on with the utmost urgency and will continue day and night should the Purchaser so direct.
2. Sheeting and Shoring:
 - a. The Subcontractor will 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 will place this sheeting and shoring without the Purchaser's instructions.

- b. Sheeting will 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) will 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, will not exceed the maximum width of a trench per Specification Section 02530. Walers and struts will be designed and installed to present no obstructions to proper placement of the pipe, pipe embedment, cradle or encasement, and they will not interfere with the satisfactory installation of the pipe.
- c. Sheeting, bracing, and shoring will be withdrawn and removed as the backfilling is being done, except where the Purchaser permits the material to be left in place. The Subcontractor will cut off sheeting left in place at least 2 feet below the surface and will remove the cut off material from the excavation.
- d. All sheeting, bracing, and shoring which are not left in place under this provision will be removed in a way that will not endanger the completed work or other structures, utilities, storm drains, sewers, or property. The Subcontractor will be careful to prevent the opening of voids during the extraction process.
- e. If sheeting and shoring are not specifically required on the Plans 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 will be carefully backfilled and compacted following trench backfill requirements.

E. Existing Utilities

1. It will 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:
 - a. The Subcontractor will protect any storm drain, sewer, or utility within the limits of the construction. The Subcontractor will proceed with caution and will use every means to establish the exact location of underground structures and facilities before excavating in the vicinity. The City or Purchaser will 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 will 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 will arrange for such work with the Owner or Owners of the facilities. No additional payment will be made by the City or Purchaser for this work.
4. Service Connections:
 - a. Sewer and utility services between mains and buildings will be maintained and adjusted as necessary by the Subcontractor to provide as nearly a continuous operation as can be expected. This will be accomplished in any way that the Subcontractor chooses, provided the individual service is not interrupted for more

than two consecutive hours. The occupants will be notified by the Subcontractor at least six hours before such service interruptions. When a break occurs, the Subcontractor will notify the affected occupant(s) of the probable length of time that the service will be interrupted.

5. If existing underground facilities or utilities require removal and replacement for the performance of this work, all replacements will be made with new material conforming to the requirements of these Specifications. If not specified, the material will be as approved by the Purchaser.
6. The removal and replacement of water services to adapt to new construction will be the Subcontractor's responsibility within the limits where the new service line grade blends smoothly with the existing service line grade.
7. The removal and replacement of sewer house connections to adapt to new construction will be the Subcontractor's responsibility from the sewer main to a point where the new grade and existing grade can be matched.
8. The Subcontractor will 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.

F. Maintenance of Flow

1. Where existing sewer lines are being modified, the Subcontractor will 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 will provide necessary bypass pumping capacity to carry flow downstream of the section to be modified.

G. Cleanup

1. After the installation work has been completed, the Subcontractor shall cleanup the entire project area. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Subcontractor. The work area shall be left in a condition equal to or better than it was prior to the performance of the Work. Disturbed grassed areas shall be seeded or sod placed as directed by the Purchaser at no additional cost to the Owner. Site restoration shall be performed in accordance with the City of Memphis Standard Construction Specifications.

3.02 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 will continue following as closely behind pipe installation as practical. All backfill will 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 will be taken to avoid allowing wood to be included in the backfill, other than sheeting and shoring that has been approved to be left in place.
2. The Subcontractor will be responsible for the condition of the trenches and filled areas during the contract and warranty period. The Subcontractor will maintain frequent inspection of the same. Anytime during the 12-month warranty period the trenches or

filled areas settle and sunken places appear, the Subcontractor will 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 will 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:

- a. Backfill for pipe trench excavations through pavements in street or highway right of way or where the Purchaser orders, will be made with pit run gravel or other acceptable material as approved by the Purchaser. The backfill will 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.
- b. Backfill for pipe trench excavations beyond pavements in street or highway right of way or outside public right of way will 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.
- c. Select material will 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 will 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.

2. Placement and Compaction:

- a. Backfill material will 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 will 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 will be mechanically placed in 9 inch, maximum, loose layers. All backfill material will 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).

C. Open Areas and Unimproved Property

1. Backfill of excavations on unimproved property will 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 will come in direct contact with the pipe. Stones and lumps will be kept separated and well distributed, and all voids will be completely filled with fine material.

3.03 METHOD OF REPAIR

- A. The Subcontractor shall replace a sufficient number of entire pipe joints to ensure that defective pipe is removed and replaced up to 10 feet in length, per repair, at the discretion of the Purchaser, in accordance with the SARP10 Sanitary Sewer Point Repair detail.
- B. If the length of the required replacement segment is not adequate to locate sufficient competent pipe for connection with the new section, the Subcontractor, at the Purchaser's instruction, may be directed to replace additional sections of pipe such that an appropriate connection is possible.
- C. The Subcontractor shall replace service wyes encountered within the point repair. Any defective service lines encountered within the point repair shall be replaced.
- D. Any service line or competent main line pipe broken by the Subcontractor shall be replaced at the Subcontractor's expense.
- E. The Subcontractor shall remove any fences, base materials, storm sewer, etc. that may interfere with the repair made at each specified point. The Subcontractor is responsible for the replacement of said fences, base materials, storm sewer etc., in the same or better condition than found.
- F. The bottom of the trench shall be reshaped so that the grade of the pipe replaced will match that required for the existing sewer line. The pipe embedment material shall be placed and the repair area shall be backfilled in accordance with Section 02530 Sewer Pipe Installation of the City of Memphis Standard Construction Specifications Modified by the SARP10 Program.
- G. If the material in the bottom of the trench is of such consistency that it is not stable, then the Subcontractor shall stabilize the bottom of the trench by placing suitable materials at the direction of the Purchaser in accordance with the 3.02 C. 1. Undercut Excavation of Section 02530 Sewer Pipe Installation of the City of Memphis Standard Construction Specifications Modified by the SARP10 Program.
- H. Prior to backfilling, point repairs shall be inspected by the Purchaser.

3.04 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 will conform to the requirements given below. At the direction of the Purchaser or as shown on the Drawings, sewer pipe and backfill will be encapsulated in geotextile fabric meeting the following requirements:
 - B. Crushed Limestone
 - 1. Pipe embedment material will be Number 67 crushed limestone. Pipe 8 inches to 24 inches in diameter will be bedded on 4-inches of Number 67 crushed limestone Pipe 27 inches to 48 inches in diameter will be bedded on 6-inches of bedding material. Pipe embedment for pipes larger than 48 inches in diameter will be by design based on anticipated soil conditions. After pipe installation, crushed limestone will 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 will be as outlined in this Specification's Backfill requirements.

3.05 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. All tests will be made by the Subcontractor who will provide necessary equipment for testing and lamping the system in the presence of and under the supervision and instructions of the Purchaser. Lamp tests will be observed first hand by the Purchaser. Each section of sewer line will show a full circle of light when lamped between manholes. All defects located will be corrected before conducting leakage tests
- B. After backfilling and resurfacing, sewer segments containing point repairs shall be internally televised (CCTV) by the Subcontractor in their entirety in accordance with Section 02541 – Closed Circuit Television Inspection of Sewer Mains and Connections for final review and approval by the Purchaser.

3.06 TRAFFIC CONTROL

- A. All traffic control shall be installed and maintained in accordance with the Manual on Uniform Traffic Control Devices (MUTCD). 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. For bidding purposes, the Subcontractor should assume that a flagman will be needed on 30 percent of the setups.

3.07 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.

PART 4 MEASUREMENT & PAYMENT

4.01 MEASUREMENT

A. Sewer Point Repair

- 1. Sewer point repairs will be measured per each. The repair length of ten linear feet will be measured along the centerline of the new pipe. Each additional linear foot of repair, directed by the Purchaser, beyond the minimum 10 feet will be measured for payment. The depth of the repair is measured from the existing grade to the pipe invert.

B. Service Connection Removal and Replacement

- 1. Service connection removal and replacement for all service wyes encountered within the point repair shall be measured per each, complete in place. Service connections damaged by the Subcontractor that do not require removal and replacement for construction of the sanitary sewer point repair will not be measured for payment.

C. Traffic Control

1. Traffic control will be paid per each sewer point repair.

D. Site Preparation and Restoration

1. The area to be considered for measurement will be the limit of the construction area unless otherwise directed by the Purchaser and shall be measured per each point repair.

E. Pavement Backfill

1. 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.

F. Hydroexcavation/ Hand Digging

1. Hydroexcavation and/or hand digging of the trench perimeter will be measured per each point repair.

4.02 PAYMENT

A. Sewer Point Repair

1. The accepted quantities of all mainline sewer point repairs will be paid for at the contract unit price per each for the various pipe sizes and depth of repair, which will be full compensation for material and material testing, excavation, special protection, protection of existing utilities, maintenance of sewage flow, pipe embedment, haunching, 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.

B. Service Connection Removal and Replacement

1. Service connection removal and replacement for all service wyes encountered within the point repair shall be paid per each at the contract unit price for all service connections and associated lateral pipe. This payment shall include the excavation, removal of old service line and appurtenances, furnishing and construction of the new service line, connections to existing service line, and appurtenances to remain, and backfilling, complete in place.

C. Traffic Control

1. Traffic control will be paid per each sewer point repair including all appurtenances required to comply with MUTCD standards.

D. Pavement Backfill

1. 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.

E. Hydroexcavation/ Hand Digging

1. Hydroexcavation and/or hand digging of the trench perimeter will be paid per each point repair where one of these methods is used. Payment shall include all material and labor required to complete the item as specified with the expectation of 4 hours of crew time. Time spent for mobilization, traveling to and from the jobsite, and disposal of spent material will not be paid for separately. Any additional hydroexcavation or hand digging necessary due to extenuating circumstances or unforeseen obstructions will be paid per hour. The hourly rate will be equal to the unit cost divided by 4. Any work to be paid above and beyond the contract unit price must be approved by the Program Manager prior to work beginning

4.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02540-4.01.A-1.1	SEWER POINT REPAIR	EACH
02540-4.01.A-1.2	EACH ADDITIONAL LINEAR FOOT BEYOND THE 10 FEET MINIMUM FOR SEWER POINT REPAIR	LINEAR FOOT
02540-4.01.B	SERVICE CONNECTION REMOVAL AND REPLACEMENT	EACH
02540-4.01.C	TRAFFIC CONTROL PER POINT REPAIR	CREW DAY
02540-4.01.D	PAVEMENT BACKFILL FOR POINT REPAIR	CUBIC YARD
02540-4.01.E	HYDROEXCAVATION/ HAND DIGGING	HOUR

END OF SECTION 02540

SECTION 02541
CLOSED CIRCUIT TELEVISION INSPECTION OF SEWER MAINS & CONNECTIONS

PART 1 General

1.01 SCOPE

- A. This Work will consist of cleaning and Pipeline Assessment Certification Program (PACP) internal closed circuit television (CCTV) surveys to digitally inspect and record conditions of existing sanitary sewer mains and connections. Sewer pipes and connections to be inspected are located in both improved streets, arterial and primary roads, backyards and unimproved easements.
- B. The Work covered by this section includes furnishing all labor, competent PACP certified technicians, equipment, tools, accessories, and materials required to clean and inspect the designated sanitary sewer lines.

1.02 SUBMITTALS

A. PACP Requirements

- 1. PACP compliant inspections, logs, data, and photos shall be delivered to the Program Manager (from hereon Program Manager shall be interpreted as “Program Manager or his designee”) on external hard drive(s) which will become property of the Program Manager. Data files shall be formatted to facilitate upload into a PACP compliant Exchange database or internet uploads formats to an FTP site approved by the Program Manager.
- B. Unless otherwise specified all sample submittals shall be delivered to the Program Manager within two weeks of the NTP.
- C. For rehabilitation work, only Post-Rehabilitation PACP submittals will be required by the Purchaser. All CCTV done prior to rehabilitation shall be at the expense of the Subcontractor to ensure conformance with the Specifications.

D. Traffic Control

- 1. Traffic Control Plan shall be submitted to the Program Manager, including the following items:
 - a. Outline of permit acquisition procedure for lane closures.
 - b. Methods for proper signing and barricades, which comply with City of Memphis requirements.
 - c. Major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit if taking a lane for mobile operations, secured through Traffic Control Plan submittal to the City and signed by a TN P.E. The City requires two-week lead time for permit processing.
 - i. The Subcontractor will be required to deliver a sample primary/arterial road Traffic Control Plan for review by the City.
 - ii. If the City determines that the nature of the work operation or the type of road in which the Subcontractor is working requires a permit, the Subcontractor will be

required to modify the sample Traffic Control Plan to obtain a permit from the City.

- d. For everywhere else where a permit is not required, the Subcontractor shall develop, provide, and implement a traffic control plan for all mobile operations in accordance with standard MUTCD specifications.

E. Permits

1. The Subcontractor is also responsible for acquiring all necessary disposal and/or landfill site permits as required to perform this work.
 2. Railroad Rights of Way: The Subcontractor shall notify the Program Manager when work or access to manholes and sanitary sewers lie within the 25 feet railroad easement as measured by 25 feet outside the nearest rail of the tracks. To access sewer facilities within the 25 feet of the railroad right of way the Subcontractor shall contact the Program Manager 48 hours in advance who will alert the City's Zone Construction Inspector to coordinate individual railroad direction and guidance.
 3. Permit required confined space entry plans in compliance with the Loss Control Manual.
- F. Copies of National Association of Sewer Service Companies (NASSCO) certification for all field staff conducting PACP inspections.
- G. Sample of PACP compliant television survey log in MS Access format.
- H. Sample of PACP compliant video inspection in MP-4 (Web optimized) format.
- I. Cleaning and CCTV vehicle, equipment, and cleaning supplies list.
- J. Disposal site(s) and appropriate landfill permits for appropriate disposal of all waste materials removed from the sewer during the light and heavy cleaning operations.

1.03 DELIVERABLES

A. Records

1. Pipe Cleaning Record
 - a. The Subcontractor shall provide a dated manifest of the volume or weight of the dewatered sewer cleaning loads taken and dumped at the permitted landfill. Each waste load manifest shall be associated with a list of corresponding sewer segments from where the waste originated.
2. Digital Inspection Record
 - a. In the digital PACP V.6.0.1 compliant format, the Subcontractor shall provide the following information:
 - i. Digital CCTV survey inspection which shall be recorded and shall be continuous as the inspection proceeds through the manholes and sewer pipes. Inspection videos should be delivered in an MP-4 (Web optimized) format.
 - ii. Digital Recordings: The digital recording shall document the visual and audio record of the manhole and sewer pipe inspection and shall be the basis of measurement and payment. Digital recording playback shall be at the same

speed that it was recorded. Original digital recordings for the Project shall be forwarded to the Program Manager on clearly labeled external hard drive(s) in PACP ACCESS format with final report submittals and shall become the property of the Program Manager. Data for a single facility asset will not be split across multiple hard drives. Digital recordings shall be available to the Program Manager by the close of business on the Monday following a week after data acquisition. File naming must be consistent. Additional instructions, naming conventions, file structures, etc. will be provided after contract award.

- (1) Picture Quality: The sewer inspection digital record shall be free of steam, fog, vapor, or other headspace distortion that degrades the quality of the picture from the intended purpose of evaluating the sewer for structural and watertight integrity. If necessary, the Subcontractor shall provide positive ventilation or other means through the sewer pipe to draw out steam, fog, and vapor that will degrade the recorded image of the pipe.

3. Inspection Documentation Logs

- a. Observations made during television inspection shall be documented in an unmodified PACP compliant manner within an electronic inspection log form, supported by accompanying audio, digital photographs and MP-4 (Web optimized) format recording written to an external hard drive and submitted to the Program Manager. Hard copies of completed inspection log photographs shall be furnished to the Program Manager with invoicing.

4. Electronic & Hard Copy Records

a. Reports:

- i. The Subcontractor shall prepare printed inspection log reports for each associated sewer pipes inspected during the actual field inspection activities. These field logs shall then be reviewed by the Subcontractor's technical staff, along with reviewing the associated digital video record, as a means of ensuring that no defects or entries are omitted or incorrect. Edited field logs shall then be used in the final project reports and submitted in pdf format.

b. Draft Report and Final Report:

- i. The Draft Final Report will contain electronic and hard copies of each of the PACP CCTV log pipe segment inspection logs. Digital recordings of the inspections written to an external hard drive and the PACP compliant database of the inspections in ACCESS format shall also be submitted in electronic and pdf format.
- ii. Draft Report shall be delivered to the Program Manager within fifteen working days the last or final inspection. The Program Manager will have two work weeks to review and comment. Subcontractor shall address all comments provided and submit a Final Report within one work week upon receipt of comments. At the Program Manager's discretion a meeting will be held so the Subcontractor can explain the processes used to address the comments.

5. Quality

- a. Rejection of deliverables will be submitted to the Subcontractor via the Program Team in a written communication discussing issues that must be addressed. The Subcontractor will be required to follow up with a response within three business days upon receipt of the written communication. Subcontractors will have seven (7)

calendar days from the rejection notice date to make the necessary corrections and resubmit the data deliverable in its entirety.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General

1. All equipment used for PACP compliant CCTV sewer segment inspections of existing sanitary sewer mains and connections shall be specifically designed and manufactured for the purpose intended under this Contract. The software and hardware for the electronic capture of the inspection defects and recorded observations must be Version 6.0.1 NASSCO PACP compliant.
2. The Subcontractor shall submit an equipment list to the Program Manager for approval before the commencement of the Work and shall certify that back-up equipment is available and can be delivered to the worksite within 72 hours.
3. The Subcontractor shall provide equipment to perform inspections of sewer mains located in streets, street rights-of-way, backyards, easements and rights-of way that are off-road.
 - a. Including but not limited to portable CCTV equipment, vehicles capable of transporting TV equipment and accessing remote easements, and adequate cleaning equipment rights of way or easement applications.

B. PACP Compliant Software & Data Logger Requirements

1. Data logger
 - a. Internal inspection logs created and captured electronically during the television inspection through the use of commercially available electronic data loggers in the truck are required. NASSCO PACP protocols Version 6.0.1 shall be used for capturing and recording the observations. Audio commentary made during the inspection and captured on the digital video shall correspond with the PACP observations on the log.
 - b. The data logger equipment and software shall allow the Program Manager access directly to the captured electronic data and provide for a non-proprietary export of the data into MS ACCESS databases in accordance with PACP standards for standalone database review.
2. Software must be compliant with the NASSCO PACP V.6.0.1 standards. Follow PACP protocol for recording of observations and defects for sewer mains.
 - a. All software shall be capable of providing complete survey reports in compliance with PACP, and the software shall be the V.6.0.1 of the PACP compliant software.
 - b. The Program Manager has no intent to specify which software the Subcontractor shall use, but requires the software and the submitted database to be fully compliant with PACP V.6.0.1 and capable of being exported to ACCESS databases. No payment will be rendered for improperly formatted data.
 - c. Software and data logger must be capable of capturing sewer main and sewer lateral observations by PACP descriptions, record travel footage along pipeline, and video

time stamp the recorded observations to support hyper linking from the digital record to the event point or location within the digital inspection record. The same requirements apply to still photo images (if provided) which shall follow PACP guidelines and be hyperlinked to the inspection log.

C. Sewer Main CCTV

1. Sewer Main Digital Color Video Camera

- a. All cameras used shall be digital format color CCTV units specifically designed and constructed for use in sewer pipe inspection work. The cameras shall be operable in 100 percent humidity conditions. The camera shall have a high-resolution, 360-degree pan and tilt or rotating head with a wide viewing angle lens and either automatic or remote focus and iris controls. Camera lighting shall be sufficient for use with digital color inspection cameras and for the manhole and pipe diameters identified in the contract.
 - i. Camera, Television Monitor, and Other Components shall be capable of producing a high resolution color digital inspection record.
 - ii. Video file to be in MP-4 (Web optimized) format
- b. In all cases, the complete digital inspection system (camera, lens, lighting, cables, monitors, and recorders) shall be capable of providing a digital picture and digital video quality acceptable to the Program Manager. Inadequate lighting, image distortions, blurry or murky images, and dirty lenses will be a cause for rejection. No payment will be made for unsatisfactory inspections and the Subcontractor shall perform work until deliverable is of acceptable quality. Digital video cameras/digital recorders not specifically intended for use for internal television inspection of manholes and sewer lines shall not be permitted.
- c. Pan and tilt type camera, capable of turning at right angles to pipe's axis over an entire pipe wall perimeter shall be used.
 - i. The camera lens shall be capable of self-righting itself after a lateral view or connection view with a return view down the pipe with a "home" capability for the lens.
- d. Lighting shall be suitable to allow clear picture of entire inner pipe wall extending at least 10 feet in front, including black High Density Polyethylene (HDPE) pipe.
- e. Document header and observations shall be in accordance with PACP V.6.0.1 protocols.

D. Cleaning Equipment

1. Hydraulic sewer pipe cleaners or combination hydraulic/vacuum cleaners shall be specifically designed and constructed for such cleaning.
2. Mechanical sewer pipe cleaners shall be specifically designed and constructed for such cleaning.

3. The Subcontractor shall possess equipment capable of hydraulically or mechanically cleaning a minimum of 1,000 linear feet of pipe from one direction and have a minimum 1,000 linear feet of hose or cable on-site during the cleaning execution.
4. Hydraulic sewer pipe cleaners shall be specifically designed and constructed for such cleaning. The sewer cleaner shall have a minimum usable water capacity of 600 gallons and a pump capable of delivering at least 30 gallons per minute at 1,500 psi at the nozzle.
 - a. The hydraulic cleaning equipment shall have multiple hydraulic cleaner hose nozzles for a variety of sewer cleaning conditions, including grease, roots, debris and granular materials.
 - b. Vacuum equipment shall be capable of lifting debris removed from the segment from the downstream manhole.
5. Mechanical sewer pipe cleaners (cable machines with buckets, brushes, swabs, root cutters, and power rodders with similar capability) shall be capable of controlled forward and reverse travel through the sewers without inflicting damage to the existing pipe in removing rocks, grit and other heavy debris and roots.

PART 3 EXECUTION

3.01 INSPECTIONS

A. CCTV Inspection of Sewer Mains

1. Cleaning
 - a. Sewer pipe cleaners or combination hydraulic-vacuum cleaners must accompany CCTV units at all times. Ideally, sewers lines are to be cleaned and then followed immediately by CCTV inspection. All sewers must be cleaned in advance of CCTV during the same calendar day they are inspected.
 - b. Light Cleaning
 - i. Before CCTV work, the Subcontractor shall light clean the sewer line from manhole to manhole, from upstream to downstream direction unless an obstruction is encountered, one sewer section at a time and performed as efficiently as possible at the Subcontractor's discretion.
 - ii. Materials shall not be passed from one sewer segment to another but must be trapped and removed from each sewer segment prior to CCTV inspection.
 - c. Heavy Cleaning
 - i. If a camera is inserted and additional debris or impediments to inspection are observed following the required light cleaning, heavy cleaning shall be approved by the Program Manager. Sections of pipe containing significant roots, large areas of debris, and/or several inches of depth of sands and gravels that will require the use of additional hydraulic nozzles, cable/bucket machine, power rodders and root cutters is considered heavy cleaning.
 - ii. Heavy cleaning will be proposed by the Subcontractor and approved by the Program Manager. The Subcontractor must obtain prior approval for heavy cleaning in each sewer segment in order to receive payment for heavy cleaning.

d. Cleaning Execution

- i. No roots, grease or debris from light or heavy cleaning shall be passed from sewer segment to sewer segment during the cleaning operation. All debris flushed from the sewer must be collected, captured, and removed from the sewer at the downstream manhole.
- ii. Roots shall be removed in the sections where root intrusion is a problem. Special precautions shall be exercised during the cleaning operation to assure complete removal of visible roots from the joint area and so as not to incur further damage to the pipe. Any visible roots that may impact rehabilitation efforts shall be removed. Fine roots are allowed if the Subcontractor made a heavy cleaning attempt to remove roots with proper root removal means. Procedures may include the use of mechanical devices such as rodding machines, expanding root cutters and porcupines, and hydraulic procedures such as high-pressure jet cleaners.
- iii. The Subcontractor is responsible for safe, responsible and legal handling and disposal of all material and debris removed from the sewers. The Subcontractor is responsible for all permits and landfill fees associated with the disposal of debris collected and removed from the sewer.
- i. Proper disposal arrangements are the exclusive responsibility of the Subcontractor. The Subcontractor shall provide a dated manifest of the volume and weight of the dewatered sewer cleaning loads taken and dumped at the permitted landfill. The Subcontractor shall not dispose of debris at a City of Memphis Wastewater Treatment Plant. Each waste load manifest shall be associated with a list of corresponding sewer segments from where the waste originated.

2. Sewer Flow Levels During Inspection Operations

- a. Maintain low sewer flow during inspection by using sandbags or flow-through plugs or by inspecting during low flow times of day, evening, or early morning hours while camera is moving and recording observations in the sewer segment. Any items used to restrict flow shall be removed immediately after intended use.
 - i. Flow-through Plugs: If used, secure the plugs so as to remain in place during inspection. Use a fail-safe device at the downstream pipe connection to ensure the plug is not lost in the downstream sewer segment if it becomes dislodged from the upstream pipe connection.
 - ii. Conduct all cleaning and CCTV operations to prevent building backups and sewer overflows.
 - iii. Subcontractor shall be responsible for cleanup, repair, fines, property damage costs, and claims for any sewage backup, spillage or sanitary sewer overflow during or as a result of the cleaning and inspection operations.
- b. Allowable Depth of Flow For Inspection Operations
 - i. For effective inspection, all flow shall be minimized in the segment being inspected. However, the depth of flow at the upstream manhole of the interceptor section being worked shall be within the specified limits provided herein.

- c. Maximum Allowable Depth of Flow for CCTV Inspection
 - i. 6 - 10 inch diameter Pipe - 20% of pipe diameter
 - ii. 12 - 18 inch diameter Pipe - 25% of pipe diameter
 - iii. 24-inch diameter and Larger Pipe - 30% of pipe diameter
 - iv. Exceptions to these guidelines shall result in rejection, and non-payment, of the CCTV inspection unless approved in advance by the Program Manager.
- 3. Camera Operations
 - a. Using the pan/tilt feature, pan the interior of the manhole for record purposes in accordance with V.6.0.1 PACP protocols and begin and terminate the inspection in the starting and ending manholes.
 - i. Capture the inside of manhole walls, manhole channel, and pipe connection to wall at both upstream and downstream manhole and lateral connections using the digital mainline sewer camera and the pan/tilt feature.
 - b. Place the camera at center of manhole and commence video before entering pipe.
 - i. Start footage counter at manhole wall/pipe connection or at a short pre-measured distance down the pipe for the sewer segment inspection.
 - c. Connections: The digital camera shall be used to look at connections and up laterals from the connection in the main sewer pipe being inspected. The camera shall pause, pan, and record all connections. Conditions noted in these sidelines and laterals shall be noted on the inspection logs.
 - d. Mainline camera operations:
 - i. Move through line at speed no greater than 30 feet per minute stopping for minimum 10 seconds to record lateral connections, mainline connections, defects, and features and points of interest.
 - ii. Do not float camera.
 - iii. Maintain technical quality, sharp focus, and distortion free picture with the camera lens centered in the pipe for the different diameters inspected.
 - (1) Eliminate steam in line for duration of inspection.
 - (2) Utilize blower as needed to defog sewer line.
 - iv. Digitally record a complete sewer segment in its entirety with no breaks, "blink-outs," or interruptions from manhole to manhole according to PACP V.6.0.1 formats.
 - v. Pan, tilt, and rotate as necessary to best view and evaluate lateral connections, pipe defects, features, obstructions, and points of interest.
 - vi. Use power winches, powered rewinds, self-propelled tractors, or other devices that do not obstruct camera view or interfere with proper documentation of sewer conditions to move camera through sewer.

- (1) Whenever non-remote powered and controlled winches are used, set up telephones or other suitable means of communication between manholes to insure good communication.
- vii. Use hydraulic jet nozzle pressure and flow to remove standing water from depressions or sags in the sewer, if necessary, for complete inspection of the sag portion of the sewer segment.
- viii. Measurement for location of defects and service laterals:
- (1) At ground level by means of Program Manager-approved footage counter or metering device.
 - (2) Electronic display measurement meters: Accurate to PACP standards over length of section being televised.
 - (3) Do not pull unnecessary length of slack camera cable if it impacts the footage counter.
- ix. Stop camera at service connections and inspect lateral with pan and tilt camera.
- (1) Identify building connection in PACP compliant terms as active, capped, or abandoned.
 - (2) If no wastewater flows are being discharged from building, consider steady, clear observed flow as infiltration/inflow.
- x. Identification of Defects
- (1) If roots, sludge, or sediment material impedes inspection after the light cleaning, withdraw camera and perform heavy cleaning at the direction of the Program Manager.
 - (2) Upon completion of heavy cleaning operation, resume internal inspection.
 - (3) Furnish media confirmation for heavy cleaning (more than three passes with jet cleaner) to Program Manager.
 - (4) If protruding tap impedes inspection trim protruding tap to 1/2 inch.
- xi. If obstructions are not passable and cannot be removed by sewer cleaning, withdraw CCTV equipment and perform a reverse inspection from opposite end of the sewer segment in accordance with PACP protocols.
- (1) Subcontractor shall be responsible for costs associated for reverse set-ups when an obstruction is encountered that cannot be passed.
 - (2) Subcontractor shall be responsible for all judgments and impacts as to whether an obstruction in the sewer main can be passed. Costs involved in extracting a stuck camera in the sewer main will be borne by the Subcontractor and at no additional cost to the Program Manager.
 - (3) When additional obstructions are encountered after reversal of equipment and no means are available for passing a second obstruction in order to complete the sewer main inspection, remand the segment inspection to the

Program Manager for resolution. The portion of the main inspected will be paid for as prescribed.

xii. Undocumented facilities

- (1) If undocumented manholes or sewer mains (facilities not on the field updated GIS sewer maps) are encountered during the inspection, the Subcontractor needs to complete the documentation requirements per PACP requirements and capture on the video the following:
 - (a) Approximate horizontal distance from the upstream or reference manhole.
 - (b) Approximate depth of the undocumented manhole by turning the pan/tilt camera vertically and estimating the height of the cover from the invert.
 - (c) A provisional manhole asset ID number shall be used by the Subcontractor by adding a dash and two-character number to the closest upstream manhole ID.

xiii. Retrieval of Stuck Equipment

- (1) The Subcontractor is responsible for hiring a licensed sub-Subcontractor to retrieve any equipment/foreign objects that get stuck in the sewer system through the execution of the scope of work (fallen cameras, jet nozzles, inflatable plugs, sandbags etc.) at the Subcontractor's own cost. Such retrieval by an appropriately licensed sub-Subcontractor shall be made within 72 hours to avoid interfering with the City of Memphis sewer system operations. Any and all impacts and related costs due to the Subcontractor's equipment in the line shall be the responsibility of the Subcontractor. Subcontractor shall follow SARP10 sewer point repair specifications outlined in "Section 02540 Sanitary Sewer Point Repairs" and "Section 02950 Removal and Replacement of Pavements and Incidentals" during retrieval of equipment. Also per "00585.2.2 Safety, Health, and Accident Prevention Program," Purchaser must approve sub-tier Subcontractors prior to mobilization to the jobsite.

4. Quality Assurance

- a. With each monthly invoice the Subcontractor shall provide a QA/QC memo documenting that 10% of the previous month's CCTV data has undergone a random, independent review by a PACP certified reviewer using NASSCO standards for Television Inspection of Main Sewer and PACP Quality control as the basis for the QA/QC procedures. The independent reviewer shall be a Tennessee P.E. or is a P.E. in another state and has a Tennessee P.E. license pending. Each line segment which has been randomly reviewed shall be identified in the QA/QC memo as well as any subsequent findings or recommendations. Internal independent QA/QC is acceptable, as long as the person is a Tennessee P.E. or is a P.E. in another state and has a Tennessee P.E. license pending. Failure to submit the QA/QC memo shall delay payment of the current month's invoice.
- b. For all new Subcontractors and Operators who begin PACP coding, an initial review of CCTV data will consist of reviewing, at a minimum, 20 of the first 100 PACP inspection records submitted. Subsequent reviews will be based on the results of the initial reviews as explained below.

c. Auditing Procedures:

- i. Header Information: As explained in the NASSCO PACP Quality Control Standards each audited inspection record is given an accuracy level for the header information and the detailed observation records. It is expected that the accuracy of the header record exceed 90% because the majority of the contents are based upon facts and not subject to operator judgment. To assess the accuracy level of the header, record the number of errors as compared to the total number of header fields using the following formula:

(1) **$100\% - (\text{error count}/\text{total header fields}) * 100\% = \text{Header Accuracy}$**

- ii. Detailed Observations: Determining the accuracy level for the detailed observation records is similar to the method for assessing the header record. The main difference being that a defect observation has multiple data entries that must also be counted towards the total number of entry fields. In the event that a defect is not coded all of the required entries for coding the missed defect are counted towards the total error count. The following formula is used to calculate the accuracy level of the detailed observation records:

(1) **$100\% - (\text{error count}/\text{total entries}) * 100\% = \text{Detail Accuracy}$**

iii. Review Scoring and Results

- (1) Satisfactory Review, No changes required. Accuracy Level of 90% or above for both the Header Record and Observation Detail with no major errors or omissions found.
- (2) Unsatisfactory Review (below levels of acceptance) will not be accepted by the Program Manager and will not be considered payable items in the Subcontractor's Request for Payment.

5. Deliverable Documentation

a. Mainline Sewer

- i. Submit V.6.0.1 PACP compliant records, logs, and electronic inspection data for sewer line inspection to Program Manager by the close of business on the Monday following a week after data acquisition.
- ii. Monthly QA/QC memo submittal listing which segments have been randomly reviewed, as well as any subsequent findings or recommendations.
- iii. Digital videos, data, and photos shall be delivered to the Program Manager on external hard drives which will become property of the Program Manager.
- iv. Data files shall be formatted to facilitate upload into a PACP Exchange Database with the approval of the Program Manager.
- v. Inspections displaying poor digital video/audio quality will be rejected. Quality refers to, but is not limited to, grease or debris on lens, camera under water, image too dark or light, image washed-out, distorted image, out of focus images, lines improperly cleaned, and poor/no audio.
- vi. Subcontractor will re-televised rejected inspections and resubmit inspections at no additional cost to the Program Manager.

- b. Map changes/undocumented manholes:
 - i. For map changes identifying undocumented manholes and network changes which were found as a result of field inspections or observations, a Map Edit Form shall also be prepared and supplied by the Subcontractor with a drawing or sketch and shall indicate special details, field measurement or distances, or locations about an observed undocumented manhole or a change to the sewer network. The Map Edit Form should also identify buried manholes and siphons that have been encountered.
 - ii. Subcontractor shall indicate all buried manholes identified in the field via CCTV using the provided Buried Manhole Form. Any additional manholes that have not been located or verified via CCTV but are impeding the completion of required CCTV work should be designated as unable to locate (UTL) and be included on the form.
 - c. Incident observation and data collection:
 - i. The Subcontractor shall report all buried manholes, pipe collapses, large void, utility conflicts, Unable to Complete line segments, and heavy cleaning requests to the Program Manager through the program-defined reporting application (Teamworx) and shall fill out all required fields and attach picture documentation as necessary. At least one picture shall be included showing the incident or condition of the sewer line encountered that required it to be recorded. All reported incident observations will be monitored by the Program Manager and inadequate reporting will result in a meeting between the Program Manager and Subcontractor.
6. Easement or Turf Operation
- a. The Subcontractor will restore the work area to its original condition as quickly as possible after the inspection is complete. The Subcontractor will not be allowed to postpone restoration of the site until the end of the project.

PART 4 MEASUREMENT & PAYMENT

4.01 MEASUREMENT

A. Light Cleaning & CCTV Inspection

- 1. Light cleaning and mainline CCTV inspection shall be measured by linear foot by each diameter of mainline sewer inspected and documented in accordance with the specification.

B. Heavy Cleaning

- 1. Heavy cleaning shall be measured by linear foot of each diameter of heavy cleaning approved by the Program Manager and documented.

C. Remote Trimming of Protruding Service Lateral

- 1. Remote trimming of protruding service lateral that prevent a thorough inspection of the pipe will be measured per each.

4.02 PAYMENT

A. Mainline CCTV Inspection

1. Light cleaning and mainline CCTV inspection shall be paid for at the unit price for each linear foot of each diameter inspected and documented in accordance with the specification.
2. The unit price for Light Cleaning and Mainline CCTV inspection shall cover the entire cost of the required light cleaning and CCTV inspection and reporting in accordance with PACP V 6.0.1 format, including but not limited to labor, mobilization and access, CCTV equipment, recording media, traffic control, light cleaning of mainline sewer, documenting results in PACP records and logs, digital format recordings, photo equipment, power supply for equipment, interim and final reports and all other appurtenant work.
3. No additional payment will be made for:
 - a. Re-inspection due to rejected inspection and/or records for any reason.
 - b. Reversals.
 - c. Performing excavation and associated sewer point repair to retrieve a stuck CCTV camera or hydraulic cleaning hose/nozzle.
 - d. Incomplete electronic logs.
 - e. Unapproved duplication of inspections: The Subcontractor is responsible to ensure duplications do not occur.

B. Heavy Cleaning

1. Heavy Cleaning shall be paid for at the unit price for each linear foot of each diameter of heavy cleaned sewers at the direction of the Program Manager and in accordance with the specification.
2. The unit price for Heavy Cleaning shall include the entire cost including but not limited to labor, mobilization and access, traffic control, appropriate disposal of sewer debris removed from sewer at permitted site and all other appurtenant work. Payment includes non-hydraulic jet efforts such as porcupines, cutters, power rodding, clam buckets, and other mechanical means, traffic control, and re-cleaning with hydraulic jet, labor, materials, and equipment necessary to clean mainline sufficiently to allow video reviewers a clear picture of pipe conditions.
3. No additional payment will be made for:
 - a. Additional passes of heavy cleaning if the inspection observation reveals roots, grease or other debris remaining in the sewer after the heavy cleaning passes.

C. Remote Trimming of Protruding Service Lateral

1. Remote trimming of protruding service lateral that prevent a thorough inspection of the pipe will be measured per each.

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4.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02541-4.01.A	LIGHT CLEANING & MAINLINE CCTV INSPECTION FOR EACH DIAMETER	LINEAR FEET
02541-4.01.B	HEAVY CLEANING FOR EACH DIAMETER	LINEAR FEET
02541-4.01.C	REMOTE TRIMMING OF PROTRUDING LATERAL	EACH

END OF SECTION 02541

**SECTION 02544
MANHOLE GPS & MACP INSPECTION**

PART 1 GENERAL

1.01 SCOPE

- A. This Work shall consist of locating sanitary sewer system facilities, gathering sub-meter grade GPS coordinates of manhole (including lamphole) covers, Manhole Assessment Certification Program (MACP) protocol Level 1 and Level 2 manhole inspections using the National Association of Sewer Service Companies (NASSCO) MACP Version 6.0.1 protocols, associated photographs, camera inspection of manholes and the associated pipe connections, and documentation of manholes not found, not on grade and/or not showing. The work shall also consist of completing an internal 3D manhole scan for each manhole with a depth greater than 25 feet or associated with large-diameter sanitary sewer interceptors (36-inch diameter and larger). Manholes to be located, documented and inspected are in both improved streets, arterial and primary roads, backyards and unimproved easements. Manholes may be elevated significantly above the existing ground level. Subcontractor shall have appropriate all-terrain vehicles necessary to access the work, in addition to any equipment necessary to access all elevated manholes while remaining in compliance with The Loss Control Manual. Once new manhole coordinates are obtained, the updated source GIS map data shall be delivered to Program Manager in order to reflect the actual sewer system network.
- B. The Work covered by this section includes furnishing all labor, competent MACP certified technicians/crew leads, equipment, tools, accessories, and materials required to GPS, perform MACP Level 1 and Level 2 inspections, conduct 3D scan camera inspections where applicable and document the specified manholes.
- C. Selected Subcontractor(s) will be provided two Geo-databases; one will have supporting records (aerial photo overlays, outfall and block maps and as-builts, as available), and a maiden database which will include the asset ID for each manhole.

1.02 SUBMITTALS

- A. GPS Requirements
 - 1. Sub-meter GPS coordinates, updated GIS map data, Levels 1 and 2 MACP data and records, and camera inspection photos and 3D scan of the manholes shall be delivered to the Program Manager on clearly labeled external hard drive(s) which will become property of the Program Manager. Inspection data for any one asset shall not be delivered on multiple drives. MACP data files shall be formatted to facilitate upload into a MACP Exchange Database or internet upload to an FTP site as approved by the Program Manager.
- B. Unless otherwise specified, all sample submittals shall be delivered to the Program Manager within two weeks of the NTP.
- C. For rehabilitation jobs, only Post-Rehabilitation MACP submittals will be required by the Purchaser.
- D. Traffic Control
 - 1. A Traffic Control Plan shall be submitted to the Program Manager, including the following items:

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- a. Outline of permit acquisition procedure for lane closures.
 - b. Methods for proper signing and barricades, which comply with local requirements and the City.
 - c. Major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit if taking a lane for mobile operations, secured through Traffic Control Plan submittal to the City and signed by a TN P.E. The City requires a two-week lead time for permit processing.
 - i. The Subcontractor will be required to deliver a sample primary/arterial road Traffic Control Plan for review by the City.
 - ii. If the City determines that the nature of the work operation or the type of road in which the Subcontractor is working requires a permit, the Subcontractor will be required to modify the sample Traffic Control Plan to obtain a permit from the City.
 - d. For everywhere else where a permit is not required, the Subcontractor shall develop, provide, and implement a Traffic Control Plan for all mobile operations in accordance with standard MUTCD specifications.
- E. Permits
- 1. The Subcontractor is also responsible for acquiring all necessary disposal and/or landfill site permits required to perform this work.
 - 2. Railroad Rights of Way: The Subcontractor shall notify the Program Manager when work or access to manholes and sanitary sewers lie within the 25 feet railroad easement, as measured by 25 feet outside the nearest rail of the tracks. To access sewer facilities within the 25 feet of the railroad right of way, the Subcontractor shall contact 48 hours in advance the Program Manager, who will alert the City's Zone Construction Inspector to coordinate individual railroad direction and guidance.
 - 3. Permit required confined space entry plans in compliance with the Loss Control Manual.
- F. GPS calibration standards, including frequency, are to be followed in the field; specify which available base stations will be used for the work.
- G. Sample of sub-meter GPS coordinates delivered in electronic and pdf format.
- H. Copies of NASSCO certifications for all field staff conducting MACP Levels 1 and 2 inspections.
- I. Sample of MACP Level 1 and Level 2 documentation logs (with photo documentation comments and photos properly referenced) in MACP formats, in both electronic and pdf format.
- J. Equipment list, including GPS and 3D camera manufacturer and model equipment to be used.
- K. Sample of the GPS coordinate delivery in an ESRI ArcPAD .axf file format.
- L. Sample of the digital inspection data delivery in MS ACCESS database format.
- M. Sample of 3D manhole inspection and all software necessary to view inspections.

1.03 DELIVERABLES

A. Records

1. GPS Manhole Cover Coordinates

- a. Subcontractor's Level 1 Lamphole and Level 2 Manhole GPS coordinate delivery to the Program Manager shall be in an ESRI ArcPAD .axf file format. The updated GIS source map data reflecting the actual sewer system network shall also be delivered. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition. Subsequent data will not be accepted if GPS data is not obtained and delivered at the same time as inspection is conducted. The requested GPS control check file (MS EXCEL) shall also be delivered at this time.

2. Level 1 and Level 2 Inspection Documentation

- a. Deliver complete MACP Level 1 for lampholes and Level 2 inspections for manholes in MACP electronic database and pdf electronic formats on an external hard drive. Delivery will be in MS ACCESS database format unless otherwise preapproved by the Program Manager. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition.

3. 3D Camera Inspection

- a. For manholes greater than 25-feet in depth or associated with lines 36-inches or greater in diameter, the Subcontractor shall provide the Program Team with the software required to view the digital film file in the way the Subcontractor can view it, including full control of the virtual pan and tilt. The digital files must include the following:

- i. An unfolded view of the manhole with a minimum of 3,000 lines of vertical resolution.
- ii. The capability to produce three-dimensional representation of the manhole structure.
- iii. A distortion-free virtual pan and tilt allowing the review of the manhole structure from any angle at any depth. The virtual pan and tilt must consist of view from the bottom and top camera, any virtual pan and tilt that artificially creates this view from a single camera will be deemed unacceptable due to distorted images on the direct side view.

2. Camera Inspection Documentation

- a. Include specified camera photo documentation of defects, leaks and pipe connections in the MACP Image reference field as appropriate, for the Level 2 documentation. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition.

3. Manhole Reports

- a. Deliver a summary report in PDF format of each manhole inspected. The report will include all MACP Level 1 & Level 2 data collected for the manhole. The report shall include the surface view photo of the manhole with the outlet pipe facing 6 o'clock as

well as a downhole photo of the channel with the outlet pipe at 6 o'clock. Any defects noted in the manhole shall also have an accompanying photo in the report.

4. Draft Report and Final Report

- a. In addition to the electronic database and pdf format reports, three copies of the Draft Report will contain hard copies of each of the MACP inspections with camera manhole defect and pipe connection photographs. The MACP compliant database of the inspections in ACCESS format shall also be submitted to the Program Manager electronically on an external hard drive.
- b. Draft Report shall be delivered to Program Manager within fifteen working days of the last or final inspection. The Program Manager will have a two workweek period to review and provide comments to the Subcontractor. The Subcontractor shall address all comments and submit the Final Report within one workweek from receipt of comments. At the Program Manager's discretion, a meeting will be held upon submittal of the Final Report to have the Subcontractor go over the processes used to address comments.

5. Quality

- a. Rejection of deliverables will be submitted to the Subcontractor via the Program Team in a written communication discussing issues that must be addressed. The Subcontractor will be required to follow up with a response within three business days upon receipt of the written communication. Subcontractors will have seven (7) calendar days from the rejection notice date to make the necessary corrections and resubmit the data deliverable in its entirety.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Subcontractor shall have appropriate all-terrain vehicles necessary to access the work. Expected terrain may require the use of four-wheel drive vehicles, ATVs, tracked vehicles, or other appropriate off-road vehicles. Additionally, the Subcontractor shall have all equipment necessary to access elevated manholes in accordance with the Loss Control Manual.
- B. All equipment used for the gathering of GPS coordinates, collection of condition assessment information, and digital 3D camera inspection of manholes shall be specifically designed and manufactured for the purpose intended under this Contract. The software and hardware for the electronic capture of the inspection defect observations must be consistent with NASSCO's MACP Level 1 and Level 2 requirements for the collection of data. ESRI ArcPad 10.1 is required for GPS data collection and GIS map updates for manhole / lamphole facility locations. Export of the electronic inspection data to an MACP format Microsoft ACCESS database for analysis is required.
- C. The Subcontractor shall submit an equipment list to the Program Manager for approval before the commencement of the Work and shall certify that back-up equipment is available and can be delivered to the worksite in 72 hours.

1. GPS Equipment

- a. GPS Equipment shall be sub-meter grade, Trimble Pro Series Receivers with Floodlight technology capability, Top Con GRS-1 Series equipment or equal (to be approved by Program Manager prior to mobilization). GPS coordinates to be real-time or post-processed to achieve sub-meter accuracy. Equipment must have ESRI ArcPad 10.1 installed for use in data acquisition.

2. Camera

- a. All camera systems used shall be digital format. The camera must have two independently or simultaneously controlled digital cameras, one facing in the downward direction and one facing in the upward direction. Each camera must have a minimum of 185 degree field of view. The inspection camera system must illuminate the interior of the manhole using a xenon strobe light. The light shall be positioned 360 degrees around the camera lens to distribute the light evenly onto the structure walls. The lighting must be able to illuminate manholes up to 120" in diameter without the need of any auxiliary lighting.
- b. A camera must also be able to obtain still images of the following specified pictures: Photo 1- surface view photos taken of the manhole should include a whiteboard (or similar) with the manhole ID number identified on it. The photographer should be standing with the outlet pipe facing their 6 o'clock position. Photo 2 - the downhole photo of the manhole channel should be taken with the outlet pipe facing their 6 o'clock position. Additional photos as specified by MACP guidance. The camera used for these images must be minimum 5 megapixel .jpg format for sufficient clarity and detail in the photos, and photos of at least 2 MB shall be submitted. If the 3D scan camera system cannot obtain photos of sufficient quality, a pole-mounted digital camera with lighting shall be used for the specified pictures in this paragraph.
- c. The 3D camera system shall produce individual images or frames with no more than 0.001 inches of movement during image or frame exposure to produce crisp, clear images. The inspection camera must provide a minimum of 3,000 lines of vertical resolution in the side view and a minimum of 500 lines in the perspective view.
- d. Inadequate lighting, image distortions, blurry or murky images, low resolution, dirty lens and/or other quality issues will be a cause for rejection. If unsatisfactory, Subcontractor shall perform work until deliverable is of acceptable quality. No payment will be made for unsatisfactory inspections or until submittal is accepted.

3. Data Logger and Software

- a. MACP inspections and logs created and captured electronically during the MACP inspection of the manhole through the use of commercially available electronic data loggers are required. Paper records for data collection in the field shall not be used. NASSCO MACP protocols shall be used for capturing and recording the observations.
- b. The data logger equipment and software shall allow Program Manager direct access to the captured electronic data, and provide for export of the data in accordance with MACP formats and standards.

4. Retrieval of Stuck Equipment

- a. The Subcontractor is responsible for hiring a licensed sub-Subcontractor to retrieve any equipment that becomes lodged in the sewer system through the execution of the scope of work (fallen cameras, jet nozzles, inflatable plugs, sandbags etc.) at the Subcontractor's own cost. Such retrieval by an appropriately licensed sub-Subcontractor shall be made within 72 hours to avoid interfering with the City of Memphis sewer system operations. Any and all impacts and related costs due to the Subcontractor's equipment in the line shall be the responsibility of the Subcontractor.

PART 3 EXECUTION

3.01 INSPECTION

A. GPS Coordinates of Manhole Cover

1. Program Manager will provide Subcontractor with a digital copy of the original GIS source map indicating the sewer system network compiled from existing City records.
2. The Subcontractor shall capture and record sub-meter grade x, y and z coordinates of each manhole cover identified in the original GIS maiden data map provided with a unique asset identification (ID) number. Additional sanitary sewer lamphole and manholes found in the field in the course of the inspection work that are not provided in current mapping nor identified with a current unique asset ID shall be documented and GPS coordinates shall be recorded. A provisional manhole asset ID number shall be used by the Subcontractor by adding a dash and a two-character number to the closest upstream manhole ID.
3. Record sub-meter GPS coordinates in NAD83 TN State Plane Coordinates horizontal, NAVD88 vertical in US Survey feet using properly-calibrated GPS equipment. If GPS coordinates cannot be obtained due to buildings, trees or cloud cover, Subcontractor shall note this on the inspection form and return at least one additional time at a different time of day or under different sky cover. If both attempts fail at securing the sub-meter coordinates, this is to be documented and reported in the submittal. Land surveying shall not be required where GPS is not available.
4. The Subcontractor shall be expected to use all reasonable means to locate the lampholes and manholes in the field. This includes walking the pipeline alignment, using measuring tapes or wheels from the last found manhole, using metal detectors, or other means. If manholes are not able to be found and documented or unknown manholes are found, record the reasons for not locating or not opening the manhole or the specifics of the new manhole found, and submit with supporting MACP documentation to the Program Manager daily.
5. Once GPS coordinates are obtained for known and newly discovered facilities, the original GIS map data shall be delivered to the Program Manager to reflect the actual sewer system network for the assigned inspection area.
6. The Subcontractor shall revisit predefined GPS control locations near project area at least one time per day per each GPS unit used as a quality control check on GPS accuracy. Subcontractor is to document these checks on a single log, which shall be kept on file for the duration of the project, and shall be released to Program Manager on a weekly basis.

B. MACP MH Inspection

1. The Subcontractor shall document and record each sanitary sewer manhole inspection in MACP Level 1 format for lampholes and Level 2 format for manholes with supporting completed MACP format database. The complete NASSCO MACP Levels 1 and Level 2 protocols must be utilized for the lamphole and manhole inspections respectively, and must be associated in the electronic database and pdf documentation with the unique asset ID provided.
2. The Subcontractor shall mark the direction of wastewater flow (one arrow per pipe) in and out of the manhole around the perimeter of the manhole cover on the street with discrete

green arrows spray painted onto the road surface using a guide or template for the arrows. The arrows shall be a minimum of 12 inches and a maximum of 18 inches in length.

3. The Subcontractor shall follow the prescribed MACP Level 1 and Level 2 procedures and use the required nomenclature and formats to document the manhole interior and exterior conditions and defects.
4. Subcontractor shall be responsible for cleanup, repair, fines, property damage costs, and claims for any sewage backup, spillage or sanitary sewer overflow during or as a result of the field operations.

C. Camera Inspection of Manholes and Associated Pipe Connections

1. For manholes greater than 25-feet in depth and manholes associated with lines 36-inches and larger in diameter, a 3D manhole scan shall be completed in conjunction with Level 2 manhole inspections of defects and include each sewer pipe connection in the manhole. The photo record of the inspection shall document defects and leaks and shall include a photo record of the connecting pipes in each manhole. Abbreviations, naming conventions, and numbering conventions shall be documented in MACP formats.
2. File naming must be consistent. Additional instructions, naming conventions, file structures, etc. will be provided after contract award.

D. Incident Observation and Data Collection

1. The Subcontractor shall report all Unable to Complete and surcharged manholes to the Program Manager through the program-defined reporting application (Teamworx) and shall fill out all required fields and attach picture documentation as necessary. For a surcharged manhole, at least one picture shall be included to document the level of surcharge. All reported incident observations will be monitored by the Program Manager and inadequate reporting will result in a meeting between the Program Manager and Subcontractor.

PART 4 MEASUREMENT and PAYMENT

4.01 MEASUREMENT

A. GPS Coordinates of Manhole Cover

1. The capture and associated documentation of sub-meter GPS x, y and z coordinates for each lamphole and manhole cover will be measured for payment per each lamphole and manhole located by GPS and its coordinates recorded in accordance with the specification, provided that documentation meets QA/QC standards.

B. MACP Level 1 for Lamphole Inspections

1. The inspection and recording of all lamphole observations in a MACP compliant fashion will be measured for payment per each lamphole inspected in accordance with the specification.

C. MACP Level 2 for Manhole Inspections

1. The inspection and recording of all manhole observations in a MACP compliant fashion will be measured for payment per each manhole inspected in accordance with the specification. For manholes greater than 25-feet in depth or associated with lines 36-

inches in diameter or greater, a 3D manhole scan shall be included as part of the MACP Level 2 inspection.

4.02 PAYMENT

A. GPS Coordinates of Manhole Cover

1. The capture and associated documentation of sub-meter GPS x, y and z coordinates for each manhole cover shall be paid for at the unit price bid for each lamphole and manhole cover coordinates documented and recorded in accordance with the specification provided that QA/QC standards are met.
2. The unit price for each manhole cover GPS set of coordinates shall cover the entire cost of the GPS equipment and time necessary to gather the coordinates, including but not limited to calibrating the equipment; setup and access; traffic control; documenting results in prescribed MACP electronic formats, records and logs; power supply for equipment; interim and final reports; and all other appurtenant work.
3. No additional payment will be made for:
 - a. Location or re-inspection due to cars parked over manholes or other impediments to on grade and showing manhole covers.
 - b. Additional visit(s) to secure the proper GPS coordinates due to lack of adequate satellite coverage or reception.

B. MACP Level 1 for Lamphole Inspections

1. The inspection and recording of all lamphole observations in a MACP format shall be paid for at the unit price bid per each MACP Level 1 inspection performed in accordance with the specification, provided that QA/QC standards are met.
2. The unit price for each MACP lamphole inspection shall cover the entire cost of the inspection and reporting, including but not limited to setup and access, documenting results in records and logs, power supply for equipment, interim and final reports and all other appurtenant work.

C. MACP Level 2 for Manhole Inspections

1. The inspection and recording of all manhole observations in a MACP format shall be paid for at the unit price bid per each MACP Level 2 inspection performed in accordance with the specification, provided that QA/QC standards are met.
2. The unit price for each MACP manhole inspection shall cover the entire cost of the inspection and reporting, including but not limited to setup and access, documenting results in records and logs, digital photos, power supply for equipment, interim and final reports, and all other appurtenant work. This also includes the materials and labor to complete 3D scan of the manhole with all associated deliverables where applicable.

4.03 PAYMENT WILL BE MADE UNDER

Item No.	Pay Item	Pay Unit
02544-4.01.A	GPS COORDINATES OF MANHOLE COVER	EACH
02544-4.01.B	MACP LEVEL 1 LAMPHOLE INSPECTIONS	EACH
02544-4.01.C-1	MACP LEVEL 2 MANHOLE INSPECTIONS-	

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02544-4.01.C-2	NO 3D SCAN	EACH
	MACP LEVEL 2 MANHOLE INSPECTIONS WITH 3D SCAN	EACH

END OF SECTION 02544

SECTION 02630
SITE PREPARATION AND RESTORATION

PART 1 GENERAL

1.01 SCOPE

- A. This Work shall consist of the removal of brush, rubbish, fences, structures, abandoned appliances, building foundations, all trees, shrubs and plants not to be protected, and all other obstacles within the right-of-way / easement limits shown on the Plans and/or in the Special Instructions; the disposal of debris; and the restoration and/or protection of trees, shrubs, plants, fences, turfed areas, and structures after construction of drainage facilities is completed.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. All equipment for the satisfactory performance of the work shall be on the project and approved before the work will be permitted to begin.

PART 3 EXECUTION

3.01 RIGHT-OF-WAY AND EASEMENT

- A. The Subcontractor shall confine his construction activities within the rights-of-way and/or easements as shown on the Plans and easement/rights-of-way plats provided by the owner. The Subcontractor shall be responsible for obtaining written agreements for use of private property outside of City of Memphis acquired rights-of-way/easements for such purposes as storage of material and equipment and access to the construction site. The Subcontractor shall provide a copy of all such written agreements to the Purchaser immediately upon obtaining the necessary documentation.

3.02 EXISTING OBSTRUCTIONS

- A. Where applicable, locations of obstructions shown on the Plans are approximate and are shown only for information purposes and are not intended as an accurate location of such obstructions. Obstructions not shown on the Plans but encountered by the Subcontractor shall be removed as necessary and, if directed by the Owner, replaced in their original state or protected by the Subcontractor at no additional cost to the Purchaser.

3.03 REMOVAL OF VEGETATION

- A. The rights-of-way/permanent easements shown on the Plans and right-of-way/easement plats shall be cleared of all dead trees, living trees, stumps, brush, projecting roots, hedge, weeds, pole stubs, logs, and other objectionable material, vegetation and growth. This work shall include the removal of all trees, shrubs, and plants not suitable for moving and replanting as determined by the Owner. All trees, stumps, roots, pole stubs, brush, hedge, and other protruding obstructions within the rights-of-way/easements shall be removed to within 3 inches of existing ground. This work shall be done well in advance of excavation operations. Trees and shrubs to be replanted shall be extracted with an ample ball of earth around roots so that transplanting may be successful. The root ball shall be wrapped in burlap. Vegetation stored for replanting shall be watered sufficiently to protect the root system from dehydration.

- B. Low hanging branches and unsound branches on trees or shrubs designated to remain, shall be removed. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

3.04 REMOVAL OF OBSTRUCTIONS

- A. Existing fence material and posts within the rights-of-way/easement limits shown on the Plans and right-of-way/easement plats shall be moved from the construction area and stored in such a manner as to protect them against damage. The Subcontractor shall be responsible for the condition of the removed fence material and posts. The Subcontractor shall demolish and remove all structures and structure foundations within the rights-of-way/easement limits unless otherwise instructed by the Purchaser. Such structures and foundations shall be removed to 12 inches below the subgrade elevation or as directed by the Purchaser. If permitted by the Purchaser, the Subcontractor shall backfill basements, cisterns, and the like in an approved manner. The Subcontractor shall remove all abandoned vehicles, appliances and rubbish within the rights-of-way/easement limits.

3.05 PROTECTION OF OBSTRUCTIONS OUTSIDE RIGHT-OF-WAY/EASEMENT LIMITS

- A. The Subcontractor shall protect and avoid damage to all trees, shrubs, plants, fences, turfed areas, structures, and all other objects outside of the right-of-way/easement limits shown on the Plans and right-of-way/easement plats from damage due to construction operations. Damage caused by the Subcontractor shall be repaired or restored at no cost to the Purchaser. Particular care shall be used to avoid damage to trees, shrubs, bushes, turfed areas, and private property located adjacent to rights-of-way/easements on private property. No trees, plants, turfed areas, or other objects outside such limits shall be disturbed or damaged without the written permission of the property owner.

3.06 SPECIAL PROTECTION OF OBSTRUCTIONS INSIDE EASEMENT LIMITS

- A. Wherever the underground installation of drainage facilities conflicts with other improvements previously made by the Purchaser, other governmental bodies, or adjacent property owners, the Contractor shall be responsible for their protection and preservation, including necessary removal and storage of such improvements, and subsequent replacement to obtain, to the fullest extent possible, the undisturbed condition.

3.07 DISPOSAL OF DEBRIS

- A. All trees, brush, logs, snags, leaves, sawdust, bark, construction debris, and refuse shall be collected and disposed of in accordance with all applicable City codes and ordinances. Debris shall be removed from the site as soon as practical and shall not be left until the completion of the contract. If burning of debris is allowed by the Purchaser, the Subcontractor must obtain and pay for a permit from the City of Memphis Department of Fire Prevention and all precautions necessary shall be exercised to prevent the spread of fire and such burning shall be in accordance with Division 1, "General Requirements" of these Specifications. Burning shall be done only at approved locations and in conformity with the laws, ordinances, and requirements of agencies and officials having jurisdiction. When materials are to be disposed of, the Subcontractor shall obtain written permission before hand from the property owner on whose property the disposal is to be made and shall file a copy of such permit with the Purchaser. Unless otherwise provided in the Contract Documents, the Subcontractor shall make his own arrangements for disposing of such materials off site.

3.08 REPLACEMENT OF VEGETATION

- A. As soon as backfill operations permit, the Contractor shall replace transplanted trees, shrubs, and plants. The Contractor shall properly water the transplanted vegetation immediately upon

replanting and at suitable intervals thereafter. If shrubs, plants, or trees die after transplanting and before final acceptance of the Work, the Contractor shall at his expensed replace same with equal shrubbery, plants, or trees.

3.09 REPLACEMENT OF FENCES

A. Any fences disturbed within the rights-of-way/easement limits shall be replaced to the satisfaction of the Purchaser. Fences in such poor condition that they cannot be removed and replaced shall be replaced with new fence material similar in original quality, size, and appearance to the removed fence or a written release shall be obtained from the property owners. For chain link fence, new fence materials and construction methods shall conform to the requirements of Specification Section 02820. For box culvert or pipe construction, any fences removed shall be replaced in their original location. Any fence damaged during construction shall be restored to original or better condition. For channel lining construction, removal of fences shall be performed with care and the fence rolled up or stacked and stored on the owner's property. All side yard fences within the easement shall be replaced or extended to the new channel with in-kind fence material.

3.10 ESTABLISHMENT OF TURFED AREAS

A. After final restoration of settled trench surfaces, all areas within the right-of-way or permanent easement limits which were established turfed areas prior to construction will be sodded in accordance with Specification Section 02921. All cut or fill slopes constructed for new drainage facilities will be sodded in accordance with Specification Section 02921 and in conformity with City cross-sections.

3.11 RESTORATION OF OTHER TURFED AREAS

A. All areas outside the right-of-way, permanent easement, or cut and fill slopes shall be restored as nearly as practical to their original condition at the Contractor's expense. Finished lawn areas upon which earth has been deposited shall be cleared to the level of the existing sod and then raked and watered. Areas where sod has been damaged, destroyed, or ruts have been filled in shall be resodded. Areas where sod is only slightly damaged may be lightly reseeded, if so permitted by the Purchaser. Sodding and seeding materials and construction methods shall conform to the requirements of Specification Section 02921.

PART 4 MEASUREMENT & PAYMENT

4.01 MEASUREMENT

A. Removal and Replacement of Vegetated/Turfed Areas

1. Removal and replacement of vegetated and turfed areas will be measured per square yard upon which the new vegetation has been set.

4.02 PAYMENT

A. Removal and Replacement of Vegetated/Turfed Areas

1. Removal and replacement of vegetated/turfed areas will be paid at the Subcontractor unit price per square yard for the accepted quantities and will be full compensation for removal and/or protection of trees, shrubs, plants, brush,; and the restoration of vegetated and turfed areas

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4.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02630-4.01.A	REMOVAL AND REPLACEMENT OF VEGETATED/TURFED AREAS	SQUAREYARD

END OF SECTION 02630

**SECTION 02820
 CHAIN LINK FENCE**

PART 1 GENERAL

1.01 SCOPE

- A. This work shall consist of the construction of chain link fences and gates in accordance with these Specifications and at the locations and in conformity with the lines, grades, and dimensions shown on the Plans or as directed by the Owner. Chain link fence may be located atop concrete channel lining walls, retaining wall or similar structure, or may be located independently of structures.

PART 2 PRODUCTS

2.01 MATERIALS.

- A. Materials used throughout the project shall be of constant design and manufacture in respect to individual items or parts, excepting where the proposed fence will be an extension of an existing fence, in which case the new fence shall be constructed of materials similar in appearance to those in the existing fence and continued until broken by cross street, railroad, fence ditch, or other physical feature. Unless otherwise directed, new materials shall be as described hereinafter.

B. Fabric.

- 1. The fabric shall be zinc coated steel chain link type meeting the requirements of AASHTO M 181 for Type I, Class B fabric (zinc coating = 2 oz/ft²). All chain link fabric shall be manufactured of No. 9 gauge wire pickets, forming a uniform 2 inch mesh, and shall be of the height shown on the Plans or specified in the Contract Documents. Fabric up to and including 60 inches high shall be knuckled at the top and bottom selvage and fabric over 60 inches high shall be twisted on the top selvage and knuckled on the bottom selvage.

C. Line Posts.

- 1. Line posts shall be zinc coated steel pipe or H-sections of the following dimensions and of the lengths shown on the Plans or specified herein:

Fence Height	H - Section				
	Nominal Size (inch)	Outside Diameter (inch)	Weight Per Foot (Pounds)	Dimension (inches)	Weight Per Foot (pounds)
6 feet or less	1 ½	1.9	2.72	1.875 x 1.625	2.70
6 feet to 8 feet	2	2.375	3.65	2.25 x 1.95	4.10

- 2. Steel pipe shall conform to ASTM A 120 or AASHTO M181-85I Grade 2 and H-Sections shall be produced from ASTM A 570 and ASTM A 572, Grade 45. The weight of zinc coating shall be a minimum of 1.8 oz/square foot. The weight of zinc coating and weight per foot for steel post meeting the requirements of AASHTO M181-85I grade 2 may vary from the above noted values.

D. End Posts, Corner And Pull Posts, And Braces.

- E. End posts, corner posts, and pull posts shall be zinc coated steel pipe or square sections of the following dimensions and of the lengths shown on the Plans or specified herein:

Fence Height	Steel Pipe			Square Section	
	Nominal Size (inch)	Outside Diameter (inch)	Weight Per Foot (Pounds)	Outside Dimension (inches)	Weight Per Foot (pounds)
6 feet or less	2	2.375	3.65	2.0	3.60
6 feet to 8 feet	2 ½	2.875	5.79	2.5	5.70

- Diagonal braces shall be 1 ¼ inch (1.660 inch O.D.) galvanized steel pipe, weighing 2.27 pounds per foot. Steel pipe and square sections shall conform to ASTM A 120 or AASHTO M181-85I Grade 2. The weight of zinc coating and weight of pipe per foot for steel post meeting the requirements of the AASHTO M181-85I grade 2 may vary from the above noted values.

F. Top Rail:

- Top rail shall be used when specified on the Plans in lieu of top tension wire. The top rail shall be 1 ¼ inch (1.660 inch O.D.) galvanized steel pipe, weighing 2.27 pounds per foot, meeting the requirements of ASTM A 120 or AASHTO M181-85I Grade 2. Top rails in random lengths shall be fitted with expansion sleeves for connecting lengths into a continuous run or shall have a 3 inch swagged end. Suitable fittings shall be provided for securing top rail to each gate, corner, and end post.

G. Barbed Wire:

- Barbed wire shall consist of two No. 12 ½ gauge, twisted steel strands with No. 14 gauge four-point barbs spaced not more than 5 inches apart. The galvanized strands shall meet the requirements of ASTM A 121, Class II coating.

H. Miscellaneous Fittings And Hardware:

- Zinc coated miscellaneous fittings and hardware shall be commercial grade steel or better quality, pressed, wrought, or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric, posts, and wires of the quality specified herein. All steel fittings and hardware shall be galvanized in accordance with AASHTO M 111.

I. Barbed Wire Support Arms:

- Barbed wire support arms shall be single arms for carrying 3 barbed wire strands. Barbed wire support arms for line posts shall be at an angle of 45 degrees (plus or minus 5 degrees) and shall be fitted with clips or other suitable means for attaching three lines of barbed wire, with the top strand of barbed wire 12 inches (plus or minus 1 inch) above and horizontally from the fence line, and the remaining two strands of barbed wire spaced uniformly between the top of the fence fabric and top strand of barbed wire. Support arms shall be capable of withstanding a load of 250 pounds when the base is clamped securely and the vertical load applied from where the outer strand of barbed wire passes over the arm.

J. Wire Ties:

1. Wire ties shall be No. 9 gauge and shall be either zinc coated steel, aluminum coated steel or aluminum alloy and sufficient in strength and other properties to provide a balanced design when used in conjunction with fabric, posts, and wire of the qualities specified herein. When tension wire is used, wire ties and clips for fastening fabric to tension wire shall be No. 11 gauge.

K. Tension Wire:

1. Tension wire shall be used at the bottom of fencing fabric when not otherwise secured and used at the top unless a top rail is specified. Tension wire shall be No. 6 gauge, spring rolled, aluminized steel wire.

L. Truss Rods and Turnbuckle:

1. Truss rods shall be 3/8 inch diameter steel rods and shall be equipped with a turnbuckle having a take-up of not less than four inches and shall be galvanized in accordance with AASHTO M 111.

M. Fence Gates:

1. Fence gates shall be of the kinds and sizes shown on the Plans or specified in the Contract Documents. They shall be of the swing type, complete with latches, stops, keepers, hinges, and fabric. The latch shall have provision for fastening with a padlock. The gates shall be covered with fabric matching the fence. The hinges shall be of adequate strength to support the gate and shall not twist or turn under action of the gate. The gates, gate posts, and braces shall be of the same material and finish as the adjoining fence. All gate posts and rails shall be furnished complete with ball caps and rail ends.
2. Posts, braces, and framing members for chain link fence gates shall be zinc coated steel pipe meeting the requirements of Specification Section 02820 Paragraph 2.01.C. Gate post shall be 2 ½ inch (2.875 inch O.D.) pipe weighing 5.79 pounds per foot for gate widths of 5 feet or less; and 3 ½ inch (4.0 inch O.D.) pipe weighing 9.10 pounds per foot for gate widths between 5 feet and 13 feet.
3. Framing members and interior bracing shall be of the following minimum dimensions:

Framing and Bracing

Fence Height	Nominal Size	Outside Diameter	Weight Per Foot
6 feet or less	1 ¼	1.66	2.27
6 feet to 8 feet	1 ½	1.90	2.72

- a. Gate frames shall be welded at all corners or assembled with corner fittings. When corner fittings are used, gates shall have truss rods as specified in Specification Section 02820 Paragraph 2.01.J to prevent sag or twist. All welded joints shall receive a shop applied zinc coating equivalent in thickness to that of the members being joined.
4. Fabric shall meet the requirements of Specification Section 02820 Paragraph 2.01.A.

5. Barbed wire shall meet the requirements of Specification Section 02820 Paragraph 2.01.E.
6. Miscellaneous fittings and accessories shall meet the applicable requirements of Specification Section 02820 Paragraphs 2.01 F, G, H, and J. The hinges shall be of such design to allow the gate to swing back 180 degrees, parallel with the fence line.

N. Concrete.

1. Concrete for post footings shall be Class A as specified in Specification Section 03050.

O. General.

1. Posts shall be fitted with ornamental tops or extension arms as stipulated in the Plans or in the Contract Documents. Caps or ornamental tops for tubular posts shall have a base fitting into the post with a flange extending over the top of the posts to protect against moisture. When a top rail is provided, all posts shall be provided with caps having a ring or hole suitable for the through passage of the top rail. Rail and brace ends, or other suitable means of connection, shall be provided when top rail or braces are required.
2. Fabrication of all materials shall be in conformity to the sizes, shapes, and other factors set out in these Specifications or shown on the Plans, and shall show careful, finished craftsmanship in all respects.
3. The weights specified for steel posts, braces, and rails are nominal weights, and a plus or minus tolerance of 5 percent will be permitted. All posts located on the top of concrete channel lining walls or similar structure shall be of sufficient length to be set fully 12 inches into the wall or structure.
4. All line posts located on the ground shall be of sufficient length to be set fully 24 inches deep into concrete footings, and all end, corner, and pull posts shall be of sufficient length to be set 30 inches deep into concrete footings.

2.02 EQUIPMENT

- A. All equipment necessary for the satisfactory performance of the work shall be on hand and inspected by the Owner before construction work will be permitted to begin.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS.

- A. Fencing shall be placed atop concrete structures, such as concrete channel linings, in accordance with Plans and Design Standards. Fence post inserts will normally have been set into the concrete walls prior to fence construction activities. Inserts shall be 12 inch ling solid wall PVC pipe conforming to ASTM D2241, thin wall metal conduit conforming to ANSI C 80.3 and sealed at one end or other material approved by the Owner. Cans, bottles and the like shall not be used as inserts. Alternatively, posts may be sect directly into the structure concrete as the concrete is poured, making sure that all posts are plumbed and held securely in the proper position until the concrete has set.
- B. The inside diameter of the inserts shall be sufficient to provide a minimum of ¼ inch clear space between the outside surface of the post and the inside surface of the insert. Inside of inserts shall be cleaned of debris and other foreign matter, insert space filled full of nonshrinking grout, the posts set into place in the insert and plumbed, and the post held plumb until the grout has set. All excess grout shall be removed before it sets. Where inserts have not been provided in the concrete structure, post holes of the same diameter and depth as required for inserts shall be

cored in the concrete. Posts shall be set in cored holes in the same manner as posts set in inserts.

3.02 FENCING SET INDEPENDENTLY OF STRUCTURES.

- A. Before beginning construction or placing of fences, all necessary work for clearing and grubbing, removal of structures and obstructions, and site preparation shall be performed in accordance with the applicable Sections of these Specifications. Clearing for fence construction shall not extend beyond the construction easements without written approval of the property owner. Living trees and shrubs one foot or more each side of the fence line shall remain undisturbed unless otherwise directed by the Owner. Any rock protruding above the ground surface and in the line of the fence shall be removed to ground surface.
- B. Posts for chain link fence shall be set at intervals not to exceed 10 feet. The interval between posts shall be measured parallel to the bottom of the fabric of the proposed fence and in line of fence from center to center of post.
- C. All line posts located on the ground shall be set fully 24 inches deep in concrete footings; end, corner and pull post shall be set 30 inches deep in concrete footings. Diameters of footing shall be : for line post not less than 8 inches; for end, corner or pull post not less than 10 inches. Footings for gate post shall be designed to support the cantilever load of the gate. Concrete for embedment of posts and for anchors shall be Class A and shall be crowned to shed water. Concrete shall be cured a minimum of 3 days prior to installation of fabric.

3.03 ERECTING FENCE.

- A. For fence heights less than 6 feet a top and bottom tension wire shall be installed, unless specified otherwise. For fence heights 6 feet or greater a top rail and bottom tension wire shall be installed. When a top rail is specified, the top rail shall be connected with expansion sleeves to form a continuous rail.
- B. Bracing assemblies consisting of the specified bracing pipe as the compression member and specified truss rod as the tension member shall be installed and securely tightened prior to installation of fabric. One brace assembly shall be provided for end post and two brace assemblies for corner and pull posts. When fence alignment changes abruptly by more than 30° a corner brace assembly shall be installed. When the internal angle of a curved fence alignment exceeds 30° one brace assembly shall be installed at each point of curvature. Pull post shall be installed at abrupt changes in grade or at the midpoint of a straight fence alignment exceeding 500 feet in length.
- C. The fabric shall be placed on the side of the post as directed by the Owner and 2" above ground or concrete structure. Fabric shall be secured at one end and sufficient tension applied to remove all slack before making attachment elsewhere. The fabric shall be fastened to the posts with wire ties at intervals not exceeding 14 inches. Fabric shall be fastened to the tension wire or rail with wire ties at intervals not exceeding 24 inches. When specified, barbed wire shall be installed and pulled taut before being permanently attached to a post or arm. Fence gates shall be constructed in accordance with the Plans, Specifications and manufacturer's standards and instructions, or as directed by the Owner.

3.04 TEST

- A. Before any fencing is installed, manufacturer's certificates stating that the fabric, post, rails, braces, barbed wire, tension wire, ties and hardware are made in accordance with applicable standards as specified herein shall be filed with the Owner. At the option of the Owner, test samples of any materials to be furnished shall be furnished at the job site before work commences.

PART 4 PAYMENT

4.01 MEASUREMENT

A. Chain Link Fence

1. Fences will be measured for payment by the linear foot along the bottom of the fabric and from end to end of fence, complete and in place, deducting the width of gates and openings, for each type and height of fence provided.

B. Fence Gates

1. Gates will be measured for payment by the unit, per each, complete and in place, for the kinds and dimensions as shown on the Plans.

4.02 PAYMENT

A. Chain Link Fence

1. The accepted quantities of chain link fence will be paid for at the contract unit price per linear foot, complete and in place, for each type and height of fence, which price will be full compensation for fabric, posts, rails, tension wire, miscellaneous hardware, post hole excavation, concrete footings, concrete coring and grouting.

B. Fence Gates

1. The accepted quantities of gates will be paid for at the contract unit price per each, complete and in place, for the kinds and dimensions of gates stipulated or shown on the Plans.

4.03 Payment will be made under:

Item No.	Pay Item	Pay Unit
02820-4.01.A	CHAIN LINK FENCE HEIGHT x DESCRIPTION	LINEAR FOOT
02820-4.01.B	FENCE GATES HEIGHT x WIDTH OF OPENING	EACH

END OF SECTION 02820

**SECTION 02921
SODDING**

PART 1 GENERAL

1.01 SCOPE

- A. This work shall consist of furnishing and placing sod at all locations shown on the Plans or where directed by the Owner, and in conformity with these Specifications. Ordinarily, the work will consist of the furnishing and placing of new sod originating from sources outside the rights-of-way and easement limits. In some cases, however, the work will include removing sod from areas where the requirements of the project would destroy existing sod, storing the sod so removed, and resetting it in areas shown on the Plans or designated by the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sod

- 1. New sod shall consist of live, dense, well rooted growth of Bermuda grass, free from Johnson grass, nutgrass, and other obnoxious grasses or weeds, well suited for the intended purpose and for the soil in which it is to be planted. All sod shall be cleanly cut in strips having a reasonably uniform thickness of not less than 2 inches and cut in 10 to 12 inch squares.
- 2. The sale or movement of sod for propagation is controlled by Tennessee Plant Pest Act of 1955, TCA 43-55 et. Seq., and the Contractor shall be responsible for obtaining all inspections, authorizations, and permits which may be required by such law and the Tennessee Department of Agriculture.

B. Fertilizer

- 1. Manufactured fertilizer shall meet the requirements of Specification Section 02920 Paragraph 2.01.B and shall be Grade 15-15-15 unless otherwise specified on the Plans or in the Contract Documents.

C. Ammonium Nitrate

- 1. Ammonium nitrate shall be a standard commercial product, shall conform to the requirements for other commercial fertilizers as specified in Specification Section 02920 Paragraph 2.01.B, and shall have a minimum of 33 ½ percent nitrogen.

D. Agricultural Limestone

- 1. Agricultural limestone shall meet the requirements of Specification Section 02920 Paragraph 2.01.C.

2.02 EQUIPMENT

- A. All equipment necessary for the satisfactory performance of this work shall be on the project and approved before work will be permitted to begin.

PART 3 EXECUTION

3.01 WEATHER LIMITATIONS

- A. Sod shall be set or reset only when the soil is moist and favorable for growth. No setting or resetting shall be done during December 1 and February 1, unless weather and soil conditions are considered favorable and permission is granted by the Purchaser.

3.02 REMOVING AND STORING SOD FOR RESETTING

- A. If specified, sod removed from such areas as lawns, yards, and lots shall be so cut, handled, and stored that the sod can be reset in the same locations from which it was removed. No exchange of sod will be permitted unless approved by the Owner. Unless reset immediately after cutting, sod shall be stacked in piles and kept moist until reset. Sod shall be reset within 7 days after removal, unless otherwise specifically permitted by the Owner. Reset sod shall show vitality and growth at the time of acceptance by the City and for duration of the warranty period.

3.03 SODDING

- A. The area to be sodded shall be brought to the lines and grades shown on the Plans or as directed by the Owner. The surface of the ground to be sodded shall be loosened to a depth of not less than one inch with a rake or other device. If necessary, it shall be sprinkled until saturated for a minimum depth of one inch and kept moist until the sod is placed. Immediately before placing the sod, fertilizer and lime shall be applied uniformly to the prepared surface of the ground. Fertilizer shall be applied at the rate of 8 pounds of Grade 15-15-15, or equivalent per 1,000 square feet. Agricultural limestone shall be applied at the rate of 100 pounds per 1,000 square feet.
- B. Sod shall be placed as soon as practical after removal from the point of origin and shall be kept in a moist condition during the interim. The sod shall be carefully placed by hand on the prepared ground surface with the edges in close contact and, as far as possible, in a position to break joints. Each strip of sod laid shall be fitted and rolled using a roller of sufficient size and weight to fix the sod into place. Immediately after placing, the sod shall be thoroughly wetted and rolled with an approved roller or hand tamped, as approved by the Owner. Pinning or pegging shall be required on slopes greater than 2 to 1 to hold the sod in place or in other instances at the direction of the Owner.

3.04 MAINTENANCE AND REPAIR

- A. The sod shall be watered as frequently as necessary for a period of two weeks, after which, ammonium nitrate shall be applied at the rate of 3.5 pounds per 1,000 square feet, and the sod given an additional watering. The Contractor shall not allow any equipment or material placed on any planted area and shall erect suitable barricades and guards to prevent his equipment, labor, or the public from traveling on or over any area planted with sod. Care shall include periodic watering, fertilizing and mowing necessary to maintain the vitality and appearance of the sod. When mowing is required, mower blades shall be set at sufficient height to protect the vitality of the growth. Sodded areas that become eroded, damaged or fail to successfully establish a stand of grass shall be repaired and/or replaced as directed by the Owner. All material and labor required to maintain and repair seeded areas shall be furnished by the Contractor at no cost to the City. Sod must be living at the time of final acceptance of the project and through the duration of the warranty period.

3.05 DISPOSAL OF SURPLUS MATERIAL

- A. All surplus material shall be disposed of off-site.

PART 4 PAYMENT

- A. No information in this section.

END OF SECTION 02921

**SECTION 02950
 REMOVAL AND REPLACEMENT OF PAVEMENTS AND INCIDENTALS**

PART 1 GENERAL

1.01 SCOPE

- A. This Work shall consist of the removal and replacement of pavements, sidewalks, driveway aprons, curbs and gutters, driveways, paved areas, and curbs made necessary by the improvement of sanitary sewer infrastructure, and other items of construction that require temporary cuts. Such replacement shall be to a condition at least equal to the condition existing prior to removal and of in-kind material and shall be compliance with the Drawings, these Specifications, or as directed by the Purchaser. The Work which will be included in the Subcontract and for which the Subcontractor shall be compensated therefore is limited to that area within the rights-of-way and construction easements for the Project. The Subcontractor will not be compensated for the removal and replacement of facilities outside the rights-of-way, easements, and limits of construction of the Project.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete:

1. Portland cement concrete shall be in accordance with Section 03050 Portland Cement Concrete.

B. Asphaltic Concrete Pavement:

1. Asphaltic concrete surface courses shall meet the requirements of Mix No. 1 and bases courses shall meet the requirements of Mix No. 2 as described below.
2. The composition of the mixes shall be as follows:

Total Percent Passing by Weight

Sieve Size	Mix No. 1	Mix No. 2
2"	100	100
1-1/2"	100	100
3/4"	100	100
3/8"	76-96	65-95
No. 4	51-76	45-70
No. 8	36-60	25-50
No. 30	16-40	12-30
No. 100	3-12	2-12
No. 200	2-8	1-6

3. The proportions of the total mixture, in percent by weight, shall be as follows:

Courses	Combined Mineral Aggregate	Asphalt Cement
Mix No. 1, Surface	92.0 – 96.0	4.0 – 8.0
Mix No. 2, Binder	93.0 – 97.5	2.5 – 7.0

4. It is the intent of this Section of the Specifications that the above described mixes shall conform to the following mixtures specified in the Tennessee Department of Transportation Standard Specifications for Road and Bridge construction.
 - a. Mix No. 1 – Section 411, Asphaltic Concrete Surface (Hot Mix), Grading E.
 - b. Mix No. 2 – Section 307, Bituminous Plant Mix Base (Hot Mix), Aggregate Grading C.
5. For multiple layer construction, succeeding layers shall not be laid until the previous layer has cooled sufficiently to support the construction equipment
6. When Mix No. 1 is to be used as a surface for traffic lanes, the mineral aggregate shall be composed of not less than 50 percent nor more than 55 percent crushed limestone and not more than 50 percent nor less than 45 percent natural sand. When Mix No. 1 is used for surfacing of shoulders or other non-traffic lane construction, the mineral aggregate may be composed entirely of limestone, including screening and manufactured sand, but in no case shall the mineral aggregate for this construction consist of less than 50 percent limestone. The natural sand shall be so graded that not more than 5 percent will be retained on the No. 4 sieve.

C. Temporary Cold Patch Asphalt

1. Temporary cold patch asphalt shall meet the requirements of TDOT Standard Specifications for Road and Bridge Construction Section 410.

D. Expansion Joint Filler:

1. Prefomed expansion joint filler shall be of the bituminous type, shall conform to the requirements of AASHTO M 213 and shall not be more than 1 inch or less than 1/2 inch in thickness. The filler shall be cut to the full depth of pavement, curb and gutter, sidewalk, or driveway being replaced.

E. Gravel Pavement or Base:

1. Crushed limestone with such material as manufactured sand or other fine materials naturally contained or added thereto as needed to match existing conditions and conform to the gradations shown below:

Grading Table for Graded Aggregate Base Course
 Total Percent, by Dry Weight, Passing Each Sieve (U.S. Standard)

Size No.	2 ½ "	2"	1 ½ "	1"	3/8"	No. 40
1	100	95-100			35-65	10-30

2.02 EQUIPMENT

- A. Equipment and tools necessary for cutting, removal, and hauling of existing items; handling and placement of new material; and all equipment necessary to perform all parts of the Work shall be at the job site sufficiently ahead of the start of construction operations to be examined and approved by the Purchaser.
- B. When saws are used to cut pavement, the Subcontractor shall provide sawing equipment adequate in power to complete the sawing to a minimum of 1-1/2 inches below the pavement

surface in one pass. An ample supply of saw blades shall be maintained at the site of the Work at all times during sawing operations.

- C. Other types of pavement cutting equipment shall be capable of cutting the pavement to a neat straight line of 1-1/2 inch minimum depth below the pavement surface in one pass.
- D. The Subcontractor shall provide equipment capable of removal of pavements, sidewalks, driveway aprons, curbs and gutters, driveways, paved areas, and curbs without disturbance of adjacent items to remain in place.

PART 3 EXECUTION

3.01 REMOVAL OF ASPHALT PAVEMENT

- A. Asphalt pavement shall be removed to a clean straight line as shown on the drawing details. Pavement shall be cut by saw or other equipment approved by the Purchaser in advance. Edges of existing asphalt pavement adjacent to trenches, where damaged, shall be recut in a clean straight line within the limits of damaged pavement only. Such recuts shall be parallel to the original cuts and perpendicular to the pavement surface.

3.02 REMOVAL OF CONCRETE PAVEMENT

- A. Concrete pavement shall be removed to a neat straight line as shown on the drawing details. Care shall be used to avoid damage to pavements and to the pavement base remaining in place.

3.03 REMOVAL OF CONCRETE SIDEWALK, CURB AND GUTTER, AND DRIVEWAY

- A. Concrete sidewalks, curbs and gutters, and driveways shall be removed to the nearest contraction or expansion joint. Care shall be used to avoid damage to sidewalks, curbs and gutters, and driveways remaining in place.

3.04 REMOVAL OF GRAVEL PAVEMENT

- A. Gravel surfaces encountered in construction shall be removed as needed to allow for the adjustment of the manhole frame and cover.

3.05 REPLACEMENT OF PAVEMENT

A. Asphalt Pavements

1. Replace asphalt paving courses to match existing thickness. The minimum surface course thickness shall be 2 inches. Asphalt pavement and base replacement shall be constructed for the entire cross-section of pavement removal area including all areas where pavement was re-cut subsequent to the initial pavement removal.

B. Concrete Pavements

1. Concrete pavement shall be replaced with Class A concrete pavement equal in thickness to the pavement removed but not less than 4 inches thick. Concrete pavement and base replacement shall be constructed for the entire cross-section of pavement removal area including all areas where pavement was re-cut subsequent to the initial pavement removal.
2. Reasonable efforts shall be made to avoid contrast in the color and texture of existing and restored surfaces.

C. Placing, Curing, and Protection of Concrete

1. After the backfill in the trench has been brought to the appropriate subgrade elevation shown on the Plans, compacted to the specified density, and permission has been given by the Purchaser, a concrete slab of the appropriate thickness shall be placed within the entire disturbed area.
2. Any loose or disturbed pavement or base shall be removed prior to placement of the concrete. Concrete shall be placed only on a moist subgrade and shall not be placed unless the ambient temperature is 35° F and rising. In no case shall concrete be placed on a frozen or frosty subgrade. After the concrete is placed, it shall be struck off in an approved manner to the appropriate grade as shown on the Plans and shall be finished with floats and straight edges until the required surface texture has been obtained.
3. No vehicles or loads shall be permitted on any concrete until the Purchaser has determined that the concrete has obtained sufficient strength for such loads. The Subcontractor shall construct and place such barricades and protection devices as are necessary to protect the concrete.

D. Installation and Replacement of Temporary Cold Patch Paving

1. With the approval of the Purchaser, during times when permanent hot mix asphalt is not available, pavement surfaces shall be restored with temporary cold patch asphalt. Once the permanent asphalt is available, the Subcontractor shall remove and replace the temporary cold patch asphalt with permanent asphalt in accordance with Section 3.05.A Asphalt Pavements.

3.06 REPLACEMENT OF SIDEWALKS, DRIVEWAY APRONS, CURBS AND GUTTERS, DRIVEWAYS AND OTHER PAVED AREAS, AND CURBS

- A. Concrete sidewalks and driveway aprons shall be replaced in accordance with the City of Memphis Standard Construction Specifications.
- B. Unless otherwise directed, curb and gutter shall be replaced with new concrete curb and gutter of the same cross-section and at the same top of curb elevation and flow line as that removed. Where curb and gutter of a different type than existing is to be used for replacement, the replacement flow line shall match existing and a transitions section provided between the existing and replacement cross-sections. Curb heights shall be transitioned at a rate of 1 inch in 5 feet. Granite curb shall be replaced with new concrete curb whose height matches existing adjacent curb top elevations. Any expansion joint material removed shall be replaced at the original locations. Existing concrete edges shall be cleaned prior to placement of concrete. The finished curb and gutter cross-section, elevations, texture, and color shall conform to the adjacent concrete surfaces.
- C. Replacement of paved areas other than street pavement; concrete, asphalt, or gravel driveways; and asphalt or concrete curb within the right-of-way or construction easement limits shall be in kind for those cross-sections removed, unless directed otherwise by the Purchaser.

3.07 DAMAGE DUE TO SETTLEMENT

- A. The Subcontractor shall be responsible for any damage caused by settlement of backfill placed beneath pavements, sidewalks, driveway aprons, curbs, curbs and gutters, driveways, paved areas other than street pavement, and asphalt or concrete curb within the right-of-way or construction easement limits. This includes any damage which may occur at any time prior

to, and during a period of one year from the date of Final Completion of the Work covered by the Subcontract.

- B. During such period, the Subcontractor shall at his own cost and expense refill all excavations where settlement damage has occurred and replace damaged pavements, sidewalks, driveway aprons, curbs, curbs and gutters, paved areas, driveways, and all other damaged items to the satisfaction of the Purchaser. Should the Subcontractor fail to repair settlement damage which may occur as described above within 5 days after being given notice thereof, the Purchaser shall have the right to repair such settlement and charge the cost of such repairs to the Subcontractor.

3.08 DAMAGE OUTSIDE CONSTRUCTION EASEMENT LIMITS

- A. The Subcontractor will be held responsible for all damage to roads, highways, shoulders, curbs and gutters, ditches, embankments, bridges, culverts, and other property, caused by him or any of this Sub-subcontractors in hauling or otherwise transporting materials to and from the several sites of Work, regardless of the location of such damage. The Subcontractor shall make arrangements relative to the payment for, or repair or replacement of, such damage or damaged surfaces or structures which are satisfactory and acceptable to the Purchaser, at the Subcontractor's cost and expense.

PART 4 MEASUREMENT & PAYMENT

4.01 MEASUREMENT

A. Pavement Removal and Replacement

- 1. Pavement removal and replacement shall be measured for payment by the square yard, complete in place.

B. Concrete Sidewalk Removal and Replacement

- 1. Sidewalk removal and replacement shall be measured for payment by the square foot, complete in place.

C. Concrete Curb and Gutter Removal and Replacement

- 1. Curb and gutter removal and replacement shall be measured for payment by the linear foot, complete in place.

D. Gravel Driveway and Gravel Area Removal and Replacement

- 1. Gravel driveways and gravel area removal and replacement shall be measured for payment by the ton of crushed limestone, complete in place.

4.02 PAYMENT

A. Pavement Removal and Replacement

- 1. The accepted quantities of pavement removal and replacement shall be paid for at the Subcontract unit price per square yard for the type specified, which price will be full compensation for cutting and recutting pavement; removal and disposal of pavement and base; preparing the subgrade; placing, finishing, curing, and protection of concrete; and placing and compacting asphaltic concrete wearing surfaces, complete in place.

2. The accepted quantities of temporary pavement removal and replacement shall be paid for at the Subcontract unit price per square yard for the type specified, which price will be full compensation for installation; maintenance; removal and disposal of pavement; preparing the subgrade; and placing and compacting temporary asphaltic concrete wearing surfaces, complete in place.

B. Concrete Sidewalk Removal and Replacement

1. The accepted quantities of sidewalk removal and replacement shall be paid for at the contract unit price per square foot, which price will be full compensation for removal and disposal of sidewalk; preparing the subgrade; and placing, finishing, curing and protection of concrete, complete in place.

C. Concrete Curb and Gutter Removal and Replacement

1. The accepted quantities of curb and gutter removal and replacement shall be paid for at the Subcontract unit price per linear foot for the type specified, which price will be full compensation for removal and disposal of curb and gutter; preparing the subgrade; and placing, finishing, curing and protection of concrete, complete in place.

D. Gravel Driveway and Gravel Area Removal and Replacement

1. The accepted quantities of gravel driveway and gravel area removal and replacement shall be paid for at the Subcontract unit price per ton of crushed limestone, which price will be full compensation for preparing the subgrade and replacing the gravel, complete in place.

4.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02950-4.01.A-1	ASPHALTIC CONCRETE PAVEMENT REMOVAL AND REPLACEMENT	SQUARE YARD
02950-4.01.A-2	CONCRETE PAVEMENT REMOVAL AND REPLACEMENT	SQUARE YARD
02950-4.01.A-3	TEMPORARY ASPHALT REMOVAL AND REPLACEMENT	SQUARE YARD
02950-4.01.B	CONCRETE SIDEWALK REMOVAL AND REPLACEMENT	SQUARE YARD
02950-4.01.C	CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT	SQUARE YARD
02950-4.01.D	GRAVEL DRIVEWAY AND GRAVEL AREA REMOVAL AND REPLACEMENT WITH CRUSHED STONE	TON

END OF SECTION 02950

**SECTION 03050
PORTLAND CEMENT CONCRETE**

PART 1 GENERAL

1.01 SCOPE

- A. This specification covers the classification, materials, proportioning of materials, equipment, mixing requirements, and testing for portland cement concrete to be used for construction of streets, bridges, and miscellaneous structures and facilities as defined in Division 2 – Site Construction of these Specifications. The classification requirements, forming, curing, measurement, and payment for specific uses of concrete are specified and defined in the appropriate sections of Division 2.

PART 2 PRODUCTS

2.01 CONCRETE CLASSIFICATION

Portland cement concrete used for construction of the various items covered in Division 2 of these Specifications shall be classified by usage as follows:

1. Class A
 - a. Class A concrete shall be used as specified for such items as concrete curb, curb and gutter, sidewalks, drainage and sewer structures other than box culverts, ditch paving, bridges (other than superstructure) and similar uses.
2. Class A S
 - a. Class A S concrete shall be used for bridge superstructures and channel lining of ditches.
3. Class B
 - a. Class B concrete shall be used for roadway base and pavement.
4. Class C
 - a. Class C concrete shall be used as specified for such items as concrete cradles, encasements, embankment slope paving at bridge abutments, and other low strength applications.
5. Class P
 - a. Class P concrete shall be used for cast-in-place box culverts and precast and precast-prestressed concrete structures or structural members. High-early-strength concrete shall be as specified in Specification Section 03050 Paragraph 6.05.

2.02 MATERIALS

- A. Materials used in the production of portland cement concrete of the various classifications specified herein shall meet the following requirements.

2.03 PORTLAND CEMENT

- A. Portland cement shall be Type I cement conforming to the requirements of AASHTO M 85,

except that for high-early-strength concrete, Type III cement may be used.

2.04 FINE AGGREGATE.

A. Fine aggregate shall consist of natural sand, clean and free from any surface film or coating and graded from fine to coarse. Fine aggregate shall conform to the requirements of ASTM C 33 and the specifications included herein. The amount of deleterious substance shall not exceed the following percentage by weight:

1. Removed by decantation.....	3 percent
2. Coal or lignite.....	1 percent
3. Clay lumps.....	1 percent
4. Other local deleterious substances (such as shale, alkali, Mica, coated grains, soft and flaky particles).....	1 percent
5. Total coal, clay lumps, shale, soft fragments and other local deleterious substances	5 percent

B. All fine aggregate shall be free from amounts of organic impurities that would be detrimental to concrete strength and durability. Aggregate shall be subjected to the colorimetric test made in the field as follows:

1. Fill a 12 oz. graduated bottle to the 4 ½ oz. mark with the sand to be tested. Add a 3% solution of sodium hydroxide until the volume, after shaking, amounts to 7 ounces. Shake thoroughly and let stand for 24 hours. The sample shall then show a practically colorless solution, or at least, a solution not darker than straw color.

C. Fine aggregate shall be well graded from coarse to fine and, when tested by means of laboratory sieves, shall conform to the following requirements:

Passing	Percent
3/8 in. Sieve.....	100
No. 4 Sieve.....	95 to 100
No. 16 Sieve.....	50 to 90
No. 50 Sieve.....	10 to 30
No. 100 Sieve.....	0 to 10
No. 200 Sieve.....	0 to 3

- a. Note: Not more than 45% should be retained between any two consecutive sieves.

D. Fine aggregate shall be of such quality that mortar composed one (1) part portland cement and three (3) parts fine aggregate, by weight when made into briquets or cylinders, shall show a tensile or compressive strength at seven (7) and twenty-eight (28) days at least equal to the strength of briquets or cylinders composed of one (1) part of the same cement and three (3) parts standard Ottawa sand by weight. The percentage of water used in making the test specimens of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand test specimens of standard consistency.

2.04 COARSE AGGREGATE

- A. Coarse aggregate for any class of portland cement concrete shall consist of crushed stone or crushed or uncrushed gravel unless otherwise specified.
- B. Coarse aggregate for Class A, Class B, or Class C concrete shall be furnished in two sizes: Size No. 4 and Size No. 67 as shown hereinafter in Table 03050.1, Coarse Aggregate Gradation Table. The two sizes shall be manufactured, within the specified limits, to produce Size No. 467 when combined in the proper proportions at the batching plant. If the supplier provides a proper stockpile to prevent segregation, then a combined Size No. 467 can be used in lieu of blending Size No. 4 and Size No. 67.
- C. Coarse aggregate for Class AS concrete shall be Size No. 57. Only limestone coarse aggregate will be used for Class AS concrete; gravel coarse aggregate will not be permitted.
- D. Coarse aggregate for Class P concrete shall be size No. 57 or Size No. 67 as may be specified or directed. Only limestone coarse aggregate shall be used for Class P concrete; gravel coarse aggregate will not be permitted.
- E. Coarse aggregate for concrete curbing placed by machine extrusion methods shall be Size No. 57 or Size No. 67.
- F. The coarse aggregates shall otherwise conform to the requirements of AASHTO M 80 and ASTM C 33 with the following exceptions and stipulations:

1. Deleterious Substances.

The amount of deleterious substances shall not exceed the following limits:

	Maximum Percent by Weight
a. Soft or nondurable fragments (fragments which are structurally weak such as shale, soft sandstone, limonite concretions, gypsum, weathered schist or cemented gravel)	3.0
b. Coal and lignite	1.0
c. Clay lumps	0.25
d. Material passing the No. 200 sieve	1.00
e. Thin or elongated pieces (length greater than 5 times average thickness)	10.00
f. Other local deleterious substances.....	1.00

i. Notes:

- (1) In the case of crushed aggregate, if all the material finer than the 200 mesh sieve consists of the dust of fracture essentially free of clay or shale, Item 4, Maximum Per Cent by Weight, may be increased to 1.5.
- (2) The sum of the percentages of Items No. a, b, c, d, and f shall not exceed 5.0.
- (3) When the coarse aggregate is subjected to five alternations of the sodium sulfate soundness test, the weighted percentage of loss shall be not more than

nine.

- (4) Alternate freeze/thaw tests for soundness will not be performed.
- (5) The percentage of wear as determined by AASHTO T 96 shall not exceed 40.

COARSE AGGREGATE GRADATION TABLE
Table 03 05 00.1

Size Number	Amounts Finer Than Each Lab. Sieve (Sq. Openings), % By Weight						No. 4	No.8
	2"	1-1/2"	1"	3/4"	1/2"	3/8"		
4	100	90-100	20-55	0-15	----	0-5	----	----
467	100	95-100	----	35-70	----	10-30	0-5	----
57	----	100	95-100	----	25-60	----	0-10	0-5
67	----	----	100	90-100	----	20-55	0-10	0-5

2.05 WATER

- A. The water used in mixing concrete shall be clean, free from oil, acid, strong alkalis, organic or vegetable matter.

2.06 AIR-ENTRAINING ADMIXTURES

- A. Air-Entraining Admixtures shall conform to the requirements of AASHTO M 154, except that the tests for bleeding, bond strength and volume change will not be required.
- B. The Purchaser will maintain a list of qualified products. The Subcontractor shall be required to furnish a material that appears on this list.
- C. A product may become approved by furnishing test data from a recognized laboratory showing that the air-entraining admixture proposed for use conforms to the requirements of these Specifications. A recognized laboratory is defined as one of the following: A State Transportation Department Laboratory; a Federal Highway Administration Laboratory; or other laboratories which are approved by the Purchaser.

2.07 Chemical Additives

- A. For Portland cement concrete mixtures, these additives shall conform to the requirements of AASHTO M 194 covering the following five types:
 - 1. Type A – Water reducing admixtures
 - 2. Type B – Retarding admixtures
 - 3. Type C – Accelerating admixtures
 - 4. Type D – Water reducing and retarding admixtures
 - 5. Type E – Water reducing and accelerating admixtures
- B. Additionally, admixtures for increasing the flowable characteristics of concrete (super plasticizers) may be used, subject to the approval of the Purchaser for each class and intended

use of the concrete. Such admixtures shall meet the applicable requirements of ASTM C 494. The use of a plasticizer shall not change the maximum water requirements for the approved design mix. When approved for use, the admixture shall be introduced into the mix in the manner and quantities recommended by the manufacturer.

- C. Additives listed in items A through E above and super plasticizers may only be used with the written approval of the Purchaser. Before any admixture is approved, the manufacturer of the admixture or the Subcontractor shall furnish the Purchaser documentary evidence that the material proposed for use has been tested in accordance with the methods of test specified in AASHTO M 194 (or ASTM C 494 for super plasticizers) and meets the requirements of the Specification. Documentary evidence for all additives shall be the results of tests conducted by a testing laboratory inspected at regular intervals by the National Bureau of Standards. The Purchaser may require a notarized certification from the manufacturer of any additives used stating that the material is identical with that originally approved and has in no way been changed or altered. Even through additives have been approved by the Purchaser, the Subcontractor shall be responsible for the successful use of the additives. No reduction in the cement content of the concrete as designed without chemical additives will be made when additives are permitted.
- D. Calcium chloride additives will not be permitted.

2.08 CURING MATERIALS

- A. Curing materials shall be as specified in the various Specification Sections of Division 2 and as specified below:
- B. Water
 - 1. Water used in curing portland cement concrete shall be free from any substance which may be injurious to concrete when applied on the surface as a curing agent.
- C. Burlap
 - 1. Burlap shall conform to AASHTO M 182, Class 3 or Class 4. If Class 1 or Class 2 burlap is permitted, at least two layers shall be use.
- D. Liquid Membrane-Forming Compounds.
 - 1. These compounds shall conform to AASHTO M 148. Where applied texture finish is specified, a Type 1-D, Class B, membrane which is compatible with the texture finish shall be used. Type 2 (white pigmented) membrane shall be used in all other applications, unless otherwise specified.
- E. White Polyethylene Sheeting.
 - 1. This material shall conform to AASHTO M 171.

2.09 FLY ASH

- A. Class C fly ash conforming to the requirements of ASTM C 618-84 may be used as a replacement for portland cement if approved in writing by the Purchaser. The maximum amount of cement being replaced by fly ash shall not exceed 15 percent. Before any fly ash will be approved for use, the Subcontractor shall furnish the Purchaser documentary evidence that the fly ash proposed for use has been tested in accordance with ASTM C 311-7 and meets the requirements of that specification. Documentary evidence shall be the results of tests conducted by a testing laboratory inspected at regular intervals by the National Bureau of Standards. Even though the fly ash has been approved by the Purchaser, the Subcontractor shall be responsible

for its successful use. When a specific air content has been required and fly ash is being used, the air content shall be tested on each truck load of concrete at the batch plant and the tested value shall be indicated on the ticket.

2.10 EQUIPMENT

A. General

1. Equipment and tools necessary for handling materials and performing all parts of the Work shall be subject to the approval of the Purchaser. The equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly and approved. The equipment and organization shall be of sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans and Design Standards or as directed by the Purchaser.

2.11 BATCHING PLANT AND EQUIPMENT

A. General

1. The batching plant shall include bins, weighing hoppers, and scales. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The Subcontractor shall provide adequate means for cement cut off checks. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. The bulk cement storage bin or hopper shall be provided with adequate means for sampling the cement in storage.

B. Bins and Hoppers

1. Bins with adequate separate compartments for fine aggregates, each size of coarse aggregate, and cement shall be provided in the batching plant. Each compartment shall discharge efficiently and freely into the weighing hopper. Means of control shall be provided so that as the quantity desired in the weighing hopper is being approached, the material may be added slowly and shut off with precision. A port or other opening shall be provided for removing an overload of any one of the several materials from the hopper. Weighing hoppers shall be constructed so as to eliminate accumulations of tare materials and to discharge fully without jarring the scales. Partitions between compartments, both in bins and in hoppers, shall be ample to prevent spilling under any working conditions.

C. Scales

1. The scales for weighing aggregates and cement shall be of either the beam type or the springless-dial type. They shall be accurate within 0.5 percent throughout the range of use. The value of the minimum graduation on the scale for weighing cement shall not be greater than 5 pounds. The value of the minimum graduation on the scale for weighing amounts of aggregates up to 10,000 pounds or more shall be not greater than 10 pounds. The value of the minimum graduation of scales used in weighing amounts of aggregate 10,000 pounds or more shall be not greater than 0.1 per cent of the nominal capacity of the scales but shall not exceed 50 pounds. When beam type scales are used, provision, such as a "tell-tale" dial, shall be made for indicating to the operator that the required load in the weighing hopper is being approached. The "tell-tale" device on weighing beams shall indicate critical position clearly. Poises shall be designed so that they cannot be easily removed from the beam and can be held firmly in place. The weigh beams and "tell-tale" device shall be in full view of the operator while charging the hopper, and he shall have convenient access to all controls.
2. Scales shall be tested no less than once monthly by a certified scale testing company. Testing shall meet the requirements of applicable City ordinances and State law. The Subcontractor shall have available not less than 10 standard 50 pound weights meeting the

requirements of the U.S. Bureau of Standards for calibrating and testing weighing equipment. The person dispensing weighed material shall certify that the amounts of materials used is in accordance with quantities shown on the delivery ticket.

D. Equipment for Structural Concrete

1. The requirements for batching plants shall be as prescribed above, except that when approved by the Purchaser, the requirement for storage compartments in addition to weigh bins, for fine and coarse aggregates may be waived, provided the batching tolerances specified in Specification Section 03050 Paragraph 5.02.A are maintained.
2. Ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms shall be provided. Closed chutes or pipes shall be used when concrete is to be dumped or dropped for a distance greater than 5 feet. Where steep slopes are required, the chutes shall be equipped with baffle boards or shall be in short lengths that will enable the direction of movement to be reversed. Tremies for placing seal concrete under water shall consist of a water tight tube 10 inches to 14 inches in diameter. It shall be constructed so that the bottom can be sealed and opened after it is in place and fully charged with concrete. It shall be supported so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow.

2.12 MIXERS

A. General

1. Concrete may be mixed at a central point or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum, in terms of mixing and agitating capacity, and the speed of rotation of the mixing drum or blades for both mixing and agitation.
2. Mixers shall be capable of combining the aggregates, cement, additives when specified, and water into a thoroughly mixed and uniform mass within the specified mixing period. They shall have a minimum capacity sufficient to comply with minimum production requirements.
3. Mixers shall be equipped with an approved device for accurately measuring water within a range of error of not more than one percent. The amount of water used in each batch shall be shown by an indicator which is accurately calibrated and easily read.
4. Central plant mixers shall be equipped with an approved batch meter and timing device which will automatically lock the discharge lever during the full time of mixing and release it at the end of the mixing period. This device shall be equipped with a bell or other suitable warning device that will give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, providing the Subcontractor furnishes a satisfactory means of determining the mixing time.

B. Mixers at Site of Construction

1. Mixers at the site of construction will not be permitted, unless permitted by the Purchaser.

C. Truck Mixers and Truck Agitators

1. Truck mixers used for mixing and hauling concrete and truck agitators used for hauling central-mixed concrete shall meet all the applicable requirements under Paragraph A above, and in addition, the manufacturer's plate shall indicate the various uses for which the equipment is designed, the gross volume of the drum, and the minimum and maximum

speed of rotation of the drum or blades for charging, mixing and agitating. Trucks equipped for mixing shall be equipped with an approved device for recording the number of revolutions of the drum or blades. Mixers or agitators used to mix and transport paving concrete shall be of the hydraulic drum lift type or other especially designed types which will discharge low slump concrete (1 – 2 ½ inch) at a satisfactory rate without segregation.

D. Non-agitator Trucks

1. Bodies of non-agitator hauling equipment for concrete shall be smooth, mortar tight, metal containers, and shall be capable of discharging the concrete at a satisfactorily controlled rate without segregation. Covers shall be provided when needed for protection of the concrete. Nonagitator trucks may be used only with approval of the Purchaser.

E. Admixture Induction

1. A satisfactory method and equipment for setting the dosage for admixtures must be furnished and if admixtures other than air entraining agents are used, they shall be added in the manner and in the dosage recommended by the manufacturer.

F. Vibrators

1. Vibrators shall be of an approved type and design, and shall operate under load at the rate as recommended by the manufacturer and approved by the Purchaser. For concrete structures, all concrete to be vibrated shall be compacted by means of approved high frequency internal vibrators or other approved types of vibrators immediately after being deposited in the forms. At least two vibrators in good operating condition and tow sources of power shall be available at the site where more than 25 cubic yards of concrete are to be poured. The use of external vibrators for compacting concrete will be permitted where the concrete is inaccessible for adequate compaction, provided the forms are sufficiently rigid to prevent displacement or damage from external vibration and approved by the Purchaser. For concrete pavement, the frequency of surface vibrators shall not be less than 3,500 impulses per minute and the frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators. When spud type internal vibrators, either hand operated or attached to spreader or finishing machines, are used adjacent to forms, they shall have a frequency not less than 7,000 impulses per minute. For prestressed concrete, all concrete shall be thoroughly compacted with approved high frequency vibrators operating at a minimum of 7,000 vibrations per minute.

PART 3 EXECUTION

3.01 HANDLING, BATCHING AND MIXING

A. Stockpiling Aggregates

1. Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates, and the ground shall be firm and smooth and well drained. A cover of at least three inches of aggregate shall be maintained in order to avoid the inclusion of soil or foreign material. The stockpiles shall be built in layers not exceeding four feet in height, and each layer shall be completely in place before the next layer is started so as to prevent segregation. The material shall be deposited in such manner as to prevent coning, except in the case of aggregate composed essentially of material finer than the No. 4 sieve and base material.
2. Dumping, casting or pushing over sides of stockpiles will be prohibited, except in the case of aggregate for base material and fine aggregate materials.

3. Unless otherwise authorized, aggregates from different sources, different gradings or differing in specific gravity by more than 0.03 shall not be stockpiled together. Stockpiles of different types or sizes of aggregates shall be spaced far enough apart, or separated by suitable walls or partitions, to prevent the mixing of the aggregates.
4. When it is necessary to operate trucks or other equipment on a stockpile in the process of building the stockpiles, it shall be done in a manner approved by the Purchaser. Any method of stockpiling aggregate which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has operated, and failure of such samples to meet all grading requirements for the aggregate shall be considered cause for discontinuance of such stockpiling procedure.
5. Stockpiles shall be maintained in a saturated surface dry condition to the extent possible.

3.02 HANDLING, MEASURING AND BATCHING MATERIAL

A. General

1. The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the Work.
2. Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to maintain a uniform grading of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain high or non-uniform moisture content, storage or stockpile periods in excess of 12 hours may be required by the Purchaser. The Purchaser may require sprinkling of aggregate that has dried to the extent that it absorbs mixing water.
3. The fine aggregate and each size of coarse aggregate shall be separately weighed into the hopper or hoppers in the respective amounts set by the Subcontractor and approved by the Purchaser. Cement shall be measured by the sack or weight. Separate scales and hoppers shall be used for weighing the cement. The scales shall be equipped with a device to indicate positively the complete discharge of the batch of cement into the batch box or container. Ninety-four pounds of bulk cement shall be considered one sack. Batches involving fractional sacks will not be allowed except when bulk cement is used.
4. Batching plants equipped to proportion aggregates and bulk cement by weight by means of automatic and interlocked proportioning devices of approved type may be used.
5. Batching shall be so conducted as to result in the required weights of each material being within a tolerance of 1.0 percent for cement and 1.5 percent for aggregates.
6. Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over 1.0 percent. Unless otherwise permitted, calibrated tanks for measuring water shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to provide for checking the setting unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

7. The use of chemical additives shall be as prescribed under Paragraph 3.06 of this Specification and they shall be added to the mix using the methods and at the time and in the manner recommended by the manufacturer of the additive, subject to approval by the Purchaser.
8. Unless specifically provided in the contract, the furnishing and use of approved additives or admixtures and the other precautions necessary to provide satisfactory concrete and concrete products shall be considered subsidiary to the furnishing and placement of the concrete and any and all additional costs related thereto and risks resulting there from shall be borne by the Subcontractor.
9. Different types of cement shall not be mixed, nor shall they be used alternately. Where it is necessary for the color of the concrete to be uniform, only those cements which will produce similar color in concrete may be used alternately. The Purchaser shall designate which cements may be used alternately.
10. Air entraining agents shall be added to the mix by an approved procedure and by the use of an approved dispenser to assure an accurate proportioning of the agent.
11. All admixtures shall be measured with an accuracy of plus or minus 3.0 percent.

B. Limitations on Concrete Operations

1. Mixing of concrete shall be discontinued in time to allow finishing to be completed in daylight hours, unless an adequate and approved artificial lighting system is provided and operated.
2. When concrete is being placed during hot weather, appropriate measures shall be taken to reduce the hazards of increased rate of cement hydration and high concrete temperatures. The temperature of the concrete at point of discharge shall not exceed 90° F. The Purchaser may require any or all, but not limited to, the following precautions to reduce the temperature of the concrete:
 - a. Sprinkle coarse aggregate stockpiles in a manner so as to distribute the water evenly and to prevent a variation of moisture within the stockpile.
 - b. Use crushed or chipped ice as a portion of the mixing water, or use water cooled by refrigeration or other means. If ice is used, it shall be substituted on a pound for pound basis for water and completely melted before the concrete is discharged from the mixer.
 - c. The Subcontractor may employ other means which he may have at his disposal if approved by the Purchaser. In order to minimize the number and extent of precautions as indicated during the production and use of concrete during hot weather, the Subcontractor may use approved chemical admixtures for set-retarding purposes, with the Purchaser's approval. However, the use of such approved set-retarding admixtures shall not relieve the Subcontractor of the necessity for other precautions deemed necessary to minimize variability of the physical characteristics, strength, and other requirements of the green concrete.
 - d. Unless authorized in writing by the Purchaser, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40° F (if the temperature is expected to reach 35° F or below), and not resumed until an ascending air temperature in the shade and away from artificial heat reaches 35° F.
 - e. When concreting at temperatures above 35° F, the aggregates or water shall be heated

or cooled if necessary prior to being placed in the mixer so that the temperature of the resultant mixture will be not less than 50°F nor more than 90°F at the time of placement. If heating is required, the apparatus used shall heat the mass uniformly and shall be so arranged as to preclude the possible occurrence of overheated areas which might injure the concrete.

- f. When concreting is authorized at temperatures 35°F or less, the Purchaser will require the water or the aggregates or both to be heated to not less than 70°F nor more than 150°F. The temperature of the mixed, heated concrete shall be not less than 50°F nor more than 100°F at the time of placement. No concrete shall be placed on frozen grade nor shall frozen aggregates be used in the concrete.
- g. When it is expected that the ambient temperature will drop below 35°F, the Subcontractor shall provide sufficient canvas and framework, other types of housing, or to enclose and protect the concrete in such a way that the air surrounding the fresh concrete can be maintained at a temperature of not less than 45°F and the temperature of the concrete shall not exceed 80°F. The above conditions shall be maintained for a period of 120 hours after the concrete is placed. The Subcontractor shall be responsible for the quality of concrete placed during cold weather, and any concrete injured by frost action or freezing shall be removed and replaced at the Subcontractor's expense. When impending weather conditions indicate the possibility of the need for such temperature protection, all necessary heating and covering material shall be on hand ready for use before the Purchaser's permission is granted to begin placement.

3.03 MIXING CONCRETE

A. General

1. The concrete may be mixed in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity, and shall comply with the applicable requirements of Paragraph 4.03 of this Specification Section. Mixers shall be cleaned at suitable intervals. Equipment having components made of aluminum or magnesium alloys which would have contact with plastic concrete during mixing, transporting or pumping of Portland cement concrete, shall not be used.
2. The batch shall be so charged into the drum that a portion of the mixing water shall enter in advance of the cement and aggregates. Mixing time shall be measured from the time all materials except water are in the drum. The flow of water shall be uniform, and all water shall be in the drum by the end of the first 15 seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the flow of materials into the drum.
3. When mixed in a central mixing plant, the mixing time shall not be less than 60 seconds nor more than 90 seconds. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers shall be included in the mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.
4. The mixer shall be operated at the drum speed recommended by the manufacturer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Subcontractor at his expense. Mixers for central mix plants shall not be operated at a capacity greater than the manufacturer's guaranteed mixing capacity.
5. Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators or nonagitating trucks having special bodies. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the Work shall not exceed 30 minutes when the concrete is hauled in nonagitating trucks, nor 60 minutes when

hailed in truck mixers or truck agitators. When high early strength concrete is used, agitator trucks only shall be used and the concrete shall be deposited in place at the site of the Work within 30 minutes from the time water is added to the mix, regardless of the method of transportation, unless otherwise approved by the Purchaser.

6. Truck mixers and truck agitators used to transport concrete from a central mixing plant and truck mixers used to mix concrete in transit from a central batching plant shall meet all applicable requirements of Paragraph 4.03 of the Specification Section, and in addition, the mixing speed and agitating speed shall be those recommended by the manufacturer of the mixer and the total revolutions at mixing speed shall not be less than 70 nor more than 100. Truck mixers and truck agitators shall be operated within the capacity recommended by the manufacturer.
7. Retempering concrete by adding water or by other means will not be permitted. Concrete that is not within the specified slump limits at time of placement shall not be used. Admixtures for increasing the workability or for accelerating the set will be used only when provided for in the Contract, or permitted by the Purchaser. The addition of admixtures to the mix shall be in accordance with the provisions of Paragraph 5.02.A of this Specification Section.
8. Tests for air content shall be made on samples of fresh concrete when and as directed. The air content shall be that specified under Part 6 of this Specification Section and shall be determined in accordance with AASHTO T 152, T 196 or T 199.

B. Ready Mixed Concrete.

1. Ready mixed concrete shall fully comply with ASTM C 94 for Ready Mixed Concrete and to the requirements of these Specifications. Ready mixed concrete shall be discharged from the mixer within 1 hour after the introduction of water, provided the air temperature or the concrete temperature does not exceed 70°F. When the air temperature or concrete temperature exceeds 70°F, the elapsed time between the addition of water to the mix and discharge shall not exceed 30 minutes. The 30 minute time limit for temperatures exceeding 70°F may be extended to 1 hour, provided an approved admixture is used. The admixture shall be a water reducing and retarding agent meeting the requirements of Paragraph 3.06, Type D of this Specification Section and shall be used in accordance with the provisions of Paragraph 5.02.A of this Specification Section. The ready-mix plant furnishing the concrete shall have been inspected and approved for use as provided for in Part 4 of this Specification Section.
2. The delivery ticket accompanying each load of concrete shall show the class and quantity of concrete, the quantity of cement, aggregates, water, and additive used in the batch, and the time of batching. Materials used in the concrete shall be tested and approved.

3.04 MIX DESIGN AND PROPORTIONING

A. General

1. A Concrete Classification Table, Table 03 05 00.2 is provided hereinafter to indicate to the Subcontractor the five classes of concrete to be use. The table contains certain criteria to be met in the design of job mixes for the different classifications of concrete. Data included are the minimum 28 day compressive strength of the concrete (14 day strength for Class B concrete), the range of slum allowed, the minimum cement content of the concrete, and the maximum water allowed. The Subcontractor shall be responsible for design of the concrete mix to be used for each classification of concrete within the limits of Table 03050.2, and for providing concrete to the Purchaser in accordance with the approved design mixes.

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2. Unless otherwise specified in the Contract Documents all concrete shall contain an air entraining admixture. The concrete shall contain between 5 percent and 8 percent entrained air. Other admixtures may be used if specifically approved by the Purchaser. The use of calcium chloride will not be allowed.
3. The Purchaser may specify differing compressive strengths for the several classifications by notation on the Plans or in the Special Provisions, and those values shall govern over the values of these Specifications.

CONCRETE CLASSIFICATION TABLE

Table 03 05 00.2

Minimum Class Of Concrete	28-Day Compressive Strength (psi)	Min. Slump In Inches	Cement Factor-Sacks/CY Gravel Course Aggregate	Limestone Course Aggregate	Min. Gravel Course Aggregate	Cement Factor-#/CY Limestone Course Aggregate	Net Water Gravel Course Aggregate	Max. Gals./CY Limestone Course Aggregate	Net Water Gravel Course Aggregate	Max. Limestone Course Aggregate
A 3,000	3-5	6.0	5.5	564	517	36	33	300	275	
AS	4,000	3-5	(2)	6.2	(2)	583	(2)	37.2	(2)	310
B 3,500 (1)	1-2 ½	6.2	5.8	583	545	34.1	31.9	284	266	
C 2,500	2-4	5.0	4.5	470	423	34	30.6	283	255	
P 5,000	1-3	(2)	7.0	(2)	658	(2)	35.0	(2)	292	

(1) Minimum compressive strength @ 14 days. Minimum flexural strength @ 14 days of 550 psi per AASHTO T 22.
 (2) Gravel Coarse Aggregate no permitted.
 (3) Tabulated values are for Type I cement conforming to the requirements of AASHTO M 85 only.

3.05 MIX DESIGN

- A. Prior to mixing any concrete for the project, the Subcontractor shall submit his proposed design mix and reports of tests for each classification of concrete to the Purchaser for approval. The design mix shall be submitted on a form that indicates the supplier and type of the concrete and materials to be used as well as the amounts of materials per cubic yard for at least the following items and units (based upon saturated surface dry aggregate):
1. Cement-Pounds
 2. Coarse Aggregate-Pounds
 3. Fine Aggregate-Pounds
 4. Air Entraining Admixture – Ounces
 5. Other Admixtures (if allowed) – Ounces
 6. Water – Pounds
 7. Fly Ash (if allowed) – Pounds

3.06 PROPORTIONING

- A. Each class of concrete shall be manufactured by combining the several materials prescribed in the design mix in the proportions necessary to obtain the specified compressive strength for each class. Proportioning shall be based upon the specified cement content, and the amount of water for each class of concrete shall not exceed the quantity shown in Table 03050.2. Below this limit, the quantity of water shall be adjusted to meet the slump requirements. Aggregate weights shown in the Subcontractor's mix design(s) shall be based on saturated surface dry aggregate; batch weights shall be corrected to compensate for surface moisture on the aggregate in order to determine the amount of water to be added at the mixer.
- B. In addition to the requirements specified herein and on Table 03050.2, portland cement concrete for pavement, Class B, (Specification Section 02750) shall have a flexural strength at 14 days of not less than 550 pounds per square inch when tested in accordance with AASHTO T 22.

3.07 CHANGES IN MIX

- A. When approved by the Purchaser, the ration of coarse and fine aggregate may be adjusted in order to assure better workability or to accommodate placement by pumping. However, in no case shall the fine aggregate exceed 44 percent of the total aggregate.
- B. If during the progress of the Work, the specific gravity of one or both of the aggregates change more than plus or minus 0.03 from those shown on the concrete design, the design weights shall be adjusted by a design change to conform to the new specific gravity.

3.08 HIGH-EARLY-STRENGTH CONCRETE

- A. High-early-strength concrete may be required in the Plans and Specifications or substituted at the request of the Subcontractor, subject to the approval of the Purchaser. When high-early-strength cement concrete is authorized, it shall conform to the requirements of Table 03050.2 except that the 28 day strength (or 14 day strength for Class B concrete) shall be obtained in 7 days. The use of Type I or Type III cement for high-early-strength concrete in lieu of using Type III cement. When type I cement is used, the concrete shall have a minimum of 7.6 sacks (714 pounds) of cement per cubic yard of concrete. If admixtures are used to obtain high-early-strength concrete,

such admixtures may only be used if previously approved by the Tennessee Department of Transportation for similar uses of the concrete and if specifically approved for the project by the Purchaser.

- B. The gradation of fine and coarse aggregates shall be the same as that approved for the concrete for which the high-early-strength concrete is substituted. All materials entering into the high-early-strength concrete shall be of the same kind and class as the materials entering into the other part or parts of the facility constructed of the class of concrete for which high-early-strength is being substituted.
- C. No additional compensation will be made if the Subcontractor elects to substitute high-early-strength concrete for any class of concrete. The unit price for the class for which the substitution is made shall be full compensation for the concrete.

3.08 TESTING

A. Test Samples

- 1. The Purchaser shall provide for all test cylinders. All samples shall be cast, cured and tested by the Purchaser at its expense. The Subcontractor will be required to assist the Purchaser in securing necessary materials for casting the required number of cylinders. Testing ages will be 7 days and 28 days unless otherwise determined by the Purchaser. Laboratory cylinders shall be used to determine the quality of concrete produced. The number of cylinders to be cast daily for any quantity of concrete and laboratory tested, shall be specified by the Purchaser. With prior consent of the Purchaser, the Subcontractor may prepare field cylinders. These cylinders may be used as a gauge for early safe removal of forms where the Subcontractor requests earlier removal than set out in the Specifications.

B. Cement Testing

- 1. All cement used in the Work shall be pre-tested before use. Cement may be used upon completion of a satisfactory 3 day physical test made in accordance with current ASTM Specifications. Cement shall be tested by an approved commercial testing laboratory at the Subcontractor's expense.

C. Core Samples

- 1. If the Purchaser's testing of cylinders indicates compressive strength less than required in Table 03050.2 for the class of concrete specified, the Subcontractor may, at his option, elect to drill core samples from the actual concrete placed. If the Subcontractor elects to drill (or is instructed by the Purchaser to drill) core samples from the hardened concrete, the costs of obtaining the cores and of repairing the core holes with nonshrinking grout shall be borne by the Subcontractor.
- 2. The cores shall be drilled as directed by the Purchaser, at the same approximate locations from which the test cylinder concrete was obtained. The locations of the drilled cores shall be selected so that the remaining structure will not be impaired or sustain permanent damage after the holes are repaired by the Subcontractor. The drilled samples shall be tested for compressive strength by the Purchaser, and the equivalent 28 day strength of the concrete placed and represented by the drilled core samples shall be determined. The Purchaser shall use the test results of the drilled cores to determine the acceptability of the concrete.

3.09 METHODS OF SAMPLING AND TESTING.

- A. Test cylinders cast to determine acceptability for minimum AASHTO strength requirements shall be made and cured in accordance with AASHTO T 23 and tested in accordance with AASHTO T

22. Test cylinders cast to determine when a precast unit or a structure may be put into service or to determine when a tensioning load may be transferred shall be cured by methods identical to those used in curing the concrete member, and tested in accordance with AASHTO T 22.

- B. Drilled core samples shall be taken and tested in accordance with AASHTO T 24. Due to possible fracturing effect of the coring operation, drilled core samples having a compressive strength of 85 per cent or more of specified strength will be considered acceptable.
- C. Slump shall be determined in accordance with AASHTO T 119 on the job site during each placement.
- D. The amount of air entrained shall be determined by pressure or volumetric meters of approved design and in accordance with AASHTO Method T 152 or AASHTO Method T 196, except that AASHTO Method T 199 may be used after the accuracy of the Chace Air Indicator has been determined by comparison tests.

3.10 CONCRETE FAILING TO MEET STRENGTH REQUIREMENTS.

- A. Concrete which has been mixed and placed in accordance with these Specifications, and which fails to meet the minimum 28 day strength requirements shall be removed and disposed of by the Subcontractor, at his expense, unless specifically authorized by the Purchaser, in writing, to remain in place. The removal shall be in such manner as will not cause damage to the remaining concrete or to other structural units or other facilities and property.
- B. The Purchaser may, at his discretion, allow concrete which fails to meet the minimum strength requirement to remain in place. Payment for this concrete will be at a reduced price, to compensate the Purchaser for loss of durability. The amount of the reduction shall be determined by the Purchaser and shall be based on the particular circumstances.

3.11 MISCELLANEOUS

- A. Concrete Mixed and/or Batched Off Project Site
 - 1. Concrete may be mixed and/or batched off the immediate project site, subject to specific approval of the Purchaser and under the direct supervision of the Subcontractor. A delivery ticket (certified by the batch plant) showing mix, quantity of cement, quantity of fine and coarse aggregate, moisture content, total water and gallons per cubic yard of concrete shall be furnished to the Purchaser with each delivery of concrete and the Subcontractor shall show to the satisfaction of the Purchaser that the plant is so located and equipped as to produce and deliver concrete fully meeting the specification requirements.

PART 4 MEASUREMENT AND PAYMENT

- A. The methods of measurement and payment for concrete shall be as specified in Divisions 2 and 3 of these Specifications for each particular item constructed by the Subcontractor.

END OF SECTION 03050

**SECTION 03310
CONCRETE STRUCTURES**

PART 1 GENERAL

1.01 SCOPE

- A. This work shall consist of the construction of all structures, or parts of structures, composed of Portland cement concrete whether plain, reinforced, or a combination of both. Concrete structures shall be constructed of Class A Concrete, unless otherwise specified. They shall be constructed on prepared foundations, at the locations indicated or directed in conformity with the dimensions, lines and grades shown on the Plans or as directed by the Purchaser and in accordance with these Specifications.
- B. The concrete used in this construction shall be composed of a mixture or mixtures of Portland cement, aggregates, air-entraining agents, water, and chemical additives when approved, combined by the methods and in the proportions defined for the particular class of concrete designated as shown in Specification Section 03050.
- C. Parts of a structure, or structures, indicated to be constructed with materials other than Portland cement concrete and concrete reinforcement steel shall be constructed in accordance with the provisions set out in the Specification Section covering the particular type of construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials used in this construction shall meet the requirements of the applicable Sections or Paragraphs of Specification Section 03 05 00, "Portland Cement Concrete" and the following:
- B. Waterstops
 - 1. Waterstops shall be of the type, shape, and dimension shown on the Plans.
 - 2. Metallic:
 - a. Metallic waterstops shall be sheet copper conforming to the requirements as specified in the current Specifications for Copper Sheet, Strip, Plate, and Rolled Bar, Type ETP, ASTM Designation B 152. The weight per square foot shall be as specified on the Plans.
 - 3. Nonmetallic:
 - a. Nonmetallic waterstops shall be manufactured from either natural rubber, synthetic rubber, or polyvinylchloride (PVC) at the option of the Subcontractor. Waterstops shall be produced by such a process that, as supplied for use, they will be dense, homogeneous, and free from holes and other imperfections. The cross-section of the waterstop shall be uniform along its length and transversely symmetrical so that the thickness at any given distance from either edge of the waterstop will be uniform.
 - b. Rubber Waterstop:
 - i. The waterstop shall be fabricated from a high grade thread-type compound. The basic polymer shall be natural rubber or a copolymer of butadiene and styrene, or a blend of both. The compound shall contain no less than 70 percent by

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volume of the basic polymer, and remainder shall consist of reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents and plasticizers, but shall contain no factice.

- ii. Samples taken from the finished waterstop shall meet the following requirements when tested in accordance with the current specified ASTM method of test.

Title	Requirement	ASTM Method of Test
Tensile Strength (Die "C")	2500 psi. min.	D 412
Ultimate Elongation (Die "C")	450 percent, min.	D 412
Shore Durometer Hardness	60-70	D 2240
Specific Gravity	1.15 + 0.03	D 297 (Sec. 17)
Water Absorption (% by Wt.)	5 percent, max	D 570
Tensile Strength after accelerated Aging, oxygen-pressure method	80 percent, min.	D 572

c. Polyvinylchloride Waterstop

- i. This waterstop shall be extruded from an elastomeric plastic material. The material shall be a plastic compound, the basic resin of which shall be polyvinylchloride. The compound shall contain any additional resins, plasticizers, stabilizers, or other materials needed to insure that when the material is compounded it will meet the performance requirements of this Specification. No reclaimed polyvinylchloride shall be used.

Title	Requirement	ASTM Method of Test
Tensile Strength (Die "C")		
Sheet Material	2,000 psi	D 412
Finished Waterstop	1,700 psi	D 412
Ultimate Elongation (Die "C")		
Sheet Material	350% Min.	D 412
Finished Waterstop	300% Min.	D 412
Stiffness in Flexure	750 psi Min.	D 747
Accelerated Extraction		CRD C 572
Tensile Strength (Die "C")	1,750 psi	D 412
Elongation (Die "C")	300%	D 412
Effect of Alkali (After 7 Days)		
Change in Weight	-0.1 to +0.25%	
Change in Hardness, Shore Durometer	+ or - 5%	

Low Temperature Brittleness	-35°	D 746
Specific Gravity	1.3	D 792

- ii. For polyvinylchloride waterstops, the supplier shall submit a certificate stating that all of the performance requirements specified for the sheet material under Polyvinylchloride Waterstops have been complied with. Field splices for Polyvinylchloride waterstops shall be performed by heat sealing the adjacent surfaces in accordance with the manufacturer's recommendations. Waterstops shall be manufactured with an integral cross-section which shall be uniform within plus or minus 1/8 inch in width, and the web thickness or bulb diameter within plus 1/16 inch and minus 1/32 inch.
- iii. The Subcontractor shall furnish the Purchaser at this request and at no cost to the Purchaser a certified test report from an approved laboratory covering each lot or unit of finished waterstops. These test reports shall contain the numerical laboratory test data of the required test.

B. Epoxy Resin Systems

1. Two Component epoxy resin systems shall conform to the requirements of the appropriate class designation of AASHTO M 200, M 234, M 235, unless otherwise designated on the Plans or in the Contract. The appropriate class designation is determined by the proposed use of the material.
2. Requirements for Specific Uses:
 - a. Bonding fresh concrete to cured concrete.
Requirements: The material shall meet the compositional specification of AASHTO M 235, Class I and applicable requirements of the Class III performance specification.
 - b. Bonding cured concrete to cured concrete.
Requirements: The material shall meet the compositional specification of AASHTO M 235, Class II and the applicable requirements of the Class III performance specification.
 - c. Binder in epoxy resin concrete and mortar for repairing spalls and other defects in concrete.
Requirements: The material shall meet the compositional specification of AASHTO M 235, Class II and the applicable requirements of the Class III performance specification.

C. Bar Reinforcement

1. Unless otherwise specified, all steel reinforcement for concrete shall be billet steel bars conforming to the requirements of ASTM A 615.

D. Dowel Bars

1. Dowel bars shall be plain and shall conform to the requirements of ASTM A 306, Grade 55, 60, 65, or 70.

E. Welded Wire Fabric

1. Fabric for reinforcement shall conform to ASTM A 185, or as indicated on the Plans, and shall be supplied in mats of the size, design and weight shown on the Plans.

1.02 EQUIPMENT

- A. Equipment and tools necessary for handling materials and performing all parts of the Work shall be subject to approval by the Purchaser as to design, capacity, and mechanical condition. Equipment shall be on hand sufficiently ahead of the start of construction operations to be examined and approved. The equipment and organization shall be of sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans or as directed by the Purchaser.
- B. The requirements for batching plant and mixers shall be as prescribed in Specification Section 03050.
- C. Ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms shall be provided. Closed chutes or pipes shall be used when concrete is to be dumped or dropped for a distance greater than 5 feet. Where steep slopes are required, the chutes shall be equipped with baffle boards or shall be in short lengths that will enable the direction of movement to be reversed.
- D. Vibrators shall be of an approved type and design and shall operate under load at a rate as recommended by the manufacturer and approved by the Purchaser.

PART 3 EXECUTION

3.01 FORMS

- A. Construction
 - 1. Forms shall be mortar-tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other stresses incidental to the construction operations, including vibration. Forms shall be so constructed and maintained as to prevent the opening of joints due to shrinkage of the lumber.
 - 2. The forms shall be built true to line and grade and shall be held in place by means of studs or uprights, and waling, which shall be sufficiently and substantially braced and tied.
 - 3. All forms and studding shall be cut off and capped with not less than a 2 inch by 4 inch piece so that the top of the cap will be at the elevation of the finished exposed surface of the concrete.
 - 4. All edges shall be chamfered with $\frac{3}{4}$ inch material, unless otherwise specified. All chamfer strips shall be straight, of uniform width, and dressed.
 - 5. Wood devices of any kind used to separate forms shall be removed before placing concrete within 4 inches of such devices.
- B. Form Lumber
 - 1. Form lumber for all exposed concrete surfaces shall be dressed at least on one side and two edges and shall be so constructed as to produce mortar-tight joints and smooth, even concrete surfaces.
 - 2. Plywood forms, or forms face-lined with plywood, masonite, or other approved similar material may be used, provided the plywood forms and form linings are substantial, of uniform thickness, and are mortar-tight when in position.

C. Metal Ties

1. Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least one inch from the face without injury to the concrete. In case wire ties are permitted, the wires shall be cut back at least ¼ inch from the surface of the concrete, and the surface left sound, smooth, even, and uniform in color.

D. Walls

1. Sufficient openings shall be provided at intervals along the bottom of wall forms to permit thorough cleaning prior to concrete placement. Such openings shall be closed before placing concrete in the forms.

E. Surface Treatment

1. Prior to placing reinforcement, all forms shall be treated to prevent the adherence of concrete. Forms not provided with a special treatment shall be treated with an approved oil. Any material that will adhere to or discolor the concrete shall not be used.

F. Metal Forms

1. The specifications for forms, as regards design, mortar tightness, filleted corner, beveled projections, bracing, alignment, removal, and reuse and oiling apply to metal forms. The metal used for forms shall be of such thickness that the forms will remain true to shape. All bolt and nut heads shall be countersunk on the face forming the concrete surface. Clamps, pins, or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or do not line up properly shall not be used. Care shall be exercised to keep metal forms free from rust, grease, or other foreign matter.
2. When the Subcontractor wishes to utilize a special forming system not specifically authorized in this Specification, he shall submit his design and calculation to the Purchaser for review and approval.

3.02 FALSEWORK

- A. The falsework used to support the forms and concrete for concrete structures shall be supported on sills resting on rigid foundations composed of piles driven until the bearing capacity of each pile is sufficient to support the load to which it will be subjected, or earth-borne footings as hereinafter provided.
- B. Earth-borne footings will be permitted only when, in the opinion of the Purchaser, the soil can adequately support the superimposed loads and the following conditions are met:
 1. Spread footings will only be permitted on stable ground, capable of supporting the superimposed load.
 2. The site is graded and so maintained to prohibit ponding of water or erosion of soil in the proximity of the spread footings.
 3. The falsework system shall be designed and constructed to preclude exceeding the bearing capacity of the soil but in no case shall exceed 3,000 pounds per square foot.
 4. The footings shall be designed and constructed to carry the superimposed loads.

5. All footings shall be constructed on a level plane.
- C. The falsework shall be designed and constructed to support the required loading without distortion or settlement of the forms.
- D. The Subcontractor shall place "tell-tales" for observation of the amount of falsework settlement at locations designated by the Purchaser.
- E. The Purchaser may require the Subcontractor to submit detailed falsework plans, together with a soils report, design calculations or any other information necessary for a thorough review. The Subcontractor is totally responsible for the design and construction of the falsework system and shall repair, or remove and replace, as directed and at his expense, any concrete, other material or portions of the structure which are damaged or destroyed due to failure of the falsework.

3.03 REINFORCEMENT

- A. All reinforcement shall consist of deformed steel bars, unless otherwise indicated or directed. Deformed steel bars shall have a net area at all sections equivalent to that of plain round or square bars of the corresponding nominal size.
- B. Structural steel shapes shall conform strictly to the shapes indicated or required.
- C. Steel wire fabric may be furnished in rolls or sheets.
- D. Reinforcing steel shall be stored above the ground surface upon platforms, skids or other supports located without the scope of the active construction operations and shall be protected at all times from injury and damage. All brush and weeds shall be removed from the area immediately prior to storing reinforcing steel thereon.
- E. Reinforcing steel, where indicated, shall be accurately bent, without heating, to the forms and dimensions indicated on the Plans. Minimum bend diameters shall be in accordance with the requirements of the American Concrete Institute. Unless otherwise indicated, all bends shall be in one plane. Bars of $\frac{3}{4}$ inch or less which have only hooks or a single bend may be bent in the field, provided satisfactory equipment for proper and accurate work is used and provided the bending is accomplished true to form and dimensions without damage to the bars. All other bending shall be done in the shop before shipment.
- F. Substitution of bars of different sizes from those indicated on the Plans may only be made with the written permission of the Purchaser. If substitution is permitted, the following shall apply:
 1. The total area of steel in any one linear foot in each direction shall not be reduced.
 2. For cast-in-place concrete the clear distance between parallel bars in a layer shall not be less than 1.5 bar diameters, 1.5 times the maximum size of the coarse aggregate, nor 1-1/2 inches.
 3. Where positive or negative reinforcement is placed in two or more layers, bars in the upper layers shall be placed directly above those in the bottom layer with the clear distance between layers not less than 1 inch.
 4. Clear distance limitation between bars shall also apply to the clear distance between a contact lap splice and adjacent splices or bars.

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5. Groups of parallel reinforcing bars bundled in contact to act as a unit shall be limited to 4 in any one bundle. Bars larger than #11 shall be limited to two in any one bundle in beams. Bundled bars shall be located within stirrups or ties. Individual bars in a bundle cut off within the span of a member shall terminate at different points with at least 40 bar diameters stagger. Where spacing limitations are based on bar diameter, a unit of bundled bars shall be treated as a single bar of a diameter derived from the equivalent total area.
6. In walls and slabs, the primary flexural reinforcement shall be spaced not farther apart than 1.5 times the wall or slab thickness, nor 18 inches.
- G. All reinforcement shall be furnished in the full lengths shown on the Plans, unless otherwise approved in writing by the Purchaser. No splices shall be made unless indicated on the Plans or authorized by the Purchaser. Splices shall be so arranged and manipulated as to provide a minimum of 2 inches net clearance between the splices and the surface of the complete concrete work, unless otherwise indicated or directed. Splices of tension reinforcement at points of maximum stress shall be avoided. The members at all splices shall be rigidly clamped by means of at least two approved metal clips located approximately 3 inches from the ends of the bars and bolted around them or securely wired in a manner satisfactory to the Purchaser.
- H. Steel shapes shall be spliced only as indicated on the Plans.
- I. Steel fabric shall be spliced by overlapping of the sheets by not less than 12 inches; by matching at least three transverse member; and by securely wiring the overlapped sections in a manner satisfactory to the Purchaser.
- J. All reinforcing steel before being placed shall be thoroughly cleaned of mill scale, rust, dirt, paint, oil, or other foreign substances or coating of any character that will reduce the bond. If reinforcement which has been placed becomes dirty, rusty, or spattered with mortar which dries before concrete is placed around it, such reinforcement, or part affected, shall be thoroughly cleaned before being covered with concrete.
- K. Reinforcement shall be accurately placed and firmly held in position as indicated on the Plans. Steel bars shall be securely fastened together with metal clips or wire at each intersection, except where spacing is less than on 1 foot in each direction then alternate intersections shall be fastened. All reinforcing steel shall be securely spaced from the forms and between adjacent reinforcement by means of precast mortar blocks, metal spacers or other approved devices or methods, and where possible, all spacer devices shall be so arranged that their use cannot be detected in the completed structure. Spacer blocks shall be cast of mortar mixed in the same proportions as that in the concrete mixture and shall not have a length or width greater than the depth required for proper spacing from the forms or between adjacent reinforcement. The use of gravel, concrete, brick, or wooden blocks is prohibited.
- L. All the reinforcing steel necessary for a section of a concrete structure shall be accurately and securely placed and the placement approved by the Purchaser before any concrete is deposited in the section, and care shall be observed not to disturb it during the placing of the concrete.
- M. All dimensions relating to reinforcing bars are to the centers of the bars, unless otherwise indicated.
- N. Tolerances for bending and cutting during fabrication shall be in accordance with the "Manual of Standard Practice" published by the Concrete Reinforcing Steel Institute.

3.04 DRAINAGE AND WEEP HOLES

- A. Drainage openings and weep holes shall be constructed using materials in the manner and at the locations shown on the Plans or established by the Purchaser. Ports or vents for equalizing hydrostatic pressure, when required, shall be placed as directed.

3.05 PLACING PIPES, CONDUITS, ANCHORS, CASTING, AND OTHER APPURTENANCES

- A. Pipes, conduits, anchors, castings, bolts, plates, grillage, and other appurtenances which are necessary or desirable to be placed in the concrete of a structure, whether indicated on the Plans or not, shall be placed by the Subcontractor during construction, as directed.
- B. No compensation will be allowed for placing such pipes, conduits, and other appurtenances, except that no deductions will be made for the volume of concrete displaced by those items.

3.06 EXPANSION JOINTS

- A. Expansion devices shall be as indicated on the Plans. The devices shall be securely anchored in correct position. All sliding surfaces shall be true and smooth and shall form complete contact throughout. Movement shall not be impeded by the concrete in which they are embedded.
- B. Unless otherwise provided, where portions of concrete bridge superstructure rest on the substructure, the contact area shall be separated by at least two layers of three-ply bituminous-saturated paper.
- C. Open joints shall be constructed using forms which will permit removal without injury to the concrete. After removal of the forms, the joints shall be cleaned thoroughly. Filled joints shall be constructed with premolded filler, unless otherwise indicated. Joints requiring a sealant shall be thoroughly cleaned and sealed with one of the specified joint sealing materials before the structure is opened to traffic. Edges of open and filled joints shall be chamfered or edged, as directed. Mortised joints shall be constructed as shown on the Plans or as directed.

3.07 PLACING CONCRETE

A. General

- 1. Concrete shall not be placed until forms and reinforcing steel have been checked and approved. The forms shall be clean of all debris and kept wet immediately before concrete is placed. The method and sequence of placing concrete shall be approved by the Purchaser. Unless otherwise permitted, all concrete shall be placed in daylight, and the placing of concrete in any portion of the structure shall not be started unless it can be entirely completed in daylight. When the placing of concrete is permitted during other than daylight hours, an adequate and approved artificial lighting system shall be provided and operated.
- 2. All concrete shall be thoroughly worked during the placing by means of tools of approved type. The working shall be such as to force all coarse aggregate from the surface and to bring mortar against the forms to produce a smooth finish, substantially free from water and air pockets or honeycomb.
- 3. If the forms show bulging or settlement while concrete is being placed, the placing shall be stopped until correction has been made.
- 4. T-beam girders, slabs, arch rings, and all horizontal sections of bridges except curbs and sidewalks shall be constructed monolithically and continuously, unless otherwise

permitted. Curbs and sidewalks shall be constructed after the bridge deck is completed, unless otherwise indicated on the Plans.

5. After initial set and prior to final set of the concrete, the forms shall not be jarred, and no strain shall be placed on the ends of the projecting reinforcement. Piles shall not be driven closer than 20 feet to footings less than 7 days old nor to foundations supporting concrete less than 7 days old.

B. Railings and Curbing

1. When constructing curb, careful attention shall be given to the installation of railing steel or anchoring devices.
2. Concrete railings shall not be constructed on any structure until the falsework has been struck.

C. Chutes and Troughs

1. Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement.
2. All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. The water used for flushing shall be discharged clear of the concrete already in place.
3. Care shall be taken to fill each part of the form by depositing the concrete as near final position as possible. The coarse aggregate shall be worked back from the forms and around the reinforcement without displacing the bars. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement.

D. Vibrating

1. Unless otherwise directed, the concrete shall be compacted with suitable mechanical vibrators operating within the concrete. When required, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate compaction.
2. Vibrators shall be so manipulated as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. Vibrators shall not be used as a means to cause concrete to flow or run into position in lieu of placing. The vibration at any point shall be of sufficient duration to accomplish compaction but shall not be prolonged to the point where segregation occurs.
3. At least one additional standby vibrating unit shall be available for all individual pours in excess of 10 cubic yards.

E. Joints

1. Feather-edge construction joints will not be permitted. Transverse or longitudinal joints through spans will not be permitted, except where specified.
2. In no case shall the concreting of any section or layer be stopped or temporarily discontinued within 18 inches of any finished surface, unless the details of the structure provide for a coping having a thickness of less than 18 inches, in which case, at the option of the Purchaser, the construction joint may be made at the underside of the coping.

3. Layers completing a day's work or placed just prior to temporarily discontinuing operations shall be cleaned of all laitance or other objectionable material as soon as the surface has become sufficiently firm to retain its form.

3.08 BONDING CONSTRUCTION JOINTS

- A. Where dowels, reinforcing bars, or other adequate ties are not indicated on the Plans, keys of a directed size shall be made by constructing projections above the concrete and monolithically with the concrete.
- B. In resuming work, the forms shall be drawn tightly against the face of the concrete. The entire surface of the concrete to be bonded shall be cleaned thoroughly and roughened with a steel tool. In addition, if directed, the surface to be bonded shall be cleaned and roughened by sandblasting. The surface shall then be soaked with clean water, after which concreting may proceed.

3.09 REMOVAL OF FORMS AND FALSEWORK.

- A. Forms for ornamental work, railings, parapets, columns, and vertical surfaces that do not carry loads shall be removed in from 12 to 48 hours, unless otherwise directed by the Purchaser. In cold, damp, or freezing weather, all vertical forms shall remain in place until the concrete has set sufficiently to withstand damage when the forms are removed. In removing forms, care shall be exercised not to mar the surface of the concrete nor to subject it to any undue pressure.
- B. Projecting wires or other metal devices used for holding forms in place and which pass through the body of the concrete shall be removed or cut as specified in Specification Section 03310 Paragraph 3.01.A, and the holes or depressions thus made and all other holes, depressions, and small voids which show upon the removal of the forms shall be filled with cement mortar mixed in the same proportions as that which was used in the body of the concrete which is being repaired.
- C. Falsework and supports under slab or girder spans, any length, may be released and removed when representative specimens of the concrete in the spans, cured by the methods and in the manner the concrete which the test specimens represent is cured, attain a compressive strength of 3,000 pounds per square inch. In addition to the above requirement, the concrete shall have been placed a minimum of 10 days, not counting the days of 24 hours each in which the temperature falls below 40° F., or 21 calendar days, whichever occurs first.
- D. For continuous concrete girder or slab units, any length, the falsework and supports shall not be released or removed from any span in the continuous unit until the concrete in all spans in the unit has been placed a sufficient length of time to meet all requirements for the removal of falsework and supports as set forth above.
- E. Forms supporting bridge decks between girders and outside curb overhangs may be removed after seven days.

3.10 DEFECTIVE CONCRETE

- A. Any defective concrete discovered after the forms have been removed shall be removed immediately and replaced. If the surface of the concrete is bulged, uneven, or shows honeycombing which cannot be repaired satisfactorily, the entire section shall be removed and replaced.

- B. Concrete having a 28 day strength of less than the minimum specified shall be removed and disposed of by the Subcontractor, at his expense, unless specifically authorized by the Purchaser, in writing, to remain in place. The removal shall be in such a manner as will not cause damage to the remaining concrete or to other structural units or other facilities and property.

3.11 FINISHING CONCRETE SURFACES

- A. Unless otherwise authorized, the surface of the concrete shall be finished immediately after form removal.
- B. All concrete surfaces shall be given a Class 1 finish. The following surfaces of all structures shall be given a Class 2 Finish: roadway face and top of curb, vertical outside face of curb overhang or sidewalk slab, bottom surface of slab overhang, bridge railings, barrier railings, all vertical surfaces of the superstructure of dual bridges exposed to view from either structure, and all surfaces of retaining walls, wingwalls, and end walls which are visible from passing vehicles.

1. Class 1, Ordinary Surface Finish

- a. Immediately following the removal of the forms, all fins and irregular projections shall be removed from all surfaces which are to be exposed or waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, saturated with water, and carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the Class of the concrete being finished. Mortar used in pointing shall not be more than 30 minutes old. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.
- b. All surfaces which cannot be repaired to the satisfaction of the Purchaser shall be "rubbed" as specified for a Class 2 finish.

2. Class 2, Rubbed Finish.

- a. After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a wetted wooden block or a medium coarse carborundum stone. The carborundum stone shall not be used until the concrete has hardened to the state where the sand will grind, rather than ravel or roll. Rubbing shall be continued until all form marks, projections, and irregularities have been removed; all voids filled; and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place. A brush finish or painting with grout will not be permitted.
- b. After all concrete above the surface being finished has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.
- c. After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder, and objectionable marks.

3. Class 3, Float Finish

- a. This finish, for unformed surfaces, except slab surfaces for pavements or bases, shall be achieved by placing an excess of material in the form and removing or striking off the excess with a template, forcing the coarse aggregate below the mortar surface. Creation of concave surfaces shall be avoided after the concrete has been struck off, the surface shall be thoroughly worked and floated with a suitable floating tool of wood, canvas, or cork. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine-grained, smooth but sanded texture.

3.12 FINISHING SLAB SURFACES FOR PAVEMENTS OR BASES.

- A. Bridge floors or top slabs of structures serving as finished pavements or bases shall be finished either by hand methods or approved mechanical finishing machines.
- B. When the hand method is used, the bridge floors or slabs shall be struck off with a screed which is parallel to the centerline of the roadway, resting on bulkheads or screed strips cut or set to the required cross-section of the roadway. This screed shall be so constructed as to have sufficient strength to retain its shape and that the cutting edge may be adjusted to conform to the profile of the roadway. Screeds shall be of sufficient length to finish the full length of spans 40 feet or less in length. Spans over 40 feet in length shall be finished in two or more sections, but no section shall be less than 20 feet in length. Screed strips or headers shall be accurately set to the specified grades, checked, and adjusted as necessary prior to the final screeding operation. The screed shall be worked back and forth over the surface until the proper profile and cross-section is obtained.
- C. When mechanical finishing machines are used, they shall be approved power driven machines, traveling on rails adjusted to conform to the profile of the roadway. The machines shall be equipped with oscillating or vibrating transverse or longitudinal screeds that may be adjusted to conform to the profile or the required cross-section of the roadway. The screeds shall have sufficient strength to retain their shape after adjustment. The finishing machine shall go over each area of the bridge floor as many times as is required to obtain the required profile and cross-section.
- D. Regardless of the method of finishing, the Subcontractor shall maintain a minimum rate of placement of 20 linear feet of bridge deck per hour when concrete is placed in a longitudinal section.
- E. After finishing as described above, the surface shall be checked with a 12 foot straightedge and shall show no deviation in excess of 1/8 inch from the testing edge of the straightedge when placed parallel to the centerline. Deviations in excess of this requirement shall be corrected before the concrete sets.
- F. The surface shall be finished by dragging a seamless strip of damp burlap over the full width of the surface. The burlap drag shall consist of sufficient layers of burlap to slightly groove the surface and shall be moved forward with minimum bow of the lead edge. The drag shall be kept damp, clean, and free of particles of hardened concrete. A light broom or brush herring bone finish that leaves a texture similar to that obtained by the burlap drag may be used when permitted by the Purchaser. For bases, the surface shall be finished by grooving lightly with a wire broom at an angle of 60° with the centerline. All strokes shall begin at the center and end at the edge. After the slab has been finished by the burlap drag, surfaces which will become traffic lanes shall be textured by the formation of transverse grooves. The grooves shall be formed in the surface at an appropriate time during the stiffening of the concrete, so that in the hardened concrete the grooves will be between 0.09 inch and 0.13 inch in width; between 0.12 inch to 0.19 inch in depth; and spaced at random intervals between 0.3 inch and 1.0 inch. The grooves shall terminate approximately 18 inches from curbs, parapets,

barrier walls, and other vertical walls. The grooves shall be relatively smooth and uniform; shall be formed without tearing the surface and without bringing pieces of coarse aggregate to the top of the surface; and shall be formed to drain transversely. All areas which do not conform to these requirements shall be corrected at the Subcontractor's expense by approved methods.

- G. As soon as the surface has set sufficiently to withstand damage when walking on it and not later than the morning following the placing of the concrete, it shall be straightedged with the 12 foot straightedge and all variations exceeding 1/8 inch shall be plainly marked. The Subcontractor shall correct a seal such variations in the same manner as specified for Portland Cement Concrete Pavement.

3.13 CURING CONCRETE

- A. All concrete surfaces, except those surfaces protected by forms that remain in place seven days or longer as required under the provisions of Specification Section 03310 Paragraph 3.09, "Removal of Forms and Falsework", shall be cured as specified below. Curing shall begin as soon as the concrete has hardened sufficiently to withstand surface damage to unformed surfaces and immediately after the forms have been removed from formed surfaces.
- B. When the temperature is expected to fall below 35° F., the concrete shall be protected in accordance with the provisions of Specification Section 03310 Paragraph 3.14.
- C. The initial curing period for concrete surfaces shall be by the "Water Method" for a period of not less than 24 hours, or until the concrete surfaces have been prepared for the application of curing compound, in accordance with the provisions under B below. During the initial curing period, the concrete shall be protected from the sun by burlap mats or other approved materials and kept completely and continuously moist.
- D. The "Water Method" and membrane-forming compound method of curing will be required for all bridge decks, and on all concrete slabs when the temperature exceeds 90° F during placement.
 - 1. Water Method
 - a. All concrete slabs shall be covered immediately with material suitable for use with the water cure and kept thoroughly wet for at least 120 hours from the beginning of the initial curing period. All surfaces other than slabs shall be protected from the sun and shall be kept wet for a period of at least 72 hours from the beginning of the initial curing period. Curbs, walls, handrails, and other surfaces requiring a Class 2 finish may have the covering temporarily removed for finishing, but the covering shall be restored as soon as possible.
 - 2. Membrane-Forming Compound Method
 - a. All surfaces shall be given the required surface finish prior to application of the curing compound. Prior to the application of curing compound, the surface shall be kept moist.
 - b. The rate of application of curing compound shall be as recommended by the manufacturer but shall not be less than one gallon for 150 square feet of concrete surface. The curing compound shall be applied, under pressure, immediately after completion of the initial curing period or acceptance of the concrete finish. If the surface is dry, the concrete shall be thoroughly wet with water and the curing compound applied just as the surface film of water disappears. At the time of use, the

compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. If the application of the compound results in a streaked or blotchy appearance, the method shall be stopped and water curing, as set out above, applied until the cause of the defective appearance is corrected. The coating shall be protected against marring for a period of seven days from date of application. Any coating marred or otherwise disturbed within the seven day period shall be replaced at once.

3.14 PROTECTION OF CONCRETE IN COLD WEATHER

- A. Concrete shall be protected in cold weather as specified in Specification Section 03050.

3.15 WATERPROOFING AND WATERSTOPS

- A. Waterproofing shall be applied as indicated in the Division 2 Specifications.
- B. Metallic or nonmetallic waterstops, as specified, shall be installed in accordance with the details shown on the Plans and in conformity with the requirements of these Specifications.
- C. Metallic waterstops shall be spliced, welded or soldered, as necessary, to form continuous, watertight joints.
- D. Nonmetallic waterstops shall be installed in continuous strips without splices, except that splices will be permitted at changes in direction when necessary to avoid buckling or distortion of the web or flange. All splices of nonmetallic waterstops shall be performed in accordance with the manufacturer's recommendations and in the case of polyvinylchloride waterstops, the heat used shall be sufficient to melt but not char the plastic.
- E. Adequate provisions shall be made to support the waterstops during the progress of work and to insure their proper embedment in the concrete. The concrete shall be thoroughly worked in the vicinity of the joints to insure maximum density and imperviousness. Forms shall be so designed that they can be removed without damaging the waterstops. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from mechanical damage.

PART 4 MEASUREMENT & PAYMENT

4.01 MEASUREMENT

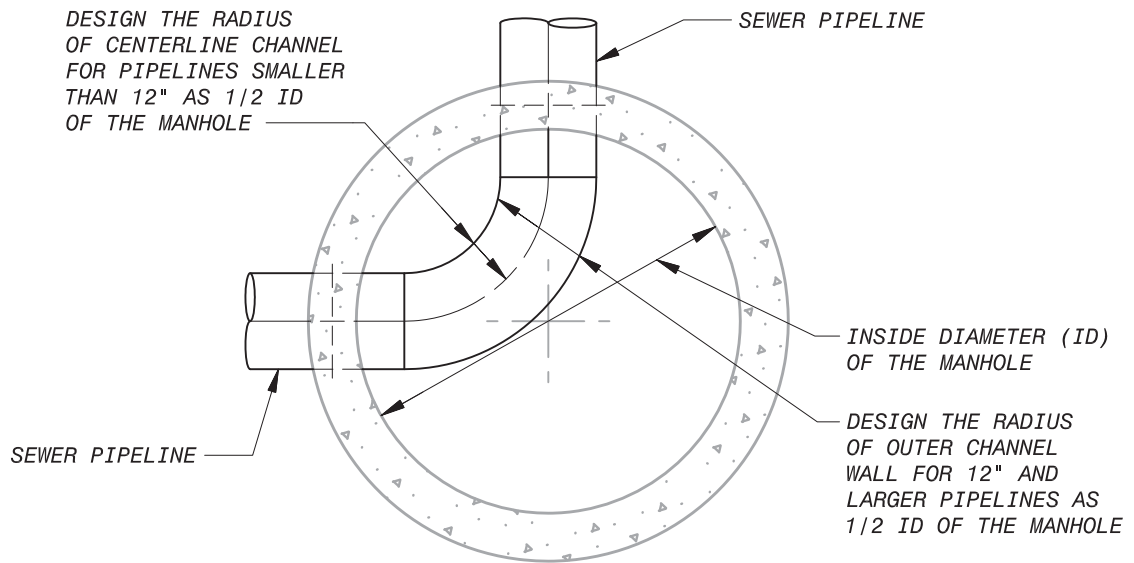
- A. All concrete will be measured for payment as stipulated under the Specification Section specifying each individual type of construction.
- B. No allowance will be made for furnishing the material and the construction of drainage openings and weep holes as indicated or as directed, provided such openings are 6 inches in diameter or less, except that no deduction will be made for such openings in the computation of concrete quantities. Allowance will be made for other openings as indicated.
- C. No allowance will be made for additional cement used in depositing concrete underwater; for use of calcium chloride or chemical additives; for fillers, sealer, and tar paper used in expansion joints; for dowels or other materials used in bonding construction joints; for waterstops; and for painting metals.
- D. No allowance will be made for concrete placed below the foundation elevation shown on the Plans or as directed by the Purchaser.

- E. No additional compensation will be made for high-early-strength concrete substituted by the Subcontractor.

4.02 PAYMENT

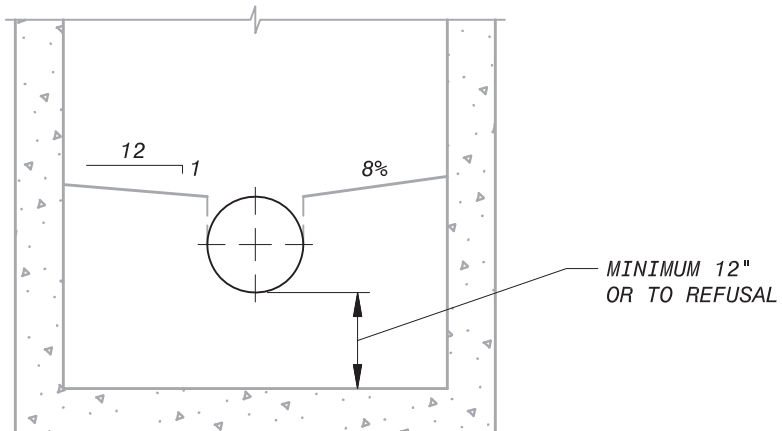
- A. All concrete will be paid for as stipulated under the Specification Section specifying each individual type of construction.

END OF SECTION 03310



MINIMUM RADIUS OF MANHOLE CHANNEL

EXAMPLE: FOR A 48-INCH DIAMETER MANHOLE FOR 8-INCH SEWERS, MINIMUM CENTERLINE CHANNEL RADIUS EQUALS TWO (2) FEET



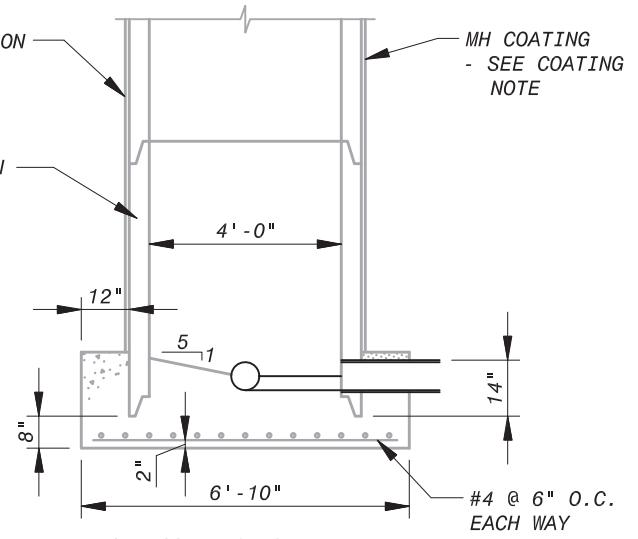
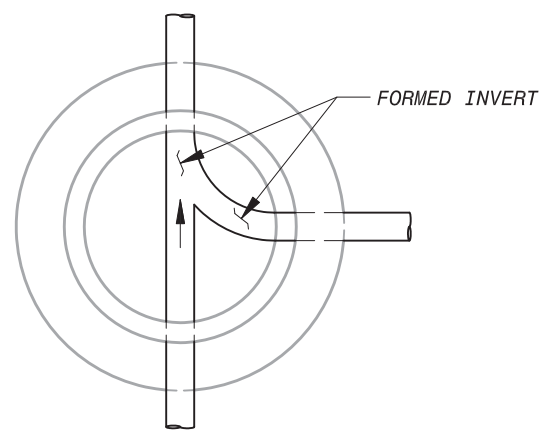
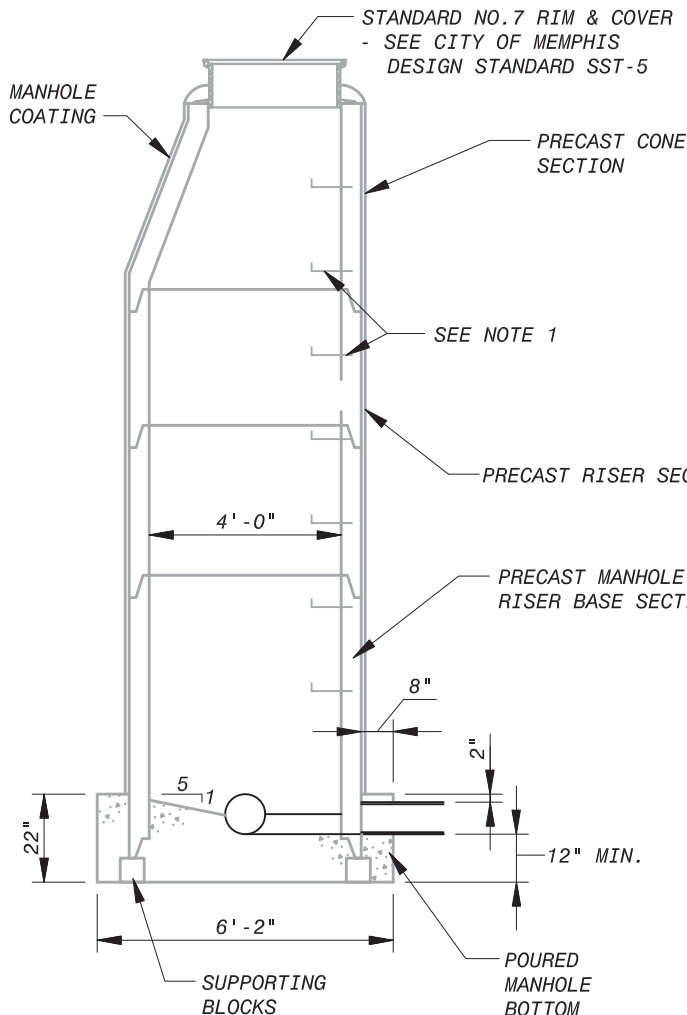
NOTES:

1. CHANNEL SHALL BE POURED WITH 3,000 PSI CONCRETE.
2. INSTALL HYDROPHILIC NEOPRENE GASKET AROUND PERIMETER OF MANHOLE, 2 INCHES TO 4 INCHES BELOW FINAL CONCRETE ELEVATION (E.G. LMK INSIGNIA END SEAL SLEEVE).
3. INVERT OF NEW MANHOLE CHANNEL SHALL BE FINISHED WITH CONSISTENT SLOPING GRADE FROM INCOMING PIPELINE INVERT TO OUTGOING PIPELINE INVERT, IF APPLICABLE WITH EXISTING INVERT ELEVATIONS.
4. RADIUS OF CHANNEL:
 - A. FOR SEWER PIPELINES SMALLER THAN 12-INCH DIAMETER, PROVIDED A MINIMUM RADIUS OF THE CENTERLINE OF THE CHANNEL OF ONE-HALF (1/2) THE INSIDE DIAMETER (ID) OF THE MANHOLE.
 - B. FOR SEWER PIPELINES 12-INCH AND LARGER, PROVIDE A MINIMUM RADIUS OF THE OUTER CHANNEL WALL OF ONE-HALF (1/2) THE INSIDE DIAMETER (ID) OF THE MANHOLE.
 - C. DESIGN THE CHANNELS TO HAVE A UNIFORM CURVE, WITH NO REVERSE CURVES WITHIN THE MANHOLE.
5. WIDTH OF CHANNEL:
 - A. THE CHANNEL WIDTH FOR SEWER PIPELINES HAVING THE SAME DIAMETER ENTER AND EXIT A MANHOLE IS THE SAME AS THE PIPE INSIDE DIAMETER.
 - B. THE CHANNEL WIDTH FOR SEWER PIPELINES HAVING DIFFERENT DIAMETER, IS TAPERED FROM ONE PIPE SIZE TO THE OTHER.
6. TOP OF BENCH ELEVATION:
 - A. WHEN BOTH THE INCOMING AND OUTGOING PIPES ARE THE SAME DIAMETER, SET THE TOP OF THE BENCH AT THE SAME ELEVATION AS THE TOP OF THE PIPE.
 - B. WHEN THE INCOMING AND OUTGOING OF THE PIPES HAVE DIFFERENT DIAMETERS, SET THE TOP OF PIPE ELEVATION OF THE HIGHEST PIPE WITHIN THE MANHOLE, EXCEPT WHEN A MANHOLE DROP CONNECTION IS DESIGNED. WHEN A SEWER HOUSE CONNECTION (SHC) ENTERING THE MANHOLE IS SIGNIFICANTLY HIGHER THAN THE MAINLINE SEWER, THE BENCH ON THE SIDE WHERE THE SHC ENTERS MAY BE ELEVATED, AND THE BENCH ON THE OPPOSITE SIDE MAY MATCH THE TOP OF THE MAINLINE SEWER FOR MORE CONVENIENT ACCESS.
7. WIDTH AND SLOPE OF THE TOP OF THE BENCH:
 - A. THE BENCH SHOULD PROVIDE GOOD FOOTING FOR A WORKER AND A PLACE WHERE TOOLS AND EQUIPMENT CAN BE LAID AND MUST BE PROVIDED WITH ADEQUATE SLOPE TO DRAIN.
 1. INSTALL THE TOP OF BENCH WITH AN EIGHT (8%) PERCENT OR 1-INCH PER FOOT SLOPE FROM THE WALL TO THE CHANNEL'S EDGE.
 2. INSTALL THE WIDTH OF THE BENCH TO HAVE A MINIMUM OF 12-INCH ON EACH SIDE OF THE CHANNEL, IF POSSIBLE.



SARP10

BENCH & CHANNEL REPLACEMENT DETAIL



MANHOLE COATING NOTE:
 OUTSIDE COATING OF MANHOLE SHALL BE WITH ASPHALTIC BLACK, AS AVAILABLE AT UNITED PAINT COMPANY.



METHOD OF APPLICATION SHALL BE PERFORMED BY BRUSH OR BY LOW PRESSURE SPAYER.

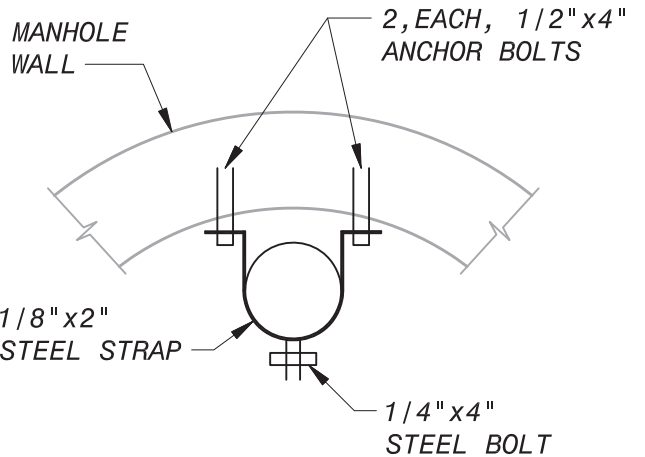
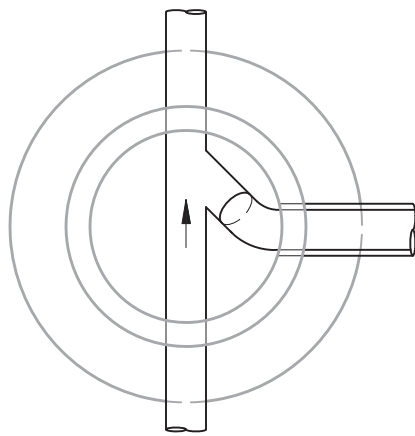
- NOTES:**
1. CAST IRON STEPS STAGGERED LATERALLY 12" C-C & UNIFORMLY SPACED VERTICALLY AT 16" O.C. MAXIMUM - SEE "MANHOLE STEPS" NOTE BELOW

TYPICAL PRECAST MANHOLE

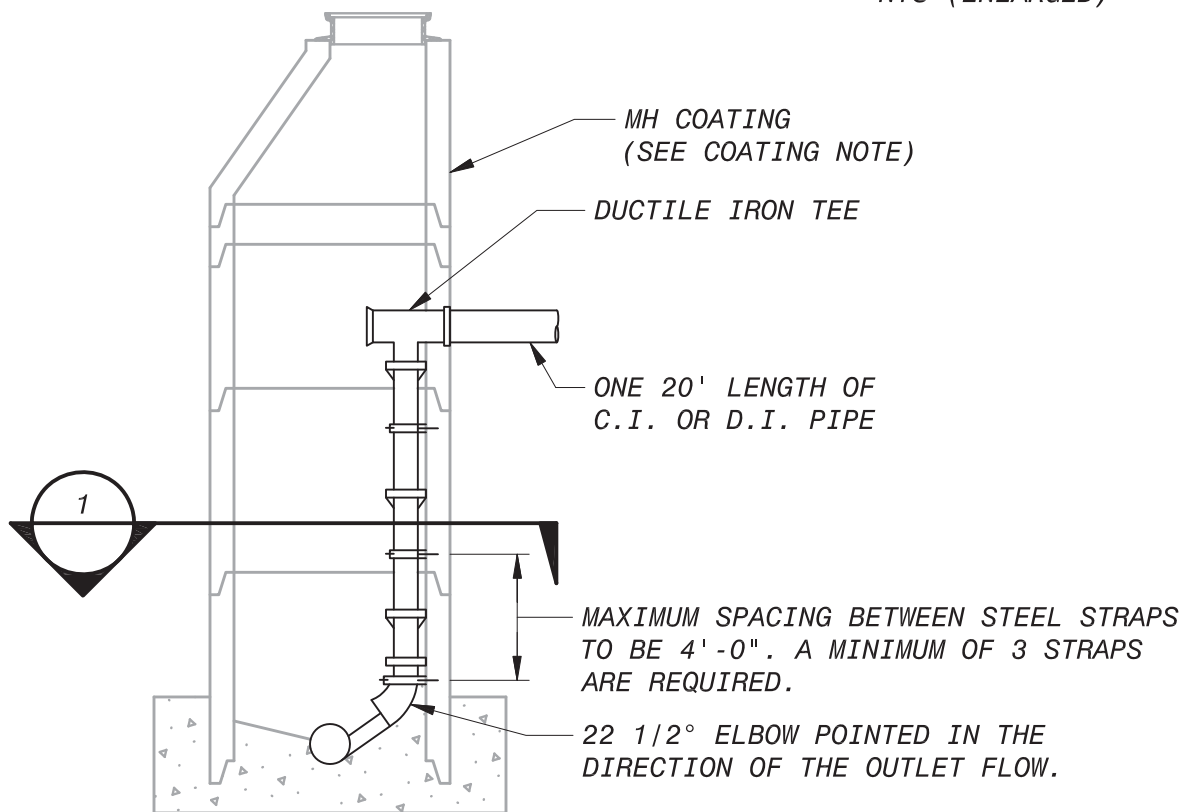
ALTERNATE (MANHOLES IN EXCESS OF 20' DEEP)

- JOINT SEALANT:** CONCRETE MORTAR SHALL BE USED TO SEAL JOINTS AFTER THE INSTALLATION OF AN APPROVED GASKET MATERIAL BETWEEN ALL PRECAST MANHOLE SECTIONS.
- BASE SECTIONS:** MANHOLE BOTTOM SHALL NOT BE POURED UNTIL PRECAST BASE SECTION OF MANHOLE AND PIPE STUBS OUT & IN ARE IN PLACE. PIPE STUBS OUTSIDE OF MANHOLE SHALL HAVE A MINIMUM LENGTH OF 12" AND A MAXIMUM LENGTH OF 15" FROM OUTSIDE OF MANHOLE TO THE FIRST JOINT OF PIPE. CONCRETE USED TO FORM BASES AND INVERTS SHALL BE 3,000 p.s.i.
- SUBSTITUTES:** POURED-IN-PLACE MANHOLES MAY BE SUBSTITUTED FOR PRECAST MANHOLES, PROVIDED A FORMAL, WRITTEN REQUEST HAS BEEN SUBMITTED TO & APPROVED BY THE ENGINEER OF DESIGN. ALL POURED-IN-PLACE MANHOLES SHALL CONFORM TO CITY OF MEMPHIS STANDARD DRAWINGS NO. SST-6 AND SST-7.
- MANHOLE STEPS:** THE FOLLOWING MANHOLE STEPS HAVE BEEN APPROVED FOR USE:
1. TOWER GROVE MH STEP NO. B-1096 BY TOWER GROVE FOUNDRY CO.
 2. M.A. MANHOLE STEPS BY M.A. INDUSTRIES, INC., EAST POINT, GA.
 3. WEDGE-LOK SAFETY STEP BY DELTA PIPE PRODUCTS, INC., ATLANTA, GA.

	<h1 style="font-size: 2em; margin: 0;">SARP10</h1> <h2 style="font-size: 1.5em; margin: 0;">PRECAST SANITARY MANHOLE SST-1</h2>
	<p>REV 0.0</p> <p>DATE: 06/04/15</p>



SECTION
NTS (ENLARGED)



INSIDE DROP
(SEE NOTE 2)

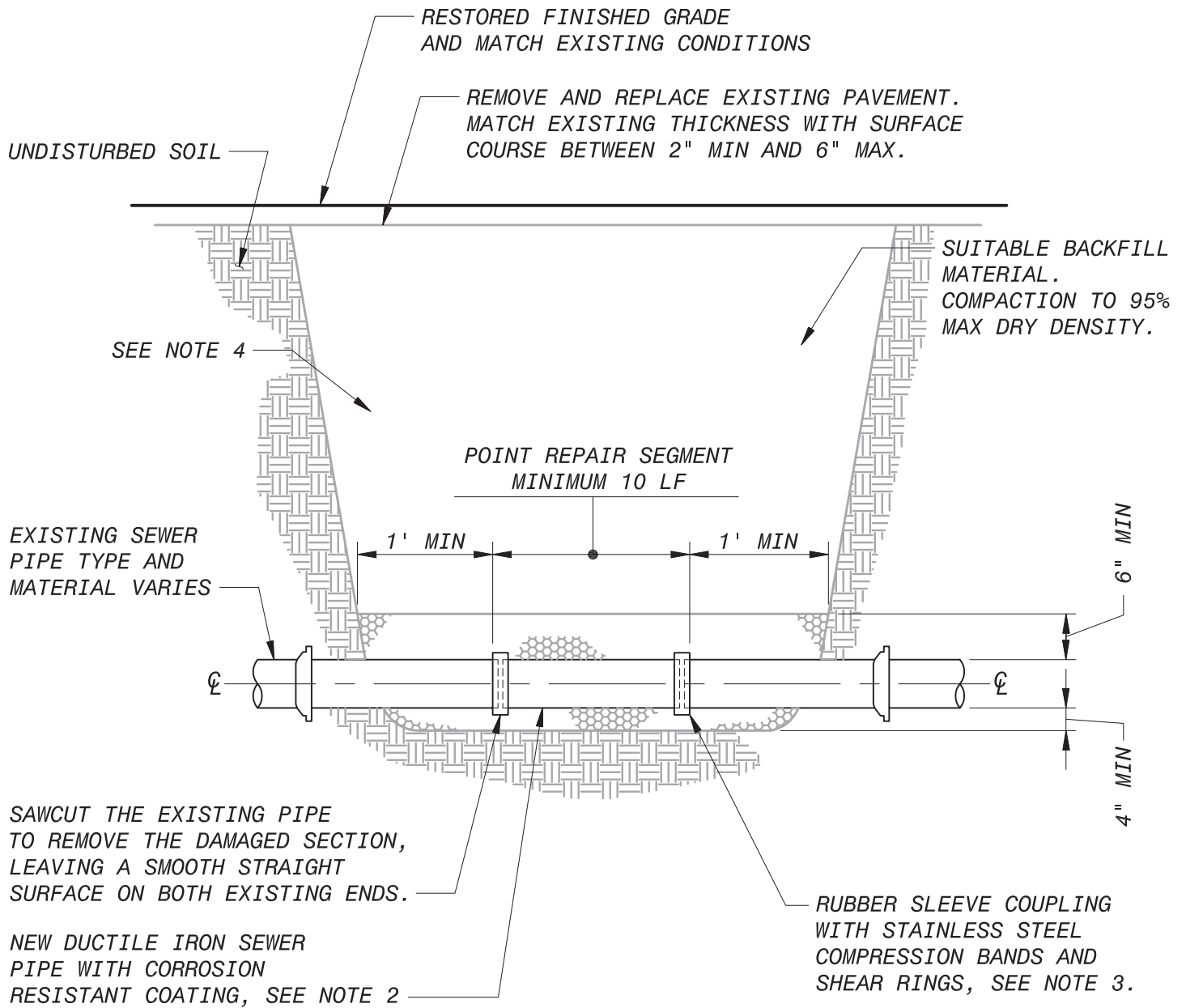
NOTES:

1. TO BE USED, WHERE REQUIRED, ON NEW MANHOLES.
2. TO BE USED ON ALL EXISTING MH'S, WHERE REQUIRED.



SARP10

SANITARY MANHOLE DROP CONSTRUCTION SST-2



NOTES

1. CONSULT WITH SARP10 CONSTRUCTION MANAGER BEFORE MAKING REPAIRS REQUIRING MORE THAN 10 LF.
2. INSTALL NEW DUCTILE IRON SEWER PIPE, IN ACCORDANCE WITH CITY OF MEMPHIS STANDARD CONSTRUCTION SPECIFICATION SECTION 02530-SEWER PIPE INSTALLATION.
3. INSTALL FERNCO SERIES 5000RC SHIELDED COUPLINGS WITH NUT AND BOLT CLAMP, MISSION "FLEX-SEAL" ADJUSTABLE SHIELDED REPAIR COUPLINGS, OR APPROVED EQUAL.
4. REMOVE EXCAVATED MATERIAL UNDER PAVED SURFACES AND BACKFILL WITH CRUSHED LIMESTONE OR RECYCLED CRUSHED CONCRETE PER CITY OF MEMPHIS STANDARD SPECIFICATIONS.



SARP10

**SANITARY
SEWER POINT REPAIR**

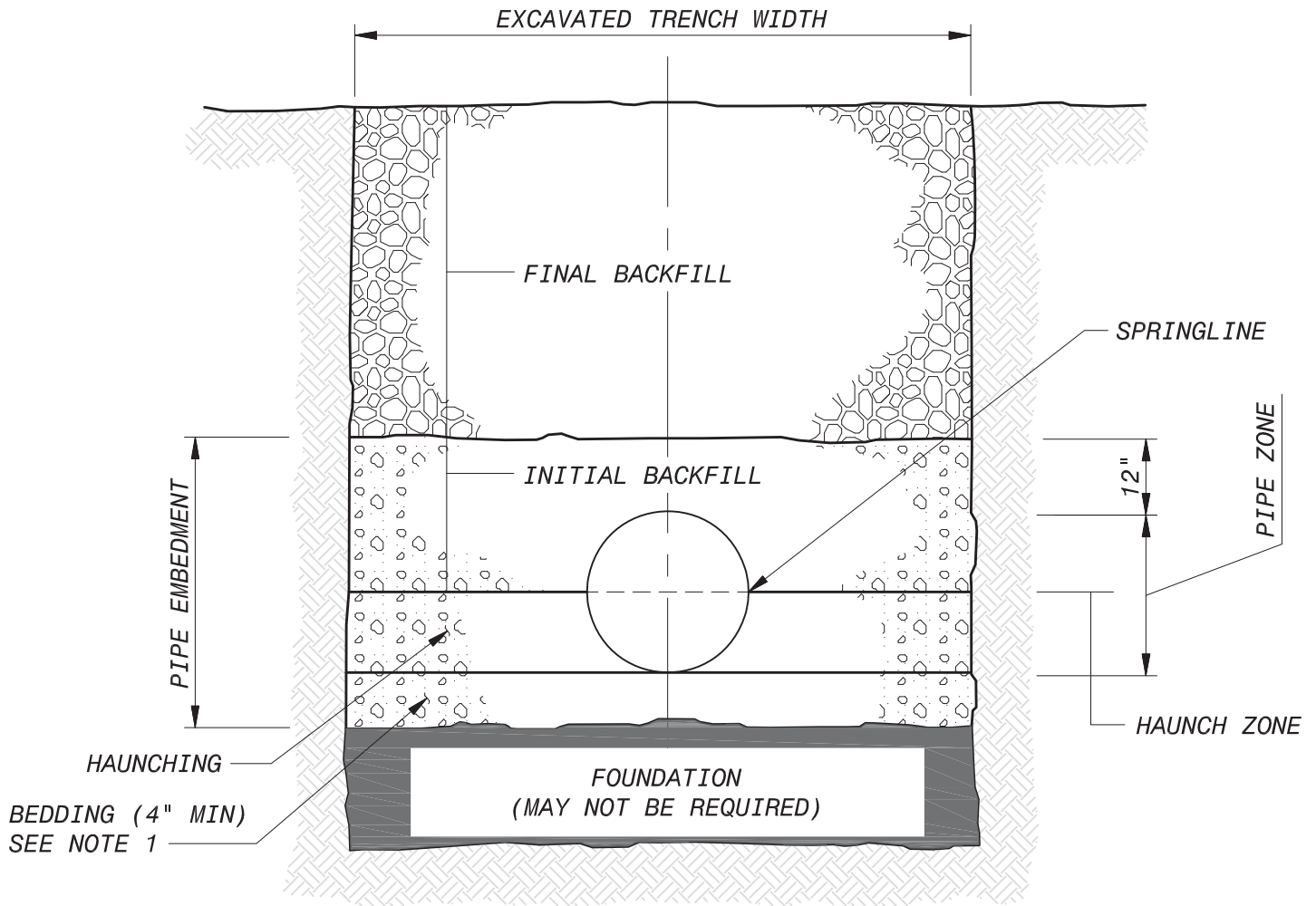


FIGURE 1

TRENCH CROSS SECTION SHOWING TERMINOLOGY - PIPE REPLACEMENT

NOTES

1. INSTALL CRUSHED LIMESTONE ASTM D-448-54 TABLE 1, #67 FOR BEDDING AND HAUNCHING MATERIAL. THE QUANTITY OF CRUSHED LIMESTONE FOR BEDDING AND HAUNCHING IS PART OF THE "SEWER POINT REPAIR" LINE ITEM AND NO SEPARATE PAYMENT WILL BE MADE.
2. INSTALL EITHER CRUSHED LIMESTONE OR RECYCLED CRUSHED CONCRETE FOR INITIAL BACKFILL AND FINAL BACKFILL PER CITY OF MEMPHIS SPECIFICATIONS.



SARP10

TRENCH CROSS SECTION
SHOWING TERMINOLOGY
- PIPE REPLACEMENT

REMOVE EXISTING PAVEMENT
AND BASE AND REPLACE
WITH NEW (MATCH EXISTING)

EXISTING PAVEMENT

INSTALL RISER
RINGS TO BRING
COVER TO GRADE

5" OR LESS

EXISTING FRAME
AND COVER

22"

EXISTING MANHOLE

NOTES

1. CITY OF MEMPHIS WILL SUPPLY RISER RINGS. CONTRACTOR SHALL MAKE ARRANGEMENTS FOR PICK UP.



BLACK & VEATCH
Building a world of difference.

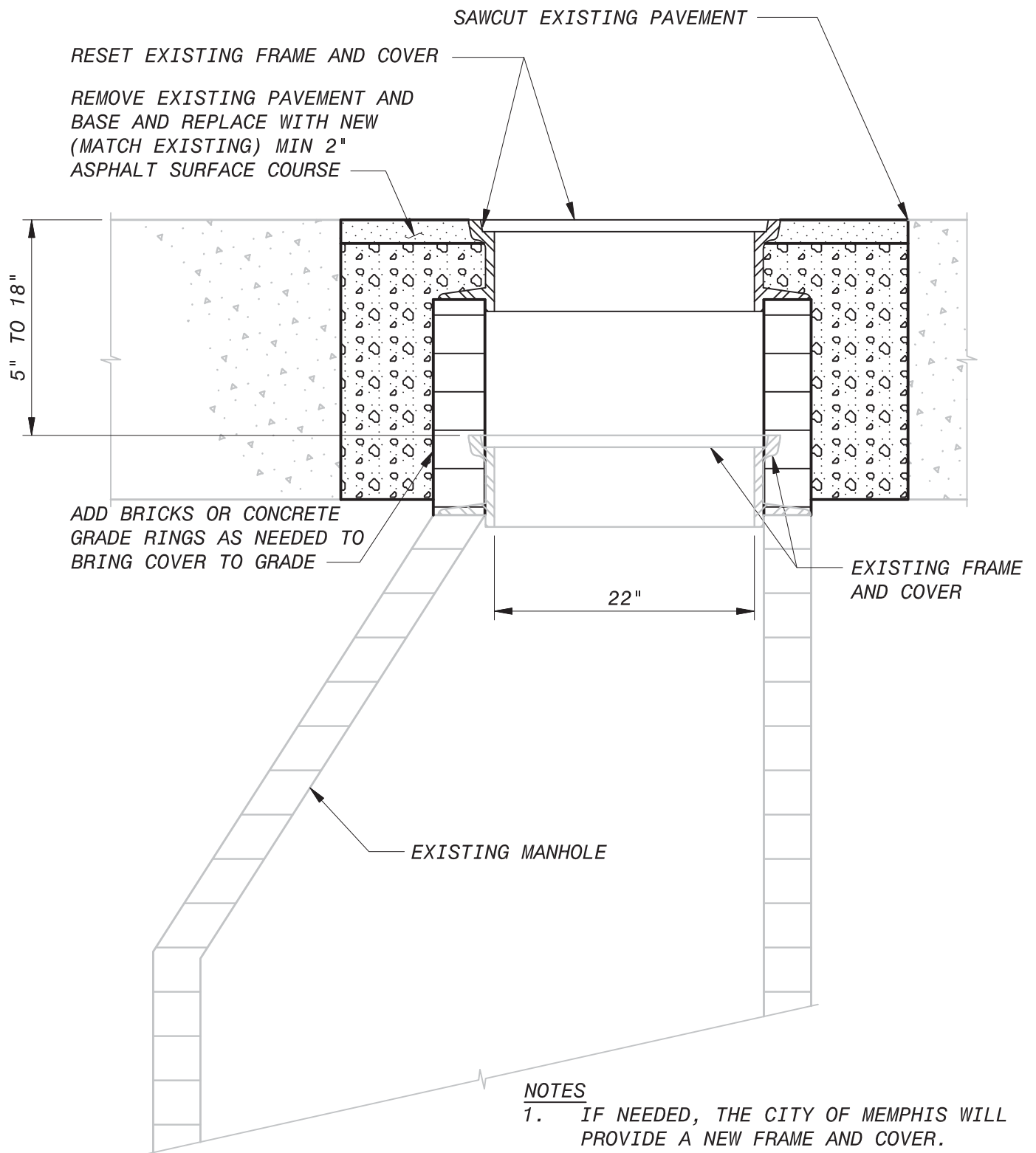
SARP10

ADJUSTING
MANHOLE FRAME AND COVER
UP TO 5 INCHES
SECTION / PROFILE

SCALE: NOT TO SCALE

REV 0.0

DATE: 04/07/14

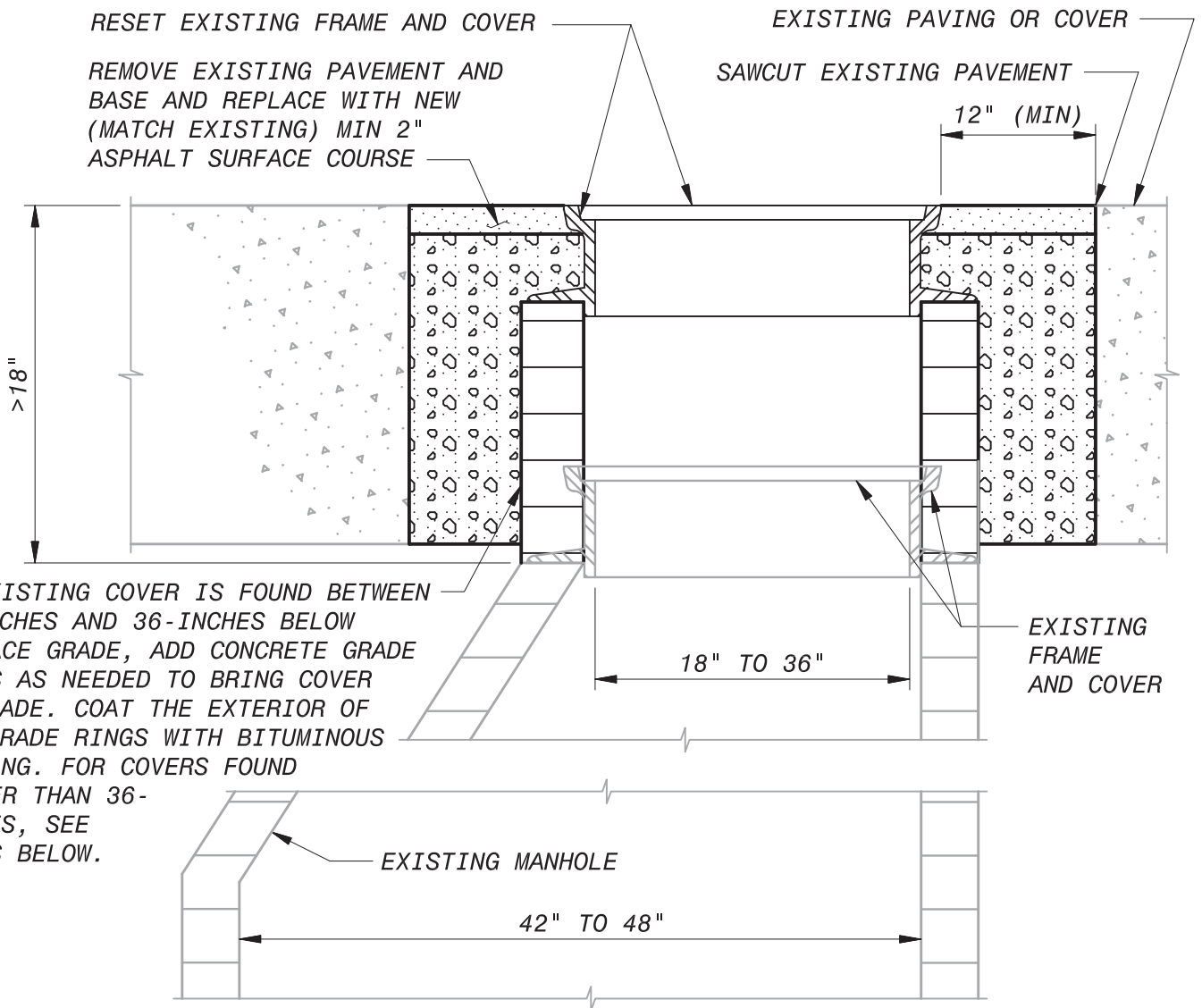


NOTES

1. IF NEEDED, THE CITY OF MEMPHIS WILL PROVIDE A NEW FRAME AND COVER. CONTRACTOR SHALL MAKE ARRANGEMENTS FOR PICK UP.



SARP10
ADJUSTING
MANHOLE FRAME AND COVER
5 TO 18 INCHES
SECTION / PROFILE



IF EXISTING COVER IS FOUND BETWEEN 18-INCHES AND 36-INCHES BELOW SURFACE GRADE, ADD CONCRETE GRADE RINGS AS NEEDED TO BRING COVER TO GRADE. COAT THE EXTERIOR OF THE GRADE RINGS WITH BITUMINOUS COATING. FOR COVERS FOUND DEEPER THAN 36-INCHES, SEE NOTES BELOW.

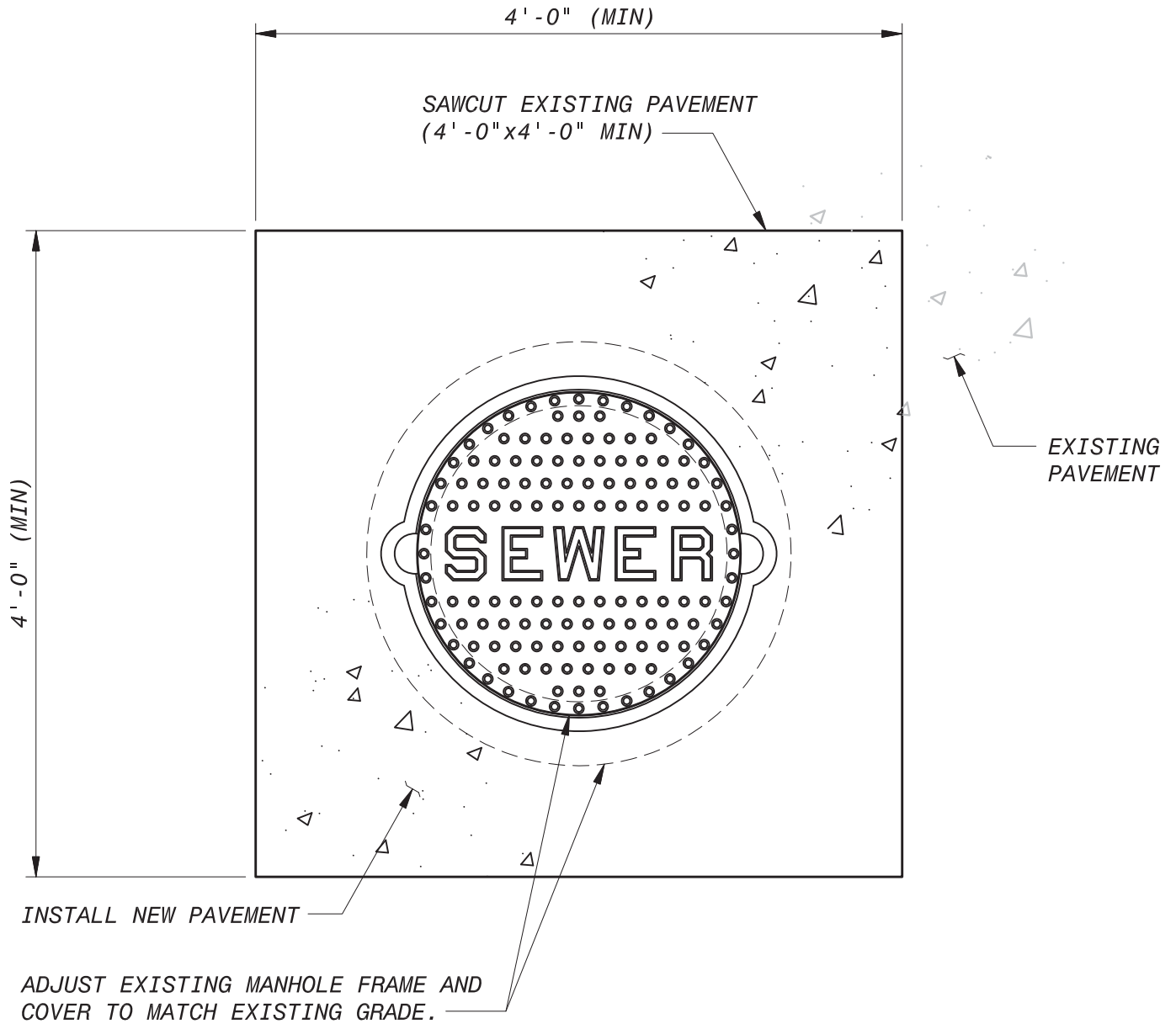
NOTES:

1. REMOVE EXISTING COVER OR PAVEMENT AND EXCAVATE TO LOCATE ACTUAL DEPTH OF EXISTING MH FRAME AND COVER.
2. DETERMINE REQUIRED ADJUSTMENT TO BRING COVER TO SURFACE GRADE.
 - A. IF LESS THAN 36-INCHES, RAISE THE FRAME AND COVER IN ACCORDANCE WITH SARP10 DETAIL "ADJUSTING MANHOLE FRAME & COVER 5 TO 18 INCHES"
 - B. IF GREATER THAN 36-INCHES, PROCEED WITH THE FOLLOWING NOTES.
3. DETERMINE FULL DIAMETER OF THE MANHOLE. IF BETWEEN 42 AND 48 INCHES NOMINALLY, REMOVE SUFFICIENT DEPTH OF EXISTING BRICK CORBEL (SLOPING WALLS) UNTIL MANHOLE WALLS ARE STRAIGHT AND ARE ABLE TO SUPPORT A PRECAST MANHOLE CORBEL 4 FEET HIGH, 48 INCHES IN DIAMETER.
4. PREPARE BED OF CONCRETE TO RECEIVE AND SUPPORT THE PRECAST CORBEL AND SEAT THE NEW CORBEL TO THE EXISTING BRICK WALLS.
5. INSTALL THE NEW FRAME TO THE PRECAST CONCRETE CORBEL AND ADJUST TO MEET SURFACE GRADE. IF ASPHALT ROAD, REPLACE WITH NEW (MATCH EXISTING) MINIMUM 2" ASPHALT SURFACE COURSE.
6. IF EXISTING MANHOLE DIAMETER IS LESS THAN 42 INCHES, REPLACE THE ENTIRE MANHOLE IN ACCORDANCE WITH CITY OF MEMPHIS SD #13.
7. IF NEEDED, THE CITY OF MEMPHIS WILL PROVIDE A NEW FRAME AND COVER. CONTRACTOR SHALL MAKE ARRANGEMENTS FOR PICK UP.



SARP10

ADJUST MANHOLE
>18 INCHES DEEP
SECTION / PROFILE



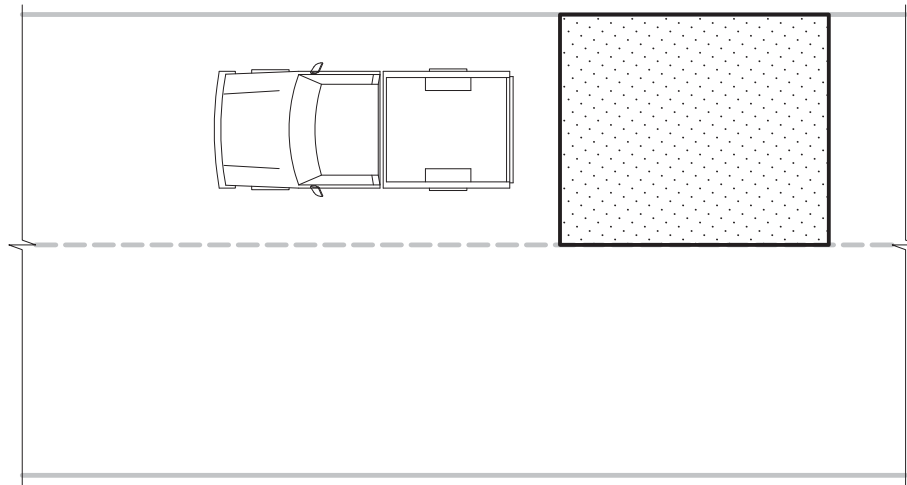
NOTES

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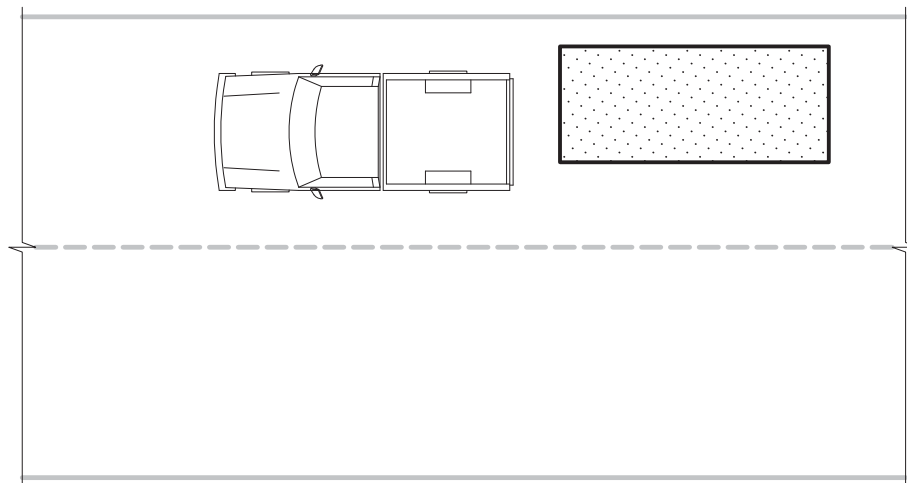


SARP10

ADJUSTING
MANHOLE FRAME AND COVER
PAVING PLAN



ACCEPTABLE



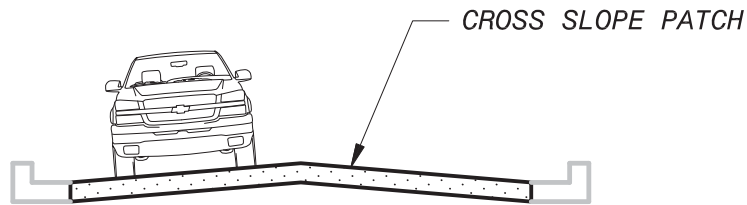
NOT ACCEPTABLE

NOTES

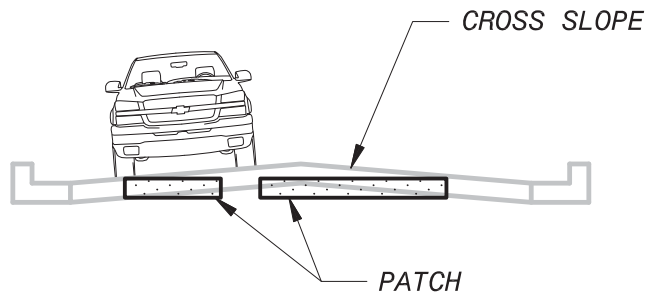
1. EXISTING PAVEMENTS SHALL BE REMOVED TO CLEAN, STRAIGHT LINES PARALLEL AND PERPENDICULAR TO THE FLOW OF TRAFFIC.
2. DO NOT CONSTRUCT PATCHES WITH ANGLED SIDES AND/OR IRREGULAR SHAPES.
3. ALL REPAIRS SHALL BE FULL LANE WIDTH.
4. FOR PATCHES IN ASPHALT, A TACK COAT SHALL BE APPLIED TO ALL EDGES OF THE EXISTING ASPHALT BEFORE PLACING THE NEW PAVEMENT.
5. AFTER PLACING THE NEW ASPHALT, ALL SEAMS (JOINTS) BETWEEN THE NEW AND EXISTING PAVEMENTS SHALL BE SEALED WITH AN ASPHALT TACK COAT OR RUBBERIZED CRACK SEAL MATERIAL.



SARP10
 PAVEMENT REPAIR
 SINGLE LANE
 DETAILS



ACCEPTABLE



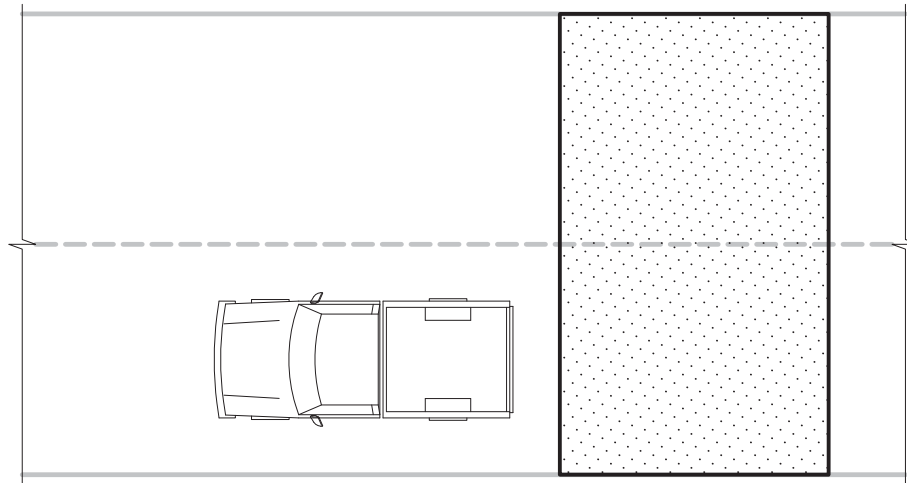
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NOTES

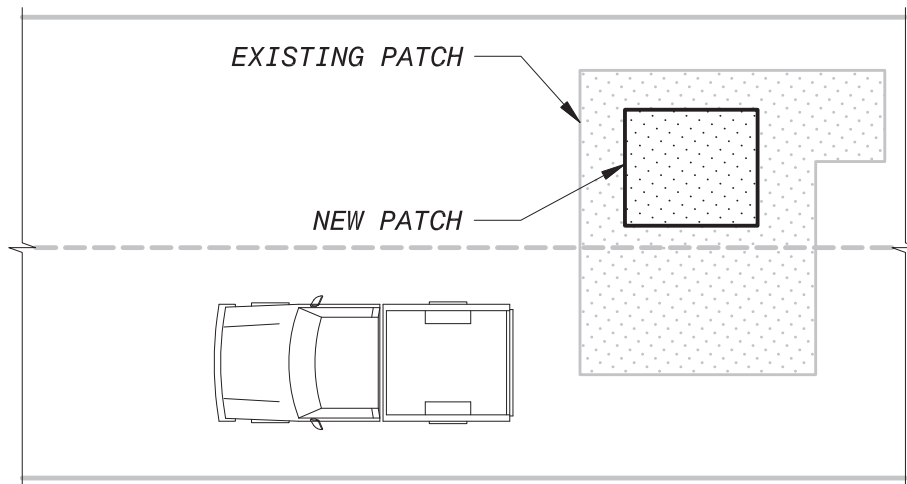
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3. ALL REPAIRS SHALL BE FULL LANE WIDTH.
4. FOR PATCHES IN ASPHALT, A TACK COAT SHALL BE APPLIED TO ALL EDGES OF THE EXISTING ASPHALT BEFORE PLACING THE NEW PAVEMENT.
5. AFTER PLACING THE NEW ASPHALT, ALL SEAMS (JOINTS) BETWEEN THE NEW AND EXISTING PAVEMENTS SHALL BE SEALED WITH AN ASPHALT TACK COAT OR RUBBERIZED CRACK SEAL MATERIAL.
6. PATCHES SHALL HAVE A SMOOTH LONGITUDINAL GRADE CONSISTENT WITH THE EXISTING ROADWAY.
7. PATCHES SHALL ALSO HAVE A CROSS SLOPE OR CROSS SECTION CONSISTENT WITH THE DESIGN OF THE EXISTING ROADWAY.



SARP10
 PAVEMENT REPAIR
 CROSS SLOPE
 DETAILS



ACCEPTABLE



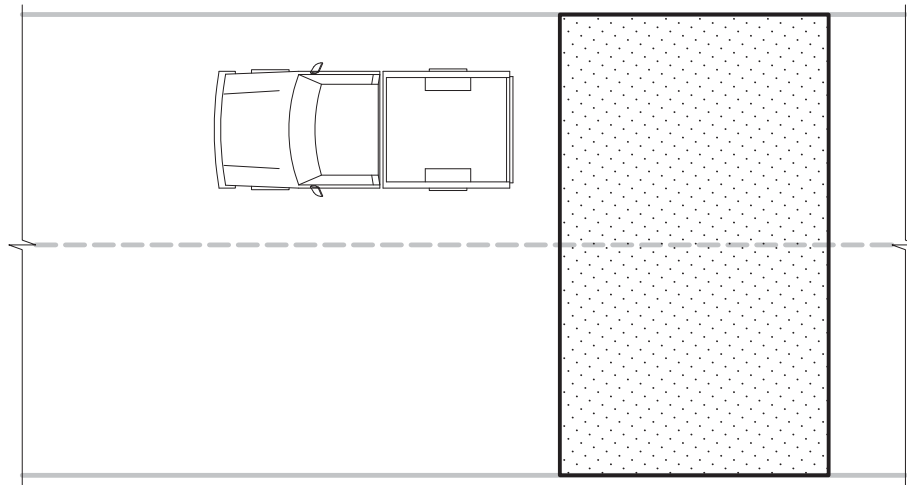
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NOTES

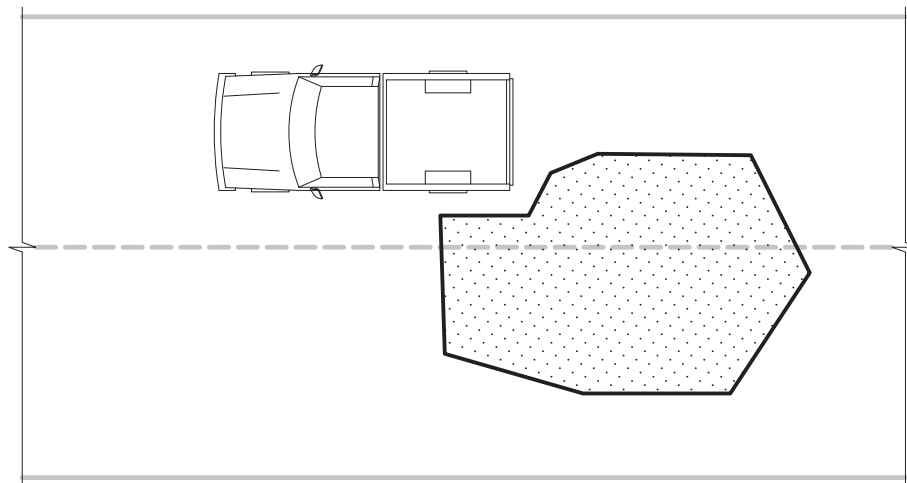
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5. AFTER PLACING THE NEW ASPHALT, ALL SEAMS (JOINTS) BETWEEN THE NEW AND EXISTING PAVEMENTS SHALL BE SEALED WITH AN ASPHALT TACK COAT OR RUBBERIZED CRACK SEAL MATERIAL.
6. AVOID PATCHES WITHIN PATCHES. IF THIS CANNOT BE AVOIDED, MAKE THE BOUNDARIES OF THE PATCHES COINCIDE.



SARP10
 PAVEMENT REPAIR
 PATCH INSIDE A PATCH
 DETAILS



ACCEPTABLE



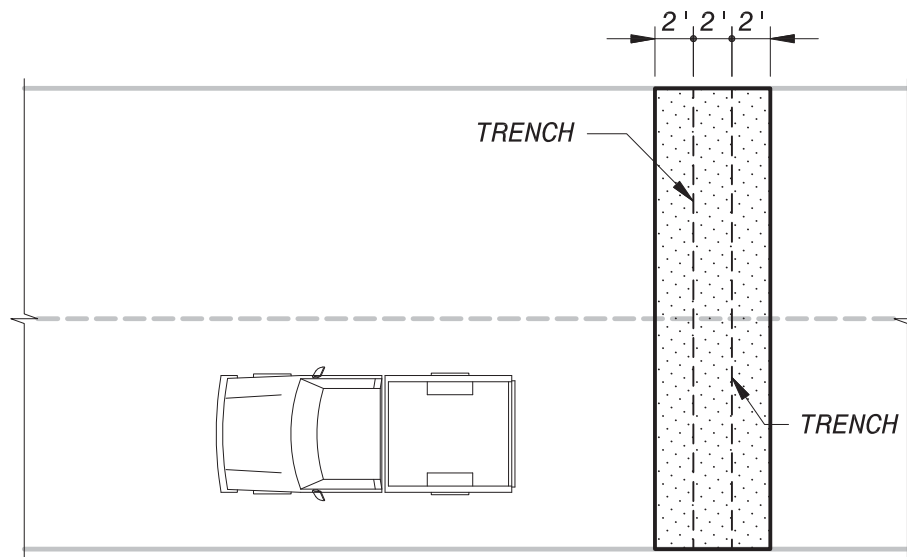
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NOTES

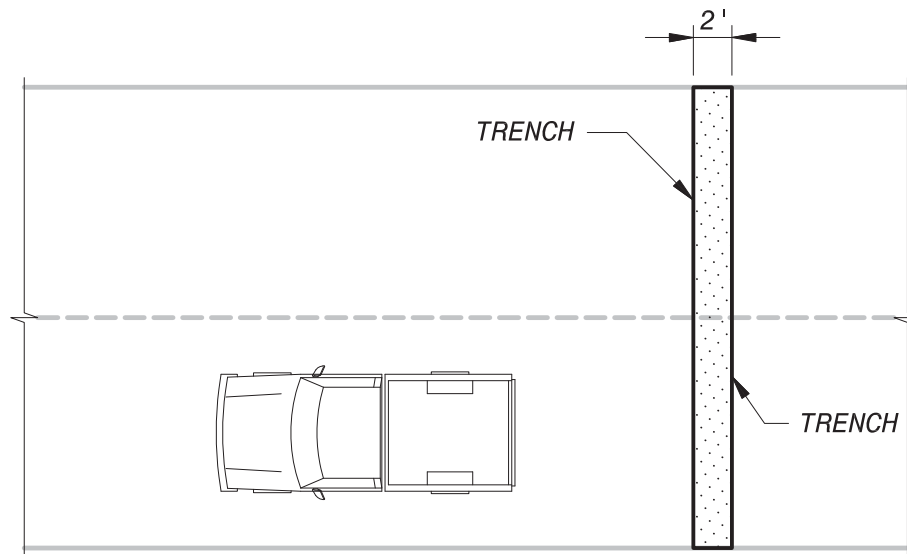
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SARP10
 PAVEMENT REPAIR
 MULTI-LANE
 DETAILS



ACCEPTABLE



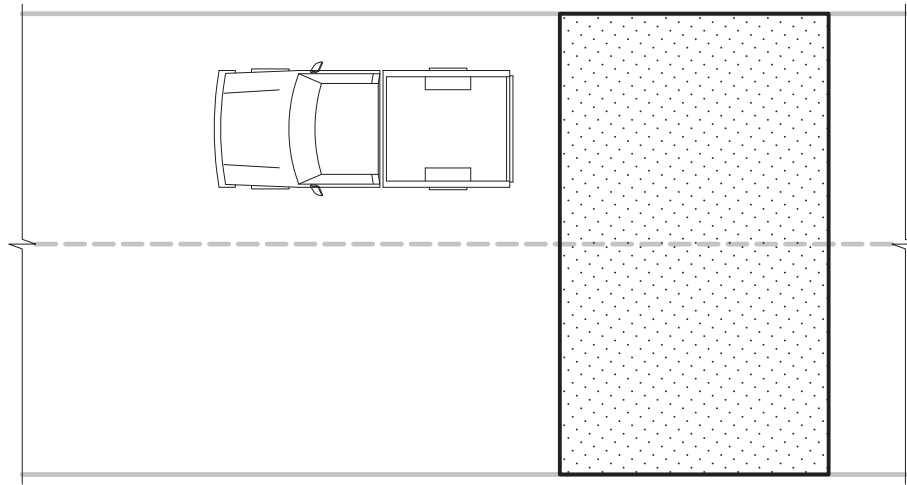
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NOTES

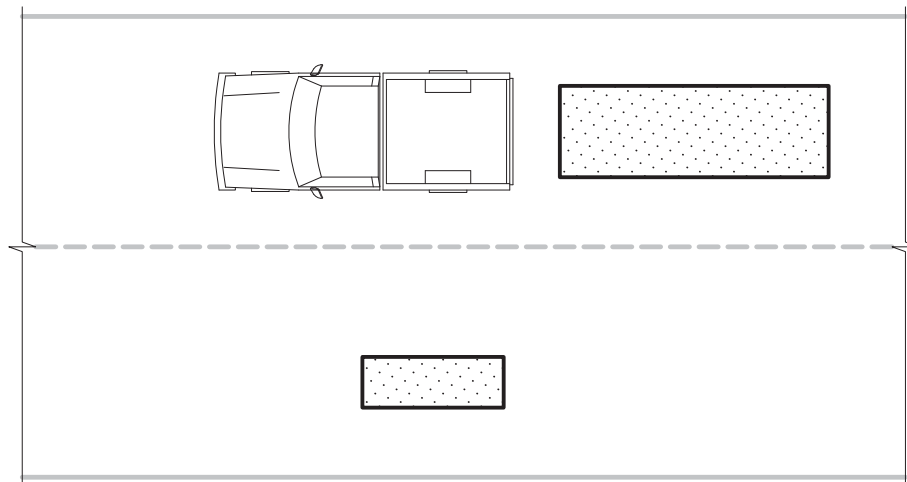
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5. AFTER PLACING THE NEW ASPHALT, ALL SEAMS (JOINTS) BETWEEN THE NEW AND EXISTING PAVEMENTS SHALL BE SEALED WITH AN ASPHALT TACK COAT OR RUBBERIZED CRACK SEAL MATERIAL.
6. TRAVERSE PATCHES SHALL BE OVERLAID ACROSS THE ENTIRE STREET WIDTH FOR A DISTANCE OF TWO (2) FEET MINIMUM ON ALL SIDES OF THE TRENCH.



SARP10
 PAVEMENT REPAIR
 TRAVERSE PATCHES
 DETAILS



ACCEPTABLE



NOT ACCEPTABLE

NOTES

1. EXISTING PAVEMENTS SHALL BE REMOVED TO CLEAN, STRAIGHT LINES PARALLEL AND PERPENDICULAR TO THE FLOW OF TRAFFIC.
2. DO NOT CONSTRUCT PATCHES WITH ANGLED SIDES AND/OR IRREGULAR SHAPES.
3. ALL REPAIRS SHALL BE FULL LANE WIDTH.
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6. TRAVERSE PATCHES SHALL BE OVERLAID ACROSS THE ENTIRE STREET WIDTH FOR A DISTANCE OF TWO (2) FEET MINIMUM ON ALL SIDES OF THE TRENCH.
7. DO NOT ALLOW THE EDGES OF PATCHES TO FALL IN EXISTING WHEEL PATHS.
8. THE EDGES OF PATCHES PARALLEL TO THE DIRECTION OF TRAFFIC SHALL BE LIMITED TO THE BOUNDARIES OF LANES OR TO THE CENTERLINE OF TRAVEL LANES.



SARP10
 PAVEMENT REPAIR
 WHEEL PATH
 DETAILS