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INCLUDE ALL
ADDENDUM
ISSUED DURING
BID

**Specifications and Contract Documents for the Construction of
Water System Capital Improvement Plan
Phase 3**

City of Keller Project Number: 601704

Prepared for:



**City of Keller
1100 Bear Creek Parkway
P.O. Box 770
Keller, Texas 76244**



Zach Graves, P.E.
Date: JANUARY 29, 2025



**teague nall and perkins, inc
5237 N. Riverside Drive, Suite 100
Fort Worth, Texas 76137
817.336.5773 phone**

www.tnpinc.com

**TNP Firm Registrations
Texas Board of Professional Engineers, Firm No. F-230
Texas Board of Professional Land Surveying, Firm No.
10011600 | 10194381 | 10011601**

**KEL 22149
JANUARY 2025**

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REQUEST FOR PROPOSALS

ARTICLE 1: GENERAL NOTICE

- 1.01 The City of Keller, Texas ("Owner") extends this Request For Competitive Sealed Proposals ("RFP") to solicit a response to the RFP ("Proposal") from any interested party ("Offeror") for the construction of the following project:

Water System Capital Improvement – Phase 3
("Project")

- A. This Project consists of:
1. 178 LF of 6" water line by open cut.
 2. 1677 LF of 8" water line by open cut.
 3. 2797 LF of 12" water line by open cut.
 4. 140 LF of 8" water line by Uncased bore (Alternate Bid).
 5. 140 LF of 8" water line by Cased Bore.
 6. 978 LF of 8" water line by pipe bursting.
 7. Temporary water line and service connections.
 8. Asphalt and concrete pavement repair.
 9. Traditional mill & overlay operations
- B. The estimated Project completion date is May 2026.
- C. The engineer's opinion of probable construction cost is \$5,060,000.
- 1.02 **This RFP is a competitive sealed proposal method in accordance with the Texas Government Code Chapter 2269, Subchapter D.**
- 1.03 ***This contract is contingent upon release of funds from the Texas Water Development Board (TWDB).***
- 1.04 Sealed Proposals must be delivered to the City of Keller at 1100 Bear Creek Parkway, Keller, TX 76248 no later than August 27th, 2025, at 2pm to be accepted. The Proposals will be publicly opened, and the names of the Offerors and any monetary proposals made by the Offerors will be read aloud at this time and place. Proposals received after this time will be returned unopened. Address Proposals to the attention of Chad Bartee, P.E. at the address immediately above.

ARTICLE 2: EXAMINATION AND PROCUREMENT OF PROPOSAL DOCUMENTS

- 2.01 Advertisement and information for the Project can be found at the following website:

<http://www.civcastusa.com/>

- 2.02 Contract Documents may be downloaded or viewed free of charge at this website. It is the downloader's responsibility to determine that a complete set of documents, as defined in the Instructions to Offerors, are received. Printed copies of the Contract Documents may be purchased at the website for the cost of printing. The cost for printed Contract Documents is not refundable.
- 2.03 This website will be updated periodically with Addenda, lists of interested parties, reports or other information relevant to submitting a Proposal for the Project.
- 2.04 Printed copies of the Contract Documents and Geotechnical Report may be examined free of charge at the following addresses:

Engineer	Owner
Teague Nall and Perkins, Inc.	City of Keller
5237 N. Riverside Drive, Suite 100	1100 Bear Creek Parkway
Fort Worth, TX 76137	Keller, TX 76248
Zach Graves, P.E.	Chad Bartee, P.E.

ARTICLE 3: QUESTIONS REGARDING PROPOSAL PROCESS OR SOLICITATION DOCUMENTS

- 3.01 To ensure fairness during the procurement process, until the Contract is executed, Offerors and their employees, representatives and agents shall not contact an Owner staff, member of the selection committee, Owner's City Council, or consultant of the Owner identified immediately below.
- A. Teague Nall and Perkins, Inc. (ENGINEER)
- 3.02 Direct questions regarding distribution of Contract Documents, design, and the RFP for this Project to Teague Nall and Perkins, Inc., 5237 N. Riverside Drive, Suite 100, Fort Worth, TX 76137. Contact Zach Graves at 817-665-7185.
- 3.03 All questions regarding the contract documents and plans must be submitted via email to Zach Graves, zgraves@tnpinc.com. Modifications to the Contract Documents prior to the award of the Contract can only be made by Addenda. Response to Requests for Information that would indicate an addition, modification or clarification of the Contract Documents ("Addenda"), other than directing the attention of the requestor to a specific reference in the Contract Documents, will be made by Addenda for the benefit of all Offerors.

ARTICLE 4: PRE-PROPOSAL CONFERENCE

- 4.01 A **Non-Mandatory** Pre-Proposal Conference for the Project will be held on August 20th, 2025, at 2pm at Keller Town Hall, 1100 Bear Creek Parkway, Keller, TX 76248, Room 106.

ARTICLE 5: BASIS FOR RANKING OF OFFERORS

- 5.01 The Owner will consider Statement of Qualifications ("Statement of Qualifications") of the Offerors and the proposed price ("Total Bid For All Items") contained in Proposal Form Exhibit A when evaluating Proposals to determine which Offeror, in the opinion of the Owner, will provide the best value to the Owner. The Proposals will be evaluated using the following criteria and weighting:

Rating Category	Evaluation Criteria Description	Weighting Points
A	Proposed Contract Price	50
B	Offeror General Information; Project Organization and Qualifications and Experience of Key Personnel	20
C	Experience of Offeror with Similar Projects, Project Resources, Subcontractors, and Suppliers; Project Safety	15
D	Construction Time	15
Total		100

- 5.02 The evaluation criteria are further defined in the Statement of Qualifications.

ARTICLE 6: AWARD OF CONTRACT

- 6.01 It is the intent of the Owner to award a construction contract for this Project (Standard Form of Agreement: "Agreement") to the Offeror who provides the best value for the Owner as determined when considering the relative importance of costs and other evaluation criteria described above. The Owner reserves the right to adopt the most advantageous interpretation of the Proposals submitted in the case of ambiguity or lack of clearness in stating Proposal prices, to reject any or all Proposals, and/or waive informalities. Ranking of the Proposals will be completed in 45 days or less. Proposals may not be withdrawn within 60 days from the date on which Proposals are opened.

ARTICLE 7: PROPOSAL SECURITY

- 7.01 Offerors must submit an acceptable Bid Bond with their Proposal as a guarantee that the Offeror will enter into the Contract for the Project with the Owner within 15 days of Notice of Award of the Contract. The Bid Bond must be payable to City of Keller in the amount of 5 percent of the proposed Contract Price. Offeror must execute the Contract, bonds and certificates of insurance on the forms provided in the Contract Documents.

ARTICLE 8: OTHER CONTRACT REQUIREMENTS

- 8.01 Performance, Payment, and Maintenance Bonds are required.

ARTICLE 9: SUBSTITUTE OR "OR EQUAL" ITEMS.

- 9.01 The Contract, if awarded, will be on the basis of materials and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a

substitute or "or equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement. The procedure for submission of any such application by Contractor and consideration by Engineer is set forth in Paragraph 6.05.A, 6.05.B, 6.05.C, 6.05.D, 6.05.E, and 6.05.F of the General Conditions and may be supplemented in the Supplementary Conditions.

ARTICLE 10: SUBCONTRACTORS, SUPPLIERS AND OTHERS.

- 10.01 Contractor shall not award Work to a subcontractor(s) that is (are) in excess of 50% of the total contract price without written approval of the Owner.
- 10.02 No Contractor shall be required to employ any subcontractor, supplier, other person or organization against whom Contractor has reasonable objection.

ARTICLE 11: DEBARMENT

- 11.01 By submitting a proposal, the offeror certifies that it is not currently debarred from receiving contracts from any political subdivision or agency of the State of Texas and that it is not an agent of a person or entity that is currently debarred from receiving contracts from any political subdivision or agency of the State of Texas.

ARTICLE 12: WAIVER OF SUBROGATION

- 12.01 The contractor and his subcontractors shall require their insurance carrier, with respect to all insurance policies, to waive all rights of subrogation against the City of Keller, its commissioners, partners, officials, agents, and employees and against all other contractors and subcontractors.

ARTICLE 13: IDENTIFICATION OF CONTRACTOR VEHICLES & EQUIPMENT

- 13.01 Contractor will be responsible for ensuring vehicles and equipment are clearly identified in a manner acceptable to the City, and be properly licensed and inspected in accordance with the State of Texas and Tarrant County regulations.

ARTICLE 14: EMPLOYEE SAFETY

- 14.01 Contractor must provide and enforce the use of appropriate safety equipment.

ARTICLE 15: SUBSTANCE ABUSE

- 15.01 Possession, consumption of, and/or reporting for work under the influence of alcohol, controlled substances, and/or dangerous drugs by subcontractors, officers, or employees of the Contractor will not be tolerated. Enforcement of this policy is the responsibility of Contractor.

ARTICLE 16: CRIMINAL HISTORY BACKGROUND CHECK

- 16.01 Prior to each employee commencing work, Contractor must conduct a criminal history check acceptable to the City, and forward all reports to an authorized City representative.

ARTICLE 17: CUSTOMER RELATIONS

- 17.01 Contractor is responsible for ensuring that its subcontractors or employees conduct themselves in a courteous and professional manner when dealing with City employees, elected or appointed officials, residents, and/or customers of the City. The City reserves the right to reject any Contractor subcontractor or employee and/or request replacement at any time.

END OF SECTION

INSTRUCTIONS TO OFFERORS

ARTICLE 1: DEFINED TERMS

- 1.01 Terms used in these Instructions for Offerors have the meanings indicated in the General Conditions and Supplementary Conditions.

ARTICLE 2: PROPOSALS RECEIVED

- 2.01 Refer to “Request for Proposals” for information on receipt of Proposals.

ARTICLE 3: COPIES OF CONTRACT DOCUMENTS

- 3.01 Obtain a complete set of the Contract Documents as indicated in “Request for Proposals.”
- 3.02 Use complete sets of Contract Documents in preparing Proposals; neither the Owner nor the Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.
- 3.03 Owner and Engineer make copies of Contract Documents available on the above terms only for the purpose of obtaining Proposals for completion of Work and do not confer a license or grant permission or authorization for any other use.

ARTICLE 4: ARTICLE 4 - STATEMENT OF QUALIFICATIONS

- 4.01 Submit information as required in “Statement of Qualifications” with the Proposal to demonstrate the Offeror’s qualifications and experience to complete the Work.

ARTICLE 5: EXAMINATION OF CONTRACT DOCUMENTS

- 5.01 Before submitting a Proposal:
 - A. Examine and carefully study the Contract Documents, including any Addenda and the related supplemental data.
 - B. Become familiar and satisfied with all federal, state, and local Laws and Regulations that may affect cost, progress, or the completion of Work.
 - C. Carefully study and correlate the information available to the Offeror with the Contract Documents, Addenda and the related supplemental data.
 - D. Promptly give the Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that the Offeror discovers in the Contract Documents, Addenda and the related supplemental data and confirm that the written resolution provided by the Engineer is acceptable to the Offeror.
 - E. Determine that the Contract Documents, Addenda and the related supplemental data are generally sufficient to indicate and convey understanding of all terms and conditions for completion of Work.

ARTICLE 6: PRE-PROPOSAL CONFERENCE

- 6.01 Requirements for a Pre-Proposal Conference will be as stipulated in the Request for Proposals.

ARTICLE 7: INTERPRETATIONS AND ALTERNATE PROPOSALS

- 7.01 Submit all questions about the meaning or intent of the Contract Documents, Addenda and the related supplemental data to the Engineer via Civcast. Interpretations or clarifications considered necessary by the Owner in response to such questions will be issued by Addenda and posted on the website to all parties recorded by the Engineer as having registered as an Offeror, received the Contract Documents, Addenda and the related supplemental data. Questions received less than 10 days prior to the date for opening of Proposals may not be answered. Only answers in Addenda authorized by the Owner will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 7.02 Submit any offer of alternate terms and conditions or offer of Work not in strict compliance with the Contract Documents to the Engineer no later than 10 days prior to the date for opening of Proposals. Engineer will issue Addenda as appropriate if any of the proposed changes to the Contract Documents are accepted. A Proposal submitted with clarifications or taking exceptions to the Contract Documents, except as modified by Addenda, may be considered non-responsive.
- 7.03 Offeror may submit a separate and additional Proposal if the Offeror includes exceptions or the Offeror wishes to make a Proposal that is not in accordance with the terms and conditions of the Contract Document, or for Work that is not in strict compliance with the Contract Documents. Describe the intent and substance of the changes in the additional Proposal in adequate detail so they are clearly understood. Alternates will not be considered in the ranking and evaluation of the Proposals. Upon selection of the Proposal that offers the best value to the Owner, and after the award of the Contract, the Owner may consider proposed alternates in negotiating a final Contract Price.
- 7.04 Addenda may be issued to clarify, correct, or change the Contract Documents, Addenda or the related supplemental data as deemed advisable by the Owner. Any addenda issued will be made available to all bidders via Civcast.

ARTICLE 8: PROPOSAL SECURITY

- 8.01 A Proposal must be accompanied by an acceptable security payable to the Owner ("Bid Bond") in an amount of 5 percent of the Construction Price. The Bid Bond must be issued by a surety legally authorized to do business in the State of Texas and meeting the requirements of the General Conditions.
- 8.02 This Bid Bond will become void when the Performance and Payment Bonds are provided. Owner may annul the Notice of Award and the Bid Bond of the Offeror will be forfeited if the apparent Successful Offeror fails to execute and deliver the Agreement or Amendment to the Agreement. The Bid Bond of other Offerors whom the Owner believes to have a reasonable chance of receiving the award may be retained by the Owner until the earlier of 7 days after the Effective Date of the Agreement or 45 days after the date Proposals are opened. Bid Bonds furnished by such Offerors will be returned at that time.

- 8.03 Owner will return the Bid Bond of the Offerors that the Owner believes do not have a reasonable chance of receiving the award within 7 days after Proposals are opened.

ARTICLE 9: CONTRACT TIMES

- 9.01 Provisions for Contract Times are set forth in the Agreement.

ARTICLE 10: LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages are set forth in the Agreement.

ARTICLE 11: RETAINAGE

- 11.01 Provisions concerning the Offeror's rights to deposit securities and or retainage are set forth in the Agreement.

ARTICLE 12: PREPARATION OF PROPOSAL FORM

- 12.01 The Proposal Form is included with the Contract Documents. Obtain additional copies, if needed, from the Owner.
- 12.02 Complete all blanks on the Proposal Form by typing or printing in ink. Indicate Proposal prices for each Proposal item or alternate shown. Execute the Proposal as indicated below:
- A. Execute a Proposal for a corporation in the corporate name with the signature of the president, a vice-president or other corporate officer accompanied by evidence of authority of the individual to sign on behalf of the corporation. Show the corporate address and state of incorporation with the signature.
 - B. Execute a Proposal for a partnership in the partnership name with the signature of a partner. The title of the partner must appear with the signature. The document must be accompanied by evidence of authority for that individual to sign on behalf of the partnership. Show the official address of the partnership with the signature.
 - C. Execute a Proposal for a limited liability company in the name of the firm with the signature of an officer of that company. The document must be accompanied by evidence of authority for that individual to sign on behalf of the company. Show the state in which the firm was formed and the official address of the firm with the signature.
 - D. Show the Offeror's name and official address for a Proposal by an individual.
 - E. Execute a Proposal for a joint venture with a signature of an authorized person from each joint venturer in the manner indicated on the Proposal Form. The document must be accompanied by evidence of authority for each individual to sign on behalf of their respective organizations. Show the official address of the joint venture with the signature.
- 12.03 Type or print all names in ink below the signature.
- 12.04 Acknowledge receipt of all Addenda by filling in the number and date of each Addenda received. Provide a signature as indicated to verify that the Addenda were received. A Proposal that does not acknowledge the receipt of all Addenda may be considered non-responsive.

- 12.05 Provide the name, address and telephone number of the individual to be contacted for any communications regarding the Proposal in the Proposal Form.
- 12.06 Provide evidence of the Offeror's authority and qualification to do business in the state of the Project Site or covenant to obtain such qualification prior to award of the Contract.

ARTICLE 13: CONFIDENTIALITY OF PROPOSAL INFORMATION

- 13.01 In accordance with Texas Government Code 552.110, trade secrets and confidential information in Proposals are not open for public inspection. Proposals will be opened in a manner that avoids disclosure of the contents to competing Offerors and keeps the Proposals secret during considerations. All Proposals are open for public inspection after the Contract is awarded, but trade secrets and confidential information in Proposals are not typically open for public inspection. The Owner will protect this information to the extent allowed by law. Clearly indicate which specific documents are considered to be trade secrets or confidential information by stamping or watermarking all such documents with the word "confidential" prominently on each page or sheet or on the cover of bound documents. Place "confidential" stamps or watermarks so that they do not obscure any of the required information on the document, either in the original or in a way that would obscure any of the required information in a photocopy of the document. Photocopies of "confidential" documents will be made only for the convenience of the selection committee and will be destroyed after the Effective Date of Agreement. Original confidential documents will be returned to the Offeror after the Effective Date of Agreement if the Offeror indicates that the information is to be returned with the Proposal, and direction for its return are provided by the Offeror. Entire Proposals will not be allowed to be marked as "Confidential".

ARTICLE 14: SUBMITTAL OF PROPOSAL

- 14.01 Each prospective Offeror is furnished one copy of the Contact Documents with one separate unbound copy of the Proposal Form. Complete and submit the unbound copy of the Proposal Form along with all attachments identified in the Proposal Form.
- 14.02 Submit the Proposal no later than the date and time prescribed and at the place indicated in "Request for Proposals." Enclose the Proposal in an opaque sealed envelope plainly marked with the project name, the name and address of the Offeror along with the Bid Bond and other required documents. Enclosed the sealed envelope containing the Proposal in a separate envelope plainly marked on the outside with the notation "PROPOSAL ENCLOSED" if the Proposal is sent by mail or other delivery system. Address the outer envelope to the mailing address shown in "Request for Proposals." Assume full responsibility for ensuring that the Proposal arrived at the prescribed location before the prescribed time.

ARTICLE 15: MODIFICATION OR WITHDRAWAL OF PROPOSAL

- 15.01 Modify or withdraw a Proposal using a document executed in the same manner that a Proposal must be executed. Deliver the document to the place where Proposals are to be submitted prior to the date and time for the opening of Proposals.
- 15.02 An Offeror may withdraw its Proposal within 24 hours after Proposals are opened if the Offeror files a signed written notice with the Owner and promptly thereafter demonstrates to the

reasonable satisfaction of the Owner that there was a material and substantial mistake in the preparation of its Proposal. The Bid Bond will be returned if it is clearly demonstrated to the Owner that there was a material and substantial mistake in its Proposal. An Offeror that requests to withdraw its Proposal under these conditions may be disqualified from responding to a reissued Request for Proposals for the Work to be furnished under these Contract Documents.

ARTICLE 16: OPENING OF PROPOSALS

- 16.01 Proposals will be opened at the time and place indicated in "Request for Proposals." The Owner will receive, publicly open and read aloud the names of the Offerors and any monetary proposals made by the Offerors at this time and place as required by Texas Government Code Section 2269.154.

ARTICLE 17: PROPOSALS TO REMAIN SUBJECT TO ACCEPTANCE

- 17.01 All Proposals will remain subject to acceptance for 60 days, but the Owner may, at its sole discretion, release any Proposal and return the Bid Bond prior to the end of this period.

ARTICLE 18: EVALUATION OF PROPOSALS

- 18.01 Within 45 days after the date of opening the Proposals, the Owner will evaluate and rank each Proposal with respect to the selection criteria described below. All procurements shall conform to Texas Government Code Chapter 2269. In evaluating Proposals, the Owner will consider whether or not the Proposals comply with the prescribed requirements, and such alternatives, prices and other data, as may be requested in the Proposal Form or may be requested from Offerors prior to a Notice of Award.
- 18.02 In evaluating Proposals, the Owner will consider the Contract Price and the Statement of Qualifications of the Offerors to determine which Proposal offers the best value to the Owner. The Proposals will be evaluated using the information submitted in the Proposal Form and information submitted in the Statement of Qualifications as required by "Statement of Qualifications."
- 18.03 Owner may conduct such investigations as the Owner deems necessary to establish the responsibility, qualifications, and financial ability of consultants, individuals, or entities proposed to furnish parts of the Work in accordance with the Contract Documents.
- 18.04 The evaluation criteria and weighting are as described this RFP
- 18.05 Submission of a Proposal indicates the Offeror's acceptance of the evaluation technique and methodology as well as the Offeror's recognition that some subjective judgments must be made by the Owner during the evaluation.

ARTICLE 19: EVALUATION CRITERIA AND WEIGHTING

- 19.01 The Owner will consider the Contract Price and the Statement of Qualifications of the Offerors to determine which Proposal offers the best value to the Owner. The Proposals will be evaluated using the criteria and weighting described.

Rating Category	Description	Weighting Value %
A	Proposed Contract Price	50
B	Offeror General Information; Project Organization and Qualifications and Experience of Key Personnel	20
C	Experience of Offeror with Similar Projects, Project Resources, Subcontractors, and Suppliers; Project Safety	15
D	Construction Time	15
Total		100

The Owner reserves the right to take into account in its evaluation of the Price Proposal, the Total Bid Amount on the Bid Form as to its reasonableness for the actual cost of the work to complete the scope of work for this Project. The Owner may take into account the increased risk for contract performance problems that a significantly low Total Bid Amount could represent.

ARTICLE 20: AWARD OF CONTRACT

- 20.01 The Offeror selected for award of the Contract will be the Offeror whose offer provides the best value to the Owner. The Owner is not bound to accept the lowest priced Proposal if that Proposal is not in the best value to the Owner, as determined by the Owner. If the Owner determines that it is unable to reach a contract satisfactory to the Owner with the selected Offeror, then the Owner will terminate discussions in writing with the selected Offeror and proceed to the next Offeror in order of selection ranking until an agreement is reached or the Owner has rejected all Proposals.
- 20.02 Owner reserves the right to reject any and all Proposals, including without limitation, nonconforming, non-responsive, or conditional Proposals. The Owner may also reject the Proposal of any Offeror if the Owner believes that it would not be in the best interest of the Owner to make an award to that Offeror. The Owner reserves the right to waive all formalities.
- 20.03 More than one Proposal for the same Work from an individual or entity under the same or different names will not be considered, except as additional Proposals in accordance with Article 7. Reasonable grounds for believing that any Offeror has an interest in more than one Proposal for the Work shall be cause for disqualification of that Offeror and the rejection of all Proposals in which that Offeror has an interest.

ARTICLE 21: BONDS AND INSURANCE

- 21.01 Article 5 of the General Conditions sets forth the Owner's requirements as to performance, payment, maintenance and other bonds and insurance. When the successful Offeror delivers the executed Agreement to the Owner, it must be accompanied by the required bonds and required certificates of insurance.
- 21.02 Performance and Payment Bonds required for this Project will comply fully with provisions of Texas Government Code Chapter 2253. Provisions for administration of Bonds shall conform to Texas Government Code Chapter 2253 and provisions of these Contract Documents.

21.03 A Maintenance Bond is required as more fully described in these Contract Documents.

ARTICLE 22: RIGHTS OF THE OWNER

- 22.01 The Proposal of an Offeror shall not deprive the Owner of the right to accept a Proposal, which in its judgment offers the best value to the Owner, reject any and all Proposals, to waive irregularities in the Proposals, or to reject nonconforming, non-responsive, or conditional Proposals. In addition, the Owner reserves the right to reject any Proposal where circumstances and developments have, in the opinion of the Owner, changed the qualifications or responsibility of the Offeror.
- 22.02 Material misstatements in the material submitted for evaluation may be grounds for rejection of the Offeror's Proposal on this Project. Any such misstatement, if discovered after award of the contract to such firm, may be grounds for immediate termination of the Contract. Additionally, the Offeror will be liable to the Owner for any additional costs or damages to the Owner resulting from such misstatements, including costs and attorney's fees for collecting such costs and damages.
- 22.03 The right to suspend and terminate the procurement process or to terminate evaluations of Proposals received at any time.
- 22.04 The right to correspondence with the Offerors to seek an improved understanding of Proposals at any time. The right to request additional information from an Offeror during the evaluation of Proposals.
- 22.05 The right to request an interview with any or all Offerors.
- 22.06 The right to seek or obtain data and information from any source that has the potential to improve the understanding and evaluation of the Proposals.
- 22.07 The right to use assistance of outside technical and legal experts and consultants in the evaluation process.
- 22.08 The right to conduct an independent investigation of any information, including prior experience identified in a Proposal by contacting project references, accessing public information, contacting independent parties or any other means.

ARTICLE 23: SIGNING OF AGREEMENT

- 23.01 The Notice of Award to the successful Offeror will be accompanied by the required number of unsigned counterparts of the Agreement with the other Contract Documents that are identified in the Agreement. The successful Offeror shall sign and deliver the required number of counterparts of the Agreement and attached documents to the Owner within 15 days. The Owner will deliver two fully signed counterparts to Successful Offeror within 10 days after receiving the signed documents from the Successful Offeror.
- 23.02 The Successful Offeror must also complete and submit a Certificate of Interested Parties (Form 1295) to the Owner as required by Texas Government Code Chapter 2252 with the signed Agreement.

ARTICLE 24: CONTRACT NOT TO BE ASSIGNED

- 24.01 Contract may not be assigned in whole or in part by the Offeror without the previous written consent of the Owner.

ARTICLE 25: SALES AND USE TAXES

- 25.01 City or state sales taxes should generally not be included in the Contract Price as the Owner qualifies as an exempt agency. Certain items such as rented equipment may be taxable even though the Owner is a tax exempt agency. Assume responsibility for including any applicable sales taxes in the Contract Price and assumes responsibility for complying with all applicable statutes and rulings of the State of Texas Comptroller.
- 25.02 It is the Owner's intent to have this Contract qualify as a "separated contract." In order for this contract to qualify:
- A. Obtain a sales tax permit from the State of Texas Comptroller if awarded this Contract.
 - B. Identify the dollar value of materials exempt from the sales tax. This information must be reported in the "Statement for Materials and Other Charges" on the Proposal Form. Proposals not showing the Statement for Materials and Other Charges may be considered non-responsive.

ARTICLE 26: TEXAS WATER DEVELOPMENT BOARD INSTRUCTIONS (FROM TWDB-0552, REV 11/18)

- 26.01 Contingent Award of Contract: This contract is contingent upon release of funds from the Texas Water Development Board. Any contract or contracts awarded under this Invitation for Bids is/are expected to be funded in part by a loan or grant from the Texas Water Development Board. Neither the state of Texas, nor any of its departments, agencies, or employees are or will be a party to this Invitation for Bids or any resulting contract.
- 26.02 Bid Guarantee: Each bidder shall furnish a bid guarantee equivalent to five percent of the bid price (Water Code §17.183). If a bid bond is provided, the Contractor shall utilize a surety company which is authorized to do business in Texas in accordance with Surety Bonds and Related Instruments, Chapter 3503 of the Insurance Code.
- 26.03 Award of Contract to Nonresident Bidder: A governmental entity may not award a governmental contract to a nonresident bidder unless the nonresident underbids the lowest bid submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresident's principal place of business is located. A non-resident bidder is a Contractor whose corporate offices or principal place of business is outside of the state of Texas (Source: Texas Government Code, Chapter 2252, Subchapter A, Nonresident Bidders, §2252.002).

The bidder will complete form TWDB-0459, Vendor Compliance with Reciprocity on Non-Resident Bidders, **which must be submitted with the bid.**

END OF SECTION

PROPOSAL FORM

ARTICLE 1: PROPOSAL RECIPIENT

1.01 This Proposal is submitted to:

City of Keller
1100 Bear Creek Parkway, Keller, TX 76248
Attention: Mr. Chad Bartee, P.E.

1.02 The principal contact person who will serve as the interface between the Owner and the Proposer for all communication during the procurement period is:

A. Name: _____
Title: _____
Address: _____
Phone: _____ Fax: _____
Email: _____

1.03 The undersigned Offeror proposes and agrees, if this Proposal is accepted, to enter into an Agreement with Owner in the form included in the Contract Documents to perform all Work as specified or indicated in Contract Documents for the Contract Price indicated in this Proposal or as modified by Amendment. Offeror agrees to complete the Work within the Contract Price and within the Contract Times established in the Agreement or as modified by Amendment and comply with the all other terms and conditions of the Contract Documents.

ARTICLE 2: OFFEROR'S ACKNOWLEDGMENTS

2.01 Offeror accepts all of the terms and conditions of the Request for Proposals and Instructions to Offerors, including without limitation those dealing with the disposition of required Bonds. The Proposal will remain subject to acceptance for 60 days after the opening of Proposals.

2.02 Offeror accepts the provisions of the Agreement as to liquidated damages in the event of its failure to complete Work in accordance with the schedule set forth in the Agreement.

ARTICLE 3: OFFEROR'S REPRESENTATIONS

3.01 In submitting this Proposal, Offeror represents, as set forth in the Agreement, that:

- A. The submittal of the Proposal has been duly authorized by, and in all respects binding upon, the Offeror.
- B. The undersigned declares that it is the Offeror or by holding the position below indicated is authorized to execute this Proposal Form on behalf of the Offeror and that all representations made on this Proposal Form are true and accurate.
- C. All information and statements contained in the Proposal are current, correct and complete and are made with full knowledge that the Owner will rely on such information and statements in determining the Successful Bidder for the Project.

- D. The submission of a Proposal will constitute an incontrovertible representation by the Offeror that the Offeror has complied with every requirement of the RFP, that without exception the Proposal is premised upon completion of Work required by the Contract Documents, Addenda and the related supplemental data, that the Offeror has given the Engineer written notice of all conflicts, errors, ambiguities and discrepancies that the Offeror has discovered in the Contract Documents, Addenda and the related supplemental data and the written resolutions provided by the Engineer are acceptable to the Offeror, and that the Contract Documents, Addenda and the related supplemental data are generally sufficient to indicate and convey understanding of all terms and conditions for completion of Work.
- E. Offeror has examined and carefully studied the Contract Documents, the other related data identified in the Contract Documents, and the following Addenda, receipt of all of which is hereby acknowledged.

Addendum No.	Addendum Date	Signature Acknowledging Receipt

- F. Offeror has visited the Site and become familiar with and is satisfied as to the general, local and Site conditions that may affect cost, progress, and performance of the Work.
- G. Offeror is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress and the furnishing of the Work.
- H. Offeror has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in SC-4.02.
- I. Offeror has obtained and carefully studied all additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions including surface, subsurface and Underground Facilities at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Offeror, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents to be employed by the Offeror, and safety precautions and programs incident thereto and accepts the consequences for not doing so.
- J. Offeror does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Proposal for performance of the Work at the Contract Price proposed, within the Contract Times proposed and in accordance with the terms and conditions of the Contract Documents.

- K. Offeror is aware of the general nature of Work to be performed by the Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- L. Offeror has correlated the information known to the Offeror, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.
- M. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Proposal is submitted.
- N. Offeror will submit written evidence of its authority to do business in Texas not later than the date of its execution of the Agreement.
- O. In accordance with Texas Government Code Chapter 2270, Offeror acknowledges that it does not boycott Israel and will not boycott Israel during the term of the Contract.
- P. Offeror acknowledges that it is aware and understands the requirements of Chapter 2252.908 of the Texas Government Code including but not limited to Form 1295-Certificate of Interested parties.
- Q. Offeror further represents that this Proposal is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Offeror has not directly or indirectly induced or solicited any other Offeror to submit a false or sham Proposal; Offeror has not solicited or induced any individual or entity to refrain from making an offer; and Offeror has not sought by collusion to obtain for itself any advantage over any other Offeror or over the Owner.

ARTICLE 4: BASIS OF OFFER

- 4.01 Offeror will complete the Work in accordance with the Contract Documents for the Contract Price shown in the attached "Proposal Form Exhibit A":
 - A. Extended amounts have been computed in accordance with the General Conditions.
 - B. Offeror acknowledges that the estimated quantities are not guaranteed, and final payment for all Unit Price items will be based on actual quantities provided, measured as provided in the Contract Documents.
 - C. Unit Price and figures column will be used to compute the actual Proposal price.

ARTICLE 5: ARTICLE 5 – TIME OF COMPLETION

- 5.01 Offeror agrees that the Work will be Substantially Complete and will be completed and ready for final payment in accordance with the General Conditions on or before the dates or within the number of Calendar Days indicated in the Agreement.

PROPOSAL

- 5.02 The following documents comprise the Proposal:
 - A. Proposal Form and the accompanying completed forms immediately below

1. "Proposal Form Exhibit A"
 2. "Conflict of Interest Questionnaire" (CIQ)
 3. "Local Government Officer Conflicts Disclosure Statement" (CIS)
 4. "Vendor Compliance with Reciprocity on Non- Resident Bidders" (TWDB-0459)
 5. "Contractor Compliance to Texas Sales Tax Code"
 6. "Form TCG 2270 Prohibition on Contracts with Companies Boycotting Israel"
 7. "Safety Record Questionnaire"
 8. "Acknowledgement of Insurance Requirements"
 9. "Disadvantaged Business Form"
- B. Required Bid Bond
- C. "Statement of Qualifications"

ARTICLE 6: DEFINED TERMS

- 6.01 The terms used in this Proposal have the meanings indicated in the RFP, General Conditions and the Supplementary Conditions. The significance of terms with initial capital letters is described in the General Conditions.

ARTICLE 7: STATEMENT OF MATERIALS AND OTHER CHARGES

- 7.01 Provide the following information with the Proposal:

Statement of Materials and Other Charges	
Materials Incorporated into the Project	\$
All Other Charges	\$
Total Contract Amount	\$

ARTICLE 8: ARTICLE 9 – VENUE

- 8.01 Offeror agrees that venue shall lie exclusively in Tarrant County, Texas for any legal action.

ARTICLE 9: PROPOSAL FORM SUBMITTAL

9.01 This Proposal Form is submitted by:

If Offeror is an Individual

Name: _____
(typed or printed)

By: _____
(Individual's Signature)

Doing business as: _____

Business Address: _____

Phone: _____ Email: _____
Proposal submitted on the following
date: _____

A Partnership

Partnership Name: _____
(typed or printed)

Name of General
Partner: _____
(typed or printed)

By: _____
(signature of general partner -- attach evidence of authority to sign)

Doing business as: _____

Business Address: _____

Phone: _____ Email: _____
Proposal submitted on the following
date: _____

A Corporation

Corporation Name: _____
(typed or printed)

State of Incorporation: _____

Type: _____
(general business, professional, service, limited liability)

Date of qualification to do business in Texas is: _____

By: _____
(signature -- attach evidence of authority to sign)

Name: _____
(typed or printed)

Title: _____

Attest: _____
(Signature of Corporate Secretary)

Business Address: _____

Phone: _____ Email: _____

Proposal submitted on the following
date: _____

Joint Venture

Joint Venturer Name: _____
(typed or printed)

By: _____
(signature of joint venture partner -- attach evidence of authority to sign)

Name: _____
(typed or printed)

Title: _____

Business Address: _____

Phone: _____ Email: _____
Proposal submitted on the following
date: _____

Joint Venturer Name: _____
(typed or printed)

By: _____
(signature of joint venture partner -- attach evidence of authority to sign)

Name: _____
(typed or printed)

Title: _____

Business Address: _____

Phone: _____ Email: _____
Proposal submitted on the following
date: _____

Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.

Affidavits

One of the following four affidavits shall be executed and provided with this information. The individual signing the affidavit shall attach evidence of their authority to bind the organization to an agreement.

AFFIDAVIT FOR CORPORATION

State _____) §

County of _____) §

_____, being duly sworn deposes and says
(Name)

that they are _____ of the
(Title)

_____ corporation submitting the foregoing
qualification form and related information; have read such documents; and that such documents are
true and correct and contain no material misrepresentations; and that they are authorized to make this
affidavit on behalf of the Corporation.

(Signature)

Signed and sworn to me before this _____ day of _____, 20__.

(Notary Public)

My commission expires:

AFFIDAVIT FOR PARTNERSHIP

State _____) §

County of _____) §

_____, being duly sworn deposes and says

(Name)

that they are _____ of the

(Title)

_____ company submitting the foregoing qualification form and related information; have read such documents; and that such documents are true and correct and contain no material misrepresentations; and that they are authorized to make this affidavit on behalf of the Partnership.

(Signature)

Signed and sworn to me before this _____ day of _____, 20__.

(Notary Public)

My commission expires:

AFFIDAVIT FOR INDIVIDUAL

State _____) §

County of _____) §

_____, being duly sworn deposes and says
(Name)

that they are _____ of the
(Title)

_____ company submitting the foregoing qualification
form and related information; have read such documents; and that such documents are true and correct
and contain no material misrepresentations.

(Signature)

Signed and sworn to me before this _____ day of _____, 20__.

(Notary Public)

My commission expires:

JOINT VENTURE STATEMENT

We the undersigned do hereby give notice to our agreement to bid as a joint venture on the Project.

(Name of Joint Venture)

(Name of Firm)

(Signature)

Signed and sworn to me before this _____ day of _____, 20__.

(Notary Public)

My commission expires:

(Name of Firm)

(Signature)

Signed and sworn to me before this _____ day of _____, 20__.

(Notary Public)

My commission expires:

KEL22149

PROPOSAL FORM EXHIBIT 'A'**Water System Capital Improvement Plan - Phase 3**

Pate Orr Road - Water Line 'L' Improvements

ITEM NO.	ESTIMATED QUANTITY	UNIT	ITEM DESCRIPTION TOTAL UNIT PRICE TO BE WRITTEN IN WORDS	UNIT PRICE	TOTAL AMOUNT BID
1	1	LS	Site Preparation and Mobilization _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
2	1	LS	Pre Construction Video _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
3	70	DAY	Electronic Message Board Signs _____ DOLLARS AND _____ CENTS PER DAY	\$ _____	\$ _____
4	178	LF	6" PVC Water Pipe by Open Cut _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
5	1540	LF	8" PVC Water Pipe by Open Cut _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
6a	140	LF	8" PVC Water Pipe by Cased Bore _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
6b	140	LF	8" PVC Water Pipe by Uncased Bore _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
7	978	LF	8" PVC Water Pipe via Pipe Bursting _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
8a	140	LF	20" Steel Casing Pipe by Bore (for 8" PVC Carrier Pipe) _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____

ITEM NO.	ESTIMATED QUANTITY	UNIT	ITEM DESCRIPTION TOTAL UNIT PRICE TO BE WRITTEN IN WORDS	UNIT PRICE	TOTAL AMOUNT BID
9	3	TON	Ductile Iron Water Fittings _____ DOLLARS AND _____ CENTS PER TON	\$ _____	\$ _____
10	4	EA	1" Long Water Service (by Method Other than Open Cut) with Meter Box and Connection to Existing Meter _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
11	8	EA	1" Short Water Service (by Open Cut) with Meter Box and Connection to Existing Meter _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
12	4	EA	Fire Hydrant Assembly (Incl. 6" Gate Valve and 6" lead) _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
13	6	EA	6" Gate Valve and Box _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
14	17	EA	8" Gate Valve and Box _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
15	13	EA	Connect to Existing Water Line _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
16	6	EA	Cut and Plug Existing Water Line _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
17	1685	LF	Abandon Existing Water Line (By Grouting) _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
18	77	LF	Remove & Dispose of Existing AC Pipe _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
19	2	EA	Remove & Dispose of Existing Fire Hydrant Assembly _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
20	18	EA	Abandon/Remove Existing Valve _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____

ITEM NO.	ESTIMATED QUANTITY	UNIT	ITEM DESCRIPTION TOTAL UNIT PRICE TO BE WRITTEN IN WORDS	UNIT PRICE	TOTAL AMOUNT BID
21	65	SY	Concrete Pavement Repair _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
22	1092	SY	Asphalt Pavement Repair _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
23	3	SY	Concrete Sidewalk Repair _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
24	8	CY	Flowable Fill _____ DOLLARS AND _____ CENTS PER CY	\$ _____	\$ _____
25	1100	SY	Temporary Asphalt Pavement Repair _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
26	65	LF	Concrete Curb & Gutter Repair _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
27	1	LS	Temporary Water Line and Connections _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
28	1718	LF	Trench Safety _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
29	1	LS	Traffic Control _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
30	28	DAY	Additional Traffic Control Flagger _____ DOLLARS AND _____ CENTS PER DAY	\$ _____	\$ _____
31	1	LS	Surface Restoration and Sodding _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____

ITEM NO.	ESTIMATED QUANTITY	UNIT	ITEM DESCRIPTION TOTAL UNIT PRICE TO BE WRITTEN IN WORDS	UNIT PRICE	TOTAL AMOUNT BID
32	1	LS	Erosion Control _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
33	3	EA	Exploratory Excavation _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
Subtotal Base Bid (incl. 6a & 8a) _____ _____ Dollars and _____ Cents \$ _____					
Subtotal Base Bid (incl. 6b) _____ _____ Dollars and _____ Cents \$ _____					
A-1		LS	Cost Adjustment for US Iron and Steel Requirements (for data collection purposed only) _____ _____ Dollars and _____ Cents Per Lump Sum	\$ _____	\$ _____
Subtotal Bid for Alternate 1 (Words and Figures) _____ _____ Dollars and _____ Cents \$ _____					

KEL22149

PROPOSAL FORM EXHIBIT 'A'**Water System Capital Improvement Plan - Phase 3**

Pate Orr Road - Mill & Overlay

ITEM NO.	ESTIMATED QUANTITY	UNIT	ITEM DESCRIPTION TOTAL UNIT PRICE TO BE WRITTEN IN WORDS	UNIT PRICE	TOTAL AMOUNT BID
1	1058	SY	3" Traditional Mill & Asphalt Overlay (TWDB SWIFT Funding) _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
2	6595	SY	3" Traditional Mill & Asphalt Overlay (City of Keller Funding) _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
3	1531	SY	Full Depth Spot Repair _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
4	4882	LF	4" Thermoplastic Solid White Stripe (100 MIL) (City of Keller Funding) _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
5	4882	LF	4" Thermoplastic Solid Yellow Stripe (100 MIL) (City of Keller Funding) _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
Subtotal Base Bid _____ _____ Dollars and _____ Cents \$ _____					

KEL22149

PROPOSAL FORM EXHIBIT 'A'**Water System Capital Improvement Plan - Phase 3**

Mount Gilead Road - Water Line 'M' Improvements

ITEM NO.	ESTIMATED QUANTITY	UNIT	ITEM DESCRIPTION TOTAL UNIT PRICE TO BE WRITTEN IN WORDS	UNIT PRICE	TOTAL AMOUNT BID
1	1	LS	Site Preparation and Mobilization _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
2	1	LS	Pre Construction Video _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
3	70	DAY	Electronic Message Board Signs _____ DOLLARS AND _____ CENTS PER DAY	\$ _____	\$ _____
4	137	LF	8" PVC Water Pipe by Open Cut _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
5	2797	LF	12" PVC Water Pipe by Open Cut _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
6	20	LF	24" Steel Casing Pipe (for 12" PVC Carrier Pipe) _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
7	5	TON	Ductile Iron Water Fittings _____ DOLLARS AND _____ CENTS PER TON	\$ _____	\$ _____
8	8	EA	1" Long Water Service (by Method Other than Open Cut) with Meter Box and Connection to Existing Meter _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
9	12	EA	1" Short Water Service (by Open Cut) with Meter Box and Connection to Existing Meter _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
10	1	EA	1" Short Water Service (by Open Cut) with Meter Box and Relocation of Existing Meter _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____

ITEM NO.	ESTIMATED QUANTITY	UNIT	ITEM DESCRIPTION TOTAL UNIT PRICE TO BE WRITTEN IN WORDS	UNIT PRICE	TOTAL AMOUNT BID
11	6	EA	Fire Hydrant Assembly (Incl. 6" Gate Valve and 6" lead) _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
12	1	EA	1" Combination Air Release Valve _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
13	1	EA	6" Gate Valve and Box _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
14	5	EA	8" Gate Valve and Box _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
15	9	EA	12" Gate Valve and Box _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
16	8	EA	Connect to Existing Water Line _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
17	9	EA	Cut and Plug Existing Water Line _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
18	1535	LF	Abandon Existing Water Line (By Grouting) _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
19	1252	LF	Remove & Dispose of Existing AC Pipe _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
20	5	EA	Remove & Dispose of Existing Fire Hydrant Assembly _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____
21	15	EA	Abandon/Remove Existing Valve _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____

ITEM NO.	ESTIMATED QUANTITY	UNIT	ITEM DESCRIPTION TOTAL UNIT PRICE TO BE WRITTEN IN WORDS	UNIT PRICE	TOTAL AMOUNT BID
22	20	LF	Remove & Replace 4" Sanitary Sewer Service Line _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
23	66	SY	Concrete Pavement Repair _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
24	2149	SY	Asphalt Pavement Repair _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
25	5	CY	Flowable Fill _____ DOLLARS AND _____ CENTS PER CY	\$ _____	\$ _____
26	2149	SY	Temporary Asphalt Pavement Repair _____ DOLLARS AND _____ CENTS PER SY	\$ _____	\$ _____
27	1	LS	Temporary Water Line and Connections _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
28	2934	LF	Trench Safety _____ DOLLARS AND _____ CENTS PER LF	\$ _____	\$ _____
29	1	LS	Traffic Control _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
30	28	DAY	Additional Traffic Control Flagger _____ DOLLARS AND _____ CENTS PER DAY	\$ _____	\$ _____
31	1	LS	Surface Restoration and Sodding _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
32	1	LS	Erosion Control _____ DOLLARS AND _____ CENTS PER LS	\$ _____	\$ _____
33	3	EA	Exploratory Excavation _____ DOLLARS AND _____ CENTS PER EA	\$ _____	\$ _____

PROPOSAL FORM EXHIBIT 'A'
Water System Capital Improvement Plan - Phase 3
Bid Summary

Summary of Base Bids (incl. "a" items)

Pate Orr - Water Line 'L'	\$
Pate Orr - Mill & Overlay	\$
Mount Gilead Road - Water Line 'M'	\$
Project Allowance	\$150,000.00
Total Base Bid (incl. "a" items)	\$

Summary of Base Bids (incl. "b" items)

Pate Orr - Water Line 'L'	\$
Pate Orr - Mill & Overlay	\$
Mount Gilead Road - Water Line 'M'	\$
Project Allowance	\$150,000.00
Total Base Bid (incl. "b" Items)	\$

Construction Time: Offeror shall complete the work within _____ calendar days from notice to proceed to substantial completion. Shall be 210 or fewer calendar days.

Summary of Alternate Bids (data collection only)

Pate Orr - Water Line 'L'	\$
Pate Orr - Mill & Overlay	\$
Mount Gilead Road - Water Line 'M'	\$
Total Alternate Bid (data collection only)	\$

CONFLICT OF INTEREST QUESTIONNAIRE

FORM CIQ

For vendor doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. See Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY

Date Received

1 Name of vendor who has a business relationship with local governmental entity.

2 ☐ **Check this box if you are filing an update to a previously filed questionnaire.** (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 Name of local government officer about whom the information is being disclosed.

Name of Officer

4 Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐ Yes ☐ No

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ No

5 Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.

6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

Signature of vendor doing business with the governmental entity

Date

LOCAL GOVERNMENT OFFICER CONFLICTS DISCLOSURE STATEMENT

FORM CIS

(Instructions for completing and filing this form are provided on the next page.)

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This is the notice to the appropriate local governmental entity that the following local government officer has become aware of facts that require the officer to file this statement in accordance with Chapter 176, Local Government Code.

OFFICE USE ONLY

Date Received

1 Name of Local Government Officer

2 Office Held

3 Name of vendor described by Sections 176.001(7) and 176.003(a), Local Government Code

4 Description of the nature and extent of each employment or other business relationship and each family relationship with vendor named in item 3.

5 List gifts accepted by the local government officer and any family member, if aggregate value of the gifts accepted from vendor named in item 3 exceeds \$100 during the 12-month period described by Section 176.003(a)(2)(B).

Date Gift Accepted _____ Description of Gift _____

Date Gift Accepted _____ Description of Gift _____

Date Gift Accepted _____ Description of Gift _____

(attach additional forms as necessary)

6 AFFIDAVIT

I swear under penalty of perjury that the above statement is true and correct. I acknowledge that the disclosure applies to each family member (as defined by Section 176.001(2), Local Government Code) of this local government officer. I also acknowledge that this statement covers the 12-month period described by Section 176.003(a)(2)(B), Local Government Code.

Signature of Local Government Officer

AFFIX NOTARY STAMP / SEAL ABOVE

Sworn to and subscribed before me, by the said _____, this the _____ day
of _____, 20 _____, to certify which, witness my hand and seal of office.

Signature of officer administering oath

Printed name of officer administering oath

Title of officer administering oath

CONTRACTOR'S ACT OF ASSURANCE RESOLUTION

I hereby certify that it was RESOLVED by a quorum of the directors of the _____(Name of Corporation),
meeting on the _____ day of _____ 20____, that:

Authorized Representative(s):

be, and hereby is/are authorized to act on behalf of _____
(Name of Corporation), as its representative in all business transactions conducted in the State of
Texas, and;

That all above resolution was unanimously ratified by the Board of Directors at said
meeting and that the resolution has not been rescinded or amended and is now in full forces and
effect; and;

In authentication of the adoption of this resolution, I subscribe my name and affix the seal
of the Corporation this _____ day of _____, 20_____.

_____(Secretary)

[SEAL]

VENDOR COMPLIANCE WITH RECIPROCITY ON NON- RESIDENT BIDDERS

Texas Government Code Section 2252.002 provides that in order for nonresident bidders to be awarded a governmental contract, the bidder must bid projects for construction, improvements, supplies, or services in Texas at an amount lower than the lowest Texas resident bidder by the same amount that a Texas resident bidder would be required to underbid the nonresident bidder in order to obtain a comparable contract in the nonresident bidder's state. A nonresident bidder is a person, including a contractor, whose principal place of business or corporate office is outside of the state of Texas. This requirement does not apply to a contract involving Federal funds. The appropriate blanks in Section A must be filled out by all nonresident bidders in order for your bid to meet specifications. The failure of a nonresident bidder to do so will automatically disqualify that bidder. Resident bidders must check the blank in Section B.

- A. Non-resident vendors in _____ (give state), our principal place of business, are required to be _____ percent lower than resident bidders by state law. A copy of the statute is attached.

Non-resident vendors in _____ (give state), our principal place of business, are not required to underbid resident bidders.

- B. Our principal place of business or corporate office is in the state of Texas: ☐.

BIDDER:

Company

City

State

Zip

By (print name)

Signature

Title (print)

THIS FORM MUST BE RETURNED WITH THE BID

CONTRACTOR COMPLIANCE TO TEXAS SALES TAX CODE

Comply with all requirements of the Texas Sales Tax Code. The Contractor hereby certifies that the Contract Amount is divided as follows:

Material incorporated into the Project
(Resold to the Owner as defined in Tax Code) \$ _____

All other charges and costs \$ _____

Total * \$ _____

* The total must equal the total amount of the Contract:

CONTRACTOR:

By: _____
(signature of authorized person)

Address _____

Signature: _____

City State Zip

Title: _____

THIS FORM MUST BE RETURNED WITH YOUR BID

Form TCG 2270
VERIFICATION REQUIRED BY TEXAS GOVERNMENT CODE CHAPTER 2279

Contract identifier: _____

Department: _____

By signing below, Company hereby verifies the following:

1. Company does not boycott Israel; and
2. Company will not boycott Israel during the term of the contract.

SIGNED BY: _____

Print Name of Person: _____
Signing, Title, and
Company _____

Date signed: _____

STATE OF TEXAS §
COUNTY OF _____ §

BEFORE ME, the undersigned Notary Public on this day personally appeared _____ (Name), on behalf of _____ (Company) who being duly sworn, stated under oath that he/she has read the foregoing verification required by Texas Government Code Section 2270.002 and said statements contained therein are true and correct..

SWORN AND SUBSCRIBED TO before me, this _____ day of _____, 20____.

NOTARY OF PUBLIC,
FOR THE STATE OF TEXAS

My Commission Expires:

Government Code § 2270.002. Provision Required in Contract

Effective: September 1, 2017

A governmental entity may not enter into a contract with a company for goods or services unless the contract contains a written verification from the company that it:

- (1) does not boycott Israel; and
- (2) will not boycott Israel during the term of the contract.

The following definitions apply:

(1) "Boycott Israel" means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes.

(2) "Company" means a for-profit sole proprietorship, organization, association, corporation, partnership, joint venture, limited partnership, limited liability partnership, or limited liability company, including a wholly owned subsidiary, majority-owned subsidiary, parent company, or affiliate of those entities or business associations that exists to make a profit.

(3) "Governmental entity" means a state agency or political subdivision of this state.

State law requires verification from a Company for contracts involving goods or services (regardless of the amount) before the City can enter into the contract.

BIDDER'S CERTIFICATIONS

Project Name: _____

Project Number: _____

Contract For: _____

The following certifications must be completed by the bidder for each contract.

A. EQUAL EMPLOYMENT OPPORTUNITY:

☐ I have developed and have on file at each establishment affirmative action programs pursuant to 41 CFR Part 60-1.7.

I have:

- ☐ participated in previous contract(s) or subcontract(s) subject to the equal opportunity clause under Executive Orders 11246 and 11375. I have filed all notices, contract specifications, and compliance reports due under the requirements contained in 41 CFR Part 60-4.
- ☐ **not** participated in previous contracts(s) subject to the equal opportunity clause under Executive Orders 11246 and 11375 and 41 CFR Chapter 60.

B. NONSEGREGATED FACILITIES

☐ I certify that I do not and will not maintain any facilities provided for my employees in a segregated manner, or permit my employees to perform their services at any location under my control where segregated facilities are maintained; and that I will obtain a similar certification prior to the award of any federally assisted subcontract exceeding \$10,000 which is not exempt from the equal opportunity clause as required by 41 CFR Part 60-1.8.

I will obtain a similar certification from any proposed subcontractor(s), when appropriate.

I understand that a false statement on this certification may be grounds for rejection of this bid proposal or termination of the contract award.

Typed Name and Title of Bidder's Authorized Representative

Signature of Bidder's Authorized Representative

Date

Name and Address of Bidder

Debarment / Suspension Certification

I, _____, hereby certify that I have checked on the federal
(Authorized Representative of Recipient)

System for Award Management (www.sam.gov) website and determined that

_____ is not shown as an “excluded party” that is debarred,
(Name of entity)

suspended or otherwise excluded from or ineligible for participation in federal assistance programs under Executive Order 12549. (See 2 CFR Part 180 and 2 CFR Part 1532 for additional information on the federal governmentwide debarment and suspension system for nonprocurement programs and activities.)

I understand that a false statement herein may subject me to penalties under federal and state laws relating to filing false statements and other relevant statutes.

Signature

Date

Title

Name of Recipient

Verifying prime contractors and subcontractors for construction, equipment, supplies and services: Using the www.sam.gov website, the recipient must verify prior to awarding the contract that the prime contractor is not listed as an “excluded party” that is debarred, suspended or otherwise excluded from or ineligible. Once any subcontractors are known, they also must be verified as not listed as an “excluded party” prior to award of a subcontract. The recipient must print a dated record of the verification from the www.sam.gov website and retain a copy that is available for review by TWDB. The prime contractors and subcontractors must be verified prior to the contract award or the costs may be disallowed.

SAFETY RECORD QUESTIONNAIRE

The Owner desires to consider the safety records of potential contractors prior to awarding a proposal on this contract. The Owner uses the following written definition and criteria for accurately determining the safety record of an offeror prior to awarding a proposal on this contract.

The definition and criteria for determining the safety record of an offeror for this consideration shall be:

The Owner shall consider the safety record of the offerors in determining the responsibility thereof. The Owner may consider any incidence involving worker safety or safety of the public, be it related or caused by environmental, mechanical, operational, supervision or any other cause or factor. Specifically, the Owner may consider, among other things:

- a. Complaints to, or final orders entered by, the Occupational Safety and Health Review Commission (OSHRC), against the proposer for violations of OSHA regulations within the past three (3) years.
- b. Citations (as defined below) from an Environmental Protection Agency (as defined below) for violations within the past five (5) years. Environmental Protection Agencies include, but are not necessarily limited to, the U.S. Army Corps of Engineers (USACOE), the U.S. Fish and Wildlife Service (USFWS), the Environmental Protection Agency (EPA), the Texas Commission on Environmental Quality (TCEQ), the Texas Natural Resource Conservation Commission (TNRCC) (predecessor to the TCEQ), the Texas Department of State Health Services (DSHS), the Texas Parks and Wildlife Department (TPWD), the Structural Pest Control Board (SPCB), agencies of local governments responsible for enforcing environmental protection or worker safety related laws or regulations, and similar regulatory agencies of other states of the United States. Citations include notices of violation, notices of enforcement, suspension/revocations of state or federal licenses or registrations, fines assessed, pending criminal complaints, indictments, or convictions, administrative orders, draft orders, final orders, and judicial final judgments.
- c. Convictions of a criminal offense within the past ten (10) years, which resulted in bodily harm or death.
- d. Any other safety related matter deemed by the Owner to be material in determining the responsibility of the offeror and his or her ability to perform the services or goods required by the proposal documents in a safe environment, both for the workers and other employees of offeror and the public.

In order to obtain proper information from offerors so that the Owner may consider the safety records of potential contractors prior to awarding a proposal on this contract, the Owner requires that offerors answer the following four (4) questions and submit them with their proposals:

QUESTION ONE

Has the offeror, or the firm, corporation, partnership, or institution represented by the offeror, or anyone acting for such firm, corporation, partnership or institution, received citations for violations of OSHA within the past three (3) years?

YES _____ NO _____

If the offeror has indicated YES for question number one above, the offeror must provide to City of Keller, with its proposal submission, the following information with respect to each such citation:

Date of offense, location of establishment inspected, category of offense, final disposition of offense, if any, and penalty assessed.

_____ Offeror's Initials

QUESTION TWO

Has the offeror, or the firm, corporation, partnership, or institution represented by the offeror, or anyone acting for such firm, corporation, partnership or institution, received citations for violations of environmental protection laws or regulations, of any kind or type, within the past five years? Citations include notice of violation, notice of enforcement, suspension/revocations of state or federal licenses, or registrations, fines assessed, pending criminal complaints, indictments, or convictions, administrative orders, draft orders, final orders, and judicial final judgments.

YES _____ NO _____

If the offeror has indicated YES for question number two above, the offeror must provide to City of Keller, with its proposal submission, the following information with respect to each such conviction:

Date of offense or occurrence, location where offense occurred, type of offense, final disposition of offense, if any, and penalty assessed.

QUESTION THREE

Has the offeror, or the firm, corporation, partnership, or institution represented by offeror, or anyone acting for such firm, corporation, partnership, or institution, ever been convicted, within the past ten (10) years, of a criminal offense which resulted in serious bodily injury or death?

YES _____ NO _____

If the offeror has indicated YES for question number three above, the offeror must provide to City of Keller, with its proposal submission, the following information with respect to each such conviction:

Date of offense, location where offense occurred, type of offense, final disposition of offense, in any, and penalty assessed.

QUESTION FOUR

Provide your company's Experience Modification Rate, for the past three years and supporting information:

2024 to 2025 _____
2023 to 2024 _____
2022 to 2023 _____

ACKNOWLEDGEMENT

THE STATE OF TEXAS

COUNTY OF TARRANT

I certify that I have made no willful misrepresentations in this Questionnaire nor have I withheld information in my statements and answers to questions. I am aware that the information given by me in this questionnaire will be investigated, with my full permission, and that any misrepresentations or omissions may cause my proposal to be rejected.

Signature

Title

CITY OF KELLER
ACKNOWLEDGEMENT OF INSURANCE REQUIREMENTS

I acknowledge that by submitting a bid for this project, I am aware of the insurance requirements outlined in these specifications. If I am awarded the bid, I will comply with all insurance requirements within 10 working days of the bid award, including providing proof that I have insurance which may include, but not be limited to, true and accurate copies of the policies. If I fail to forward all insurance requirements within the 10 working days of the award of the bid, I understand my bid bond will be forfeited.

Signature Printed name

Name of Company: _____

Address of Company: _____

City, State & Zip: _____

Telephone Number: (____) _____ Date: _____

****THIS PAGE MUST BE COMPLETED OR BID WILL BE REJECTED****



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:		
	PHONE (A/C, No, Ext):	FAX (A/C, No):	
INSURED	E-MAIL ADDRESS:		
	INSURER(S) AFFORDING COVERAGE		NAIC #
	INSURER A :		
	INSURER B :		
	INSURER C :		
	INSURER D :		
INSURER E :			
INSURER F :			

COVERAGES**CERTIFICATE NUMBER:****REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
	COMMERCIAL GENERAL LIABILITY						EACH OCCURRENCE \$
	☐ CLAIMS-MADE ☐ OCCUR						DAMAGE TO RENTED PREMISES (Ea occurrence) \$
							MED EXP (Any one person) \$
							PERSONAL & ADV INJURY \$
	GEN'L AGGREGATE LIMIT APPLIES PER:						GENERAL AGGREGATE \$
	☐ POLICY ☐ PRO-JECT ☐ LOC						PRODUCTS - COMP/OP AGG \$
	OTHER:						\$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident) \$
	☐ ANY AUTO						BODILY INJURY (Per person) \$
	☐ OWNED AUTOS ONLY ☐ SCHEDULED AUTOS						BODILY INJURY (Per accident) \$
	☐ HIRED AUTOS ONLY ☐ NON-OWNED AUTOS ONLY						PROPERTY DAMAGE (Per accident) \$
							\$
	UMBRELLA LIAB						EACH OCCURRENCE \$
	☐ EXCESS LIAB ☐ CLAIMS-MADE						AGGREGATE \$
	DED ☐ RETENTION \$						\$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY						☐ PER STATUTE ☐ OTH-ER
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH)	Y / N ☐	N / A				E.L. EACH ACCIDENT \$
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - EA EMPLOYEE \$
							E.L. DISEASE - POLICY LIMIT \$

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

CERTIFICATE HOLDER**CANCELLATION**

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

FOR DISADVANTAGED BUSINESS ENTERPRISES ONLY

Disadvantaged Business Enterprises (DBE) are encouraged to participate in the City of Keller BID process. The City of Keller will provide additional clarification of specifications, assistance with BID Proposal Forms, and further explanation of bidding procedures to those DBEs who request it.

Representatives from DBE companies should identify themselves as such and submit a copy of the Certification.

The City recognizes the certifications of both the State of Texas Building and Procurement Commission HUB Program and the North Central Texas Regional Certification Agency. All companies seeking information concerning DBE certification are urged to contact:

State of Texas HUB Program
Texas Building & Procurement Commission
P O Box 13047
Austin, TX 78711-3047
(512) 463-5872

OR

North Central Texas Regional
Certification Agency
616 Six Flags Drive, #416-LB24
Arlington, TX 76011
(817) 640-0606

If your company is already certified, attach a copy of your certification to this form and return with BID.

COMPANY NAME: _____

REPRESENTATIVE: _____

ADDRESS: _____

CITY, STATE, ZIP: _____

TELEPHONE NO. _____ FAX NO. _____

INDICATE ALL THAT APPLY:

_____ Minority-Owned Business Enterprise
_____ Women-Owned Business Enterprise
_____ Disadvantaged Business Enterprise

INSERT BID BOND HERE

STATEMENT OF QUALIFICATIONS

ARTICLE 1: REQUIREMENTS FOR THE STATEMENT OF QUALIFICATIONS

- 1.01 The Statement of Qualifications must be submitted and include, as a minimum, the information as described herein. Failure to submit the required information in the Statement of Qualifications may result in the Owner considering the Proposal non-responsive and result in rejection of the Proposal by the Owner. Offerors may be required to provide supplemental information if requested by the Owner to clarify, enhance or supplement the information provided in the Statement of Qualifications.
- 1.02 Offerors must provide the information requested in the Statement of Qualifications using the forms attached to this Section. A copy of these forms can be provided in Microsoft Word to assist with the preparation of the Statement of Qualifications. Information in these forms must be provided completely and in detail. The information in these forms will be used to make direct comparisons with the information provided by other Offerors. Failure to include the information completely and clearly may result in lower scores in the evaluations. Information that cannot be totally incorporated in the form may be included in an appendix to the form. This appendix must be clearly referenced by appendix number in the form, and the appended material must include the appendix number on every sheet of the appendix. The appendix must include only the information that responds to the question or item number to which the appended information applies.
- 1.03 Owner, at its discretion, may also choose to conduct interviews with the top-ranking Offerors to provide the Offerors a better opportunity to demonstrate they can provide the best value to the Owner for this Project.
- A. Should the Owner choose to conduct interviews with any or all of the Offerors, they will be notified of:
1. The time and place for the interview.
 2. Interview format and agenda.
 3. Questions to be asked at the interview.
 4. Individuals that are expected to participate in the interview as a minimum.
- B. Failure to participate in the interview may result in disqualification from consideration for the Project.

ARTICLE 2: STATEMENT OF QUALIFICATIONS SUBMITTAL REQUIREMENTS, EVALUATION CRITERIA AND WEIGHTING **STATEMENT OF QUALIFICATIONS SUBMITTAL REQUIREMENTS ARE AS FOLLOWS:**

- A. Offeror General Information:
1. Offeror shall complete and submit Table 1 and any needed appendix to the form (See section 1.02 above).
- B. Project Organization and Experience and Qualifications of Proposed Key Personnel:
1. Provide an organizational chart for this Project showing the structure of Proposer's Project team with lines identifying the significant positions which shall include as a

minimum the Key Personnel positions and other positions that are responsible for major elements of the Project execution. Significant positions indicated on the organizational chart can have named individuals other than Key Personnel. For those additional individuals, a summary paragraph can be included on these individual's qualifications and experience to describe their Project role and responsibilities. Except for the Key Personnel, it is acceptable for chart to have a position without a named individual. Chart shall indicate the anticipated percent of each person's time that will be committed to the Project. At a minimum the anticipated percent of each Key Personnel's time will be provided. Critical support elements of project management and administration, quality control, safety, subcontractor management, etc. shall be identified. Charts and accompanying summary paragraph on other individuals named on the charts will be not subject to the page limit.

2. Offeror shall complete and submit Table 2. Provide the names of the Key Personnel that will be actively working on this Project in Table 2. Key Personnel include the Project Manager, Project Superintendent, Safety Manager and Quality Control Manager. If one or more of these Key Personnel roles are to be filled by one individual, this information is to be provided with the list of proposed individuals. The Offeror must provide the services of the proposed Key Personnel for the life of the Project as a condition of qualification. Failure to provide the proposed Key Personnel may result in the disqualification of the Offeror and may void the award of the Contract. Key Personnel may only be changed with the prior written consent of the Owner. The Owner reserves the right to request a resume and conduct an interview with the substitute candidate to demonstrate that he/she is as qualified and experienced or better than the Key Personnel individual. The Owner also reserves the right to reject the substitute candidate.
 3. Provide the resumes (not to exceed one page for each) of proposed Key Personnel with the Statement of Qualifications. The resume shall include:
 - a. Education and formal training credentials
 - b. Technical and managerial experience
 - c. Pertinent work history which describes project experience along with role and responsibilities on those projects
 - d. Information on prior projects that demonstrates experience with similar projects as this Project.
 4. Offerors are to include a list of the current project assignments for each of the Key Personnel proposed, the anticipated completion date for this assignment and the percentage of the time they will have available to devote to this Project. The Project Superintendent must be dedicated to this Project full time for the duration of the Project.
 5. Offeror will provide information on past projects where Key Personnel worked together.
- C. Experience of Offeror with Similar Projects:**
- Similar Projects are defined as: Water line construction in rural road neighborhoods of at least 500 linear feet (per project) of 6"-12" diameter pipe, including (1) open cut and (2) pipe bursting, as well as (3) handling and disposal of asbestos cement (AC) pipe. A minimum of five (5) Similar Projects must be provided for each category (1-3). Projects

included must have been completed within the last seven (7) years. A single project may be used to represent experience with multiple categories if it involved more than one of the categories (1-3).

Offerors shall complete and submit Table 3 for each Similar Project. The involvement of the Key Personnel and/or Subcontractors in these projects shall be identified and highlighted with a minimum of project position/title and responsibilities.

The Offeror will submit Similar Project descriptive narratives which describes lessons learned from previous project experiences that would benefit this Project in the areas of: minimization of water service disruption to residents and inconveniences of construction, and delivering projects at or under owner's budgets. This narrative is not to exceed one (1) page in length per Similar Project.

D. Project Resources; Subcontractors and Suppliers; Safety and Construction Time

1. Offeror shall complete and submit Table 4. Describe in narrative the Offeror's approach to managing Subcontractors and Suppliers for this Project. Offeror shall also complete and submit the Safety Record Questionnaire.
2. Offeror shall provide the number of calendar days from Notice to proceed to substantial completion for this project in the place provided on the Proposal Form Exhibit A. (Shall be 210 or fewer calendar days.)
3. Offeror shall provide a narrative that demonstrates its ability to complete projects on time. Offeror will provide examples of projects where owner expectations for schedule were not met and the lessons learned.
4. Limit the narrative portion responding to D.1 and D3 above to two (2) pages.

Table 1 – Offeror General Information

Offeror doing business as			
Business address of principle office			
Telephone numbers			
Main number			
Fax number			
Website address			
Form of business (check one)	☐ A corporation	☐ A partnership	☐ An individual
If a Corporation			
Date of incorporation			
State of incorporation			
Chief Executive name			
President name			
Senior Management Names and Position	Name	Position	
Secretary name			
Treasurer name			
If a Partnership			
Date of organization			
State whether partnership is general or limited			
If an Individual			
Name			
Business address			
Indicators of Offerors Size			
Average number of current full-time employees		Average estimate of revenue for the current year	

Offeror Regional/Local Office	
Business address of office	

Name of office manager			
Telephone numbers			
Main number			
Fax number			
Website address			
Organization History			
List of names that this Offeror has and currently operates under over the history of the organization, including the names of related companies presently doing business:			
Names of Offeror	From date	To date	
List of companies, firms or organizations that own any part of the Offeror.			
Name of companies, firms or organization.	Percent ownership		
Construction Experience			
Years' experience in projects similar to the proposed project:			
As a general contractor			
• Lines of business and service offerings • Location of home office and other offices • Number of employees • Growth of business lines and service offerings • Other appropriate information Provide information as to the history of the Offeror, including lines of business and service offerings, growth over time in terms of number of projects, size of projects, types of projects, firm revenue and number of employees.			

Provide narrative information to indicate the number and types of projects and dollar volume currently under contract by the Offeror.

Surety References

Name:		Telephone (main number):
Mailing address (principal place of business):		Telephone (for notice of claim):
		Local Agent for Surety:
		Name: _____
Physical address (principal place of business):		Address: _____

		Telephone: _____
Surety is a corporation organized and existing under the laws of the state of: _____.		
Is surety authorized to provide surety bonds in the state of Texas? _____.		
Is surety listed in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury? _____		
If applicable, Surety A.M. Best rating _____		

Table 2– Proposed Key Personnel

Offeror doing business as:		
Experience of Key Personnel		
Provide information on the Key Personnel proposed for this Project that will fill the positions listed below. Provide information for individuals for each of these positions on the pages for each of these Key Personnel.		
Position	Key Personnel	
[Project Manager]		
[Project Superintendent]		
[Project Safety Manager]		
[Project Quality Control Manager]		
If Key Personnel are to fulfill more than one of the roles listed above, provide a written narrative describing how much time will be devoted to each function, their qualifications to fulfill each role and the percentage of their time that will be devoted to each role. If the individual is not to be devoted solely to this Project, indicate how time it to be divided between this Project and their other assignments.		

Table 2 continued – Proposed Project Manager

Offeror doing business as			
Primary candidate			
Name of individual			
Years of experience as project manager			
Years of experience with this Offeror			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current project assignments			
Name of assignment	Percent of time used for this project	Estimated project completion date	
Reference contact information (listing names indicates approval to contacting the named individuals as a reference)			
Name		Name	
Title/ position		Title/ position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate role on project		Candidates role on project	

Table 2 continued – Proposed Project Superintendent

Offeror doing business as			
Primary candidate			
Name of individual			
Years of experience as project superintendent			
Years of experience with this Offeror			
Number of similar projects as superintendent			
Number of similar projects in other positions			
Current project assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference contact information (listing names indicates approval to contacting the named individuals as a reference)			
Name		Name	
Title/ position		Title/ position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate role on project		Candidate role on project	

Table 2 continued – Proposed Safety Manager

Offeror doing business as			
Primary candidate			
Name of individual			
Years of experience as project superintendent			
Years of experience with this Offeror			
Number of similar projects as superintendent			
Number of similar projects in other positions			
Current project assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference contact information (listing names indicates approval to contacting the named individuals as a reference)			
Name		Name	
Title/ position		Title/ position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate role on project		Candidate role on project	

Table 2 continued – Proposed Quality Control Manager

Offeror doing business as			
Primary candidate			
Name of individual			
Years of experience as project superintendent			
Years of experience with this Offeror			
Number of similar projects as superintendent			
Number of similar projects in other positions			
Current project assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference contact information (listing names indicates approval to contacting the named individuals as a reference)			
Name		Name	
Title/ position		Title/ position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate role on project		Candidate role on project	
Project		Project	
Candidate role on project		Candidate role on project	

Table 3 – Project Information for Similar Projects

Project owner		Project name	
General description of project and how this project meets the definition of similar project			
Project Budget and Schedule Performance			
Budget history		Schedule performance	
	Amount	% of Bid Amount	
Bid			Notice to Proceed
Change orders			Contract Substantial Completion date at Notice to Proceed
Owner enhancements			Contract final completion date at Notice to Proceed
Unforeseen conditions			Change Order authorized Substantial Completion date
Design issues			Change Order authorized final completion date
Total			Actual / estimated Substantial Completion date
Final cost			Actual / estimated final completion date
Key Project Personnel			
Identify with an asterisk (*) individuals that are Key Personnel for this Project		Project Manager	Project Superintendent
Name			
Percentage of time devoted to the project.			
Proposed for this project.			
Did Individual start and complete the project?			
If not, who started or completed the project in their place.			
Reason for change.			
Reference contact information (listing names indicates approval to contacting the named individuals as a reference)			
	Name	Title/ position	Organization
Owner			
Designer			
Construction Manager			
Surety			
Issues / disputes resolved or pending resolution by arbitration, litigation or dispute review boards			
Number of issues resolved:		Total amount involved in resolved issues:	
Number of issues pending:		Total amount involved in resolved Issues:	

Table 4 – Project Resources and Subcontractors and Suppliers

What work will the Offeror complete using its own resources?	
What work does the Offeror propose to subcontract on this project?	
Estimate of the amount of the Project that will be performed using in-house resources.	Estimate of the amount of the Project that will be performed by Subcontractors and Suppliers.
_____ % of the total project value.	_____ % of the total project value.

END OF SECTION

CERTIFICATE OF INTERESTED PARTIES**FORM 1295**

Complete Nos. 1 - 4 and 6 if there are interested parties.
Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.

OFFICE USE ONLY

1 Name of business entity filing form, and the city, state and country of the business entity's place of business.

2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.

3 Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the goods or services to be provided under the contract.

4 Name of Interested Party	City, State, Country (place of business)	Nature of Interest (check applicable)	
		Controlling	Intermediary

5 Check only if there is NO Interested Party.

☐**6 AFFIDAVIT**

I swear, or affirm, under penalty of perjury, that the above disclosure is true and correct.

Signature of authorized agent of contracting business entity

AFFIX NOTARY STAMP / SEAL ABOVE

Sworn to and subscribed before me, by the said _____, this the _____ day
of _____, 20 _____, to certify which, witness my hand and seal of office.

Signature of officer administering oath

Printed name of officer administering oath

Title of officer administering oath

ADD ADDITIONAL PAGES AS NECESSARY

STANDARD FORM OF AGREEMENT

STATE OF TEXAS §
 §
COUNTY OF TARRANT §

THIS AGREEMENT is dated as of the _____ day of _____

in the year 20____ by and between the City of Keller, TX (hereinafter called OWNER) and

_____ (hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article 1. WORK.

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Water System Capital Improvement Plan – Phase 3

The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Improvements associated with Phase 3 of City of Keller's Water System Capital Improvement Plan. The project involves the construction of approximately 6,000 LF of water line replacements ranging in size from 6" to 12" by open cut, boring, and pipe bursting.

Article 2. ENGINEER.

The Project has been designed by:

Teague Nall and Perkins, Inc.
5237 N. Riverside Drive, Suite 100
Fort Worth, Texas 76137

Teague Nall and Perkins Inc. is hereinafter called ENGINEER and is to act as OWNER's representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

Article 3. CONTRACT TIME.

3.1. The Work will be substantially completed within 210 calendar days from the date when the Contract Time commences to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraphs 14.07.B and 14.07.C of the General Conditions within 240 calendar days from the date when the Contract Time commences to run.

3.2. Liquidated Damages. OWNER and CONTRACTOR recognize that time of completion is the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the times specified in paragraph 3.1. above plus any extensions thereof allowed in accordance with Article 12.02 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on time.

Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER one thousand and 00/100 dollars (\$ 1,000.00) for each day that expires after the time specified in paragraph 3.1. for Substantial Completion until the Work is substantially complete. After Substantial Completion if CONTRACTOR shall neglect, refuse or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER one thousand and 00/100 dollars (\$ 1,000.00) for each day that expires after the time specified in paragraph 3.1 for completion and readiness for final payment.

Article 4. CONTRACT PRICE.

4.1. Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents for the unit prices shown in the "Proposal Form Exhibit A". Unit Prices have been computed in accordance with Paragraph 11.03.B of the General Conditions. Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price bid items will be based on actual quantities, determined as provided in the Contract Documents.

Article 5. PAYMENT PROCEDURES.

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

5.1. Progress Payments. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER, on or about the 25th day of each month during construction as provided below. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in paragraph 2.05.B.3. of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Conditions.

The retainage amount shall be five (5%) percent on contracts equal to or exceeding \$500,000 in value. For contracts less than \$500,000, the retainage amount shall be ten (10%) percent.

5.1.1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 14.02.B.5 of the General Conditions.

95 % of Work completed (90% for projects costing less than \$500,000 and 95% for for all others).

N/A % of materials and equipment not incorporated in the Work (but delivered, suitably stored and accompanied by documentation satisfactory to OWNER as provided in paragraph 14.02.A of the General Conditions).

5.2. Final Payment. Upon final completion and acceptance of the Work in accordance with paragraphs 14.07.B and 14.07.C of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said paragraphs 14.07.B and 14.07.C.

Article 6. INTEREST.

6.1 Interest will be paid on overdue payments as required by Texas Government Code Chapter 2251.

6.2 Interest will be paid on amounts withheld as retainage as required by Texas Government Code Chapter 2252.

Article 7. CONTRACTOR'S REPRESENTATIONS.

In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representations:

7.1. CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

7.2. CONTRACTOR has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in paragraph 4.02.A and 4.02.B of the General Conditions, and accepts the determination set forth in paragraphs SC-4.02 and 4.03 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which CONTRACTOR is entitled to rely.

7.3. CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraphs 4.02 and 4.03 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTOR for such purposes.

7.4. CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data in respect of said Underground Facilities are or will be required by CONTRACTOR in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.04 of the General Conditions.

7.5. CONTRACTOR has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

7.6. CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

Article 8. CONTRACT DOCUMENTS.

The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work consist of the following:

- 8.1. This Agreement.
- 8.2. Performance, Payment and Maintenance Bonds as contained herein.
- 8.3. Certificate of Insurance.
- 8.4. General Conditions.
- 8.5. Supplementary Conditions.
- 8.6. TWDB Supplemental Conditions
- 8.7. Specifications bearing the title **CONTRACT DOCUMENTS AND SPECIFICATIONS FOR Water System Capital Improvement Plan – Phase 3**
- 8.8. Drawings bearing the following general title:
Water System Capital Improvement Plan – Phase 3
- 8.9. Addenda numbers _____ to _____, inclusive.
- 8.10. CONTRACTOR's Proposal Form Exhibit A as contained herein.
- 8.11. Documentation submitted by CONTRACTOR prior to Notice of Award (Statement of Qualification forms, Safety Record Questionnaire, resumes, and other forms submitted with the proposal).
- 8.12. The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to paragraph 3.04 of the General Conditions.

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraph 3.04 of the General Conditions.

Article 9. MISCELLANEOUS.

9.1. Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.

9.2. No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law) and unless specifically stated to the contrary in any written consent to an assignment no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

9.3. OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.

Article 10. OTHER PROVISIONS

10.1. Contractor Key Personnel, Alternate Key Personnel and Subcontractors: Contractor shall not substitute or replace any Key Personnel or Subcontractor listed on Exhibit 1 of this Agreement without receiving prior written approval from Owner. Contractor will provide Owner with a written request for any such substitution or replacement stating the reason for the substitution or replacement, identification of the substitute or replacement Key Personnel or Subcontractor and the qualifications, experience and references to demonstrate substitute or replacement is equally or better qualified and experienced. The Owner reserves the right to request additional information and interview the Key Personnel or Subcontractor. Owner reserves the right to reject substitute or replacement.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in triplicate. One counterpart each has been delivered to OWNER, CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

This Agreement will be effective on _____, 20_____.

OWNER

CONTRACTOR

City of Keller, Texas

By_____

By_____

(CORPORATE SEAL)

(CORPORATE SEAL)

Attest_____

Attest_____

Address for giving notices:

1100 Bear Creek Parkway

P.O. Box 770

Keller, TX 76244

Address for giving notices:

Agreement Exhibit 1 Key Personnel and Subcontractors

Key Personnel shall consist of the following: **[Fill in the names contained in the Proposal]**

Project Manager: _____

Project Superintendent: _____

Safety Manager: _____

Quality Control Manager: _____

[Include in this Exhibit Table 2 of the Statement of Qualifications (pages 7 through 11), from Offeror's Proposal]

Subcontractors

Subcontractors shall comprise those listed on Table 4 attached to this Exhibit.

[Include in this Exhibit Table 4 of the Statement of Qualifications (page 12), from Offeror's Proposal]

END OF SECTION

PERFORMANCE BOND

STATE OF TEXAS

§

COUNTY OF TARRANT

§

§

KNOW ALL MEN BY THESE PRESENTS: That _____

_____ of the City of _____,

County of _____, State of _____,

as principal, and _____

authorized under the laws of the State of Texas to act as surety on bonds for principals, in accordance with Surety Bonds and Related Instruments, Chapter 3503 of the Insurance Code, are held and firmly bound unto City of Keller, Texas (OWNER),

in penal sum of _____ Dollars (\$ _____),

which is not less than 100% of the contract price of the contract referenced below, for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the __ day of

_____, 20____, to construct the

Water System Capital Improvement Plan – Phase 3

which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

The performance bond shall include without limitation guarantees that work done under the contract will be completed and performed according to approved plans and specifications and in accordance with sound construction principles and practices (Water Code 17.183 (2)(A)).

The performance bond shall be in a penal sum of not less than 100 percent of the contract price and remain in effect for one year beyond the date of approval by the engineer of the political subdivision (Water Code 17.183 (2)(B)).

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH, that if the said Principal shall faithfully perform, without limitations, said Contract and shall in all respects duly and faithfully observe and perform all and singular the covenants, conditions and agreements in and by said contract agreed and covenanted by the Principal to be observed and performed, and according to the true intent and meaning of said Contract and the Plans and Specifications hereto annexed, and in accordance with sound construction principles and practices, then this obligation shall be void one year after approval of the work by the OWNER's Engineer; otherwise to remain in full force and effect;

"PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of (Article 5160 for Public Work) (Article 5472d for Private Work) * of the Revised Civil Statutes of Texas as amended and all liabilities on this bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copied at length herein."

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract, or to the work performed thereunder, or the plans, specifications, or drawings accompanying the same, shall in anyway affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract, or to the work to be performed thereunder.

*Not applicable for federal work. See "The Miller Act," 40 U.S.C. S270

PERFORMANCE BOND (Cont'd)

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this ____ day of _____, 20____.

_____ Principal	_____ Surety
By _____	By _____
Title _____	Title _____
Address _____	Address _____
_____	_____
Phone No. _____	Phone No. _____

The name, address, and phone number of the Resident Agent of Surety is:

PAYMENT BOND

STATE OF TEXAS
COUNTY OF TARRANT

§
§
§

KNOW ALL MEN BY THESE PRESENTS: That _____

_____ of the City of _____

County of _____, and State of _____,

as principal, and _____

authorized under the laws of the State of Texas to act as surety on bonds for principals, in accordance with Surety Bonds and Related Instruments, Chapter 3503 of the Insurance Code, are held and firmly bound unto

_____ City of Keller, Texas _____ (OWNER),

in penal sum of _____ Dollars (\$ _____),

which is not less than 100% of the contract price of the contract referenced below, for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the ____

day of _____, 20____, to construct the **Water System Capital Improvement Plan – Phase 3** which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

The payment bond shall be in a penal sum of not less than 100 percent of the contract price and remain in effect for one year beyond the date of approval by the engineer of the political subdivision. (Water Code 17.183 (2)(B)).

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH, that if the said Principal shall pay all claimants supplying labor and material to him or a subcontractor in the prosecution of the work provided for in said contract, then, this obligation shall be void one year after approval of the work by the OWNER's Engineer; otherwise, to remain in full force and effect;

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Article 5160 of the Revised Civil Statutes of Texas as amended and all liabilities on this bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract, or to the work performed thereunder, or the plans, specifications, or drawings accompanying the same, shall in anyway affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract, or to the work to be performed thereunder.

PAYMENT BOND (Cont'd)

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this

day of _____, 20____.

Principal

Surety

By _____

By _____

Title _____

Title _____

Address _____

Address _____

Phone No. _____

Phone No. _____

The name, address, and phone number of the Resident Agent of Surety is:

MAINTENANCE BOND

STATE OF TEXAS

§
§
§

COUNTY OF TARRANT

KNOW ALL MEN BY THESE PRESENTS: That _____
(NAME OF CONTRACTOR)
as principal, and _____
(NAME OF SURETY)
a corporation organized under the laws of _____
and _____ as sureties,
do hereby expressly acknowledge themselves to be held and bound to pay unto the _____
City of Keller, Texas
(NAME OF OWNER)
_____, a private corporation, the sum of _____

(AMOUNT DETERMINED BY % OF TOTAL CONTRACT PRICE STATED IN SUPPLEMENTARY CONDITIONS)

Dollars (\$_____) for the payment of which sum well and truly to be made unto said _____
City of Keller, Texas
(NAME OF OWNER) and its successors, said principal and sureties
do hereby bind themselves, their assigns, and successors jointly and severally.

This obligation is conditioned, however, that, whereas said _____
(NAME OF CONTRACTOR)
has this day entered into a written contract with said _____
City of Keller, Texas
(NAME OF OWNER)
to build and construct the _____
Water System Capital Improvement Plan – Phase 3
(DESCRIPTION OF PROJECT AS IT APPEARS ON COVER OF CONTRACT DOCUMENTS)

which contract and the plans and specifications therein mentioned and adopted by the _____
City of Keller, Texas
(NAME OF OWNER)
_____ are hereby expressly made a part thereof as though the same were written and
embodied herein.

WHEREAS, under the specifications and contract, it is provided that the Contractor shall maintain and keep in good repair the work constructed and/or equipment furnished by him as contemplated by the plans, specifications, drawings, etc., and perform for a period of TWO (2) year(s) [NOTE: Period to be stated in Supplementary Conditions. If not so stated, the period shall be one (1) year.] from the date of acceptance as shown on the "Certificate of Completion" as issued by the Engineer, or the date of final payment by the Owner, whichever bears the later date, all necessary repairs, reconstruction and renewal of any part of said construction, and to furnish the labor and materials to make good and to repair any defective condition growing out of or on account of the breakage or failure of any substance or the improper function of any part of the construction work. The Contractor shall reimburse the Owner for the costs of all Engineering and special services required to be furnished by the Owner which are directly attributable to the restoration of the constructed work. Said maintenance contemplates the complete restoration of the constructed work to a functional use during the said period as set forth above. It is being understood that the purpose of this section is to require the correction of all defective conditions resulting from materials furnished or work and labor performed by the said Contractor under the conditions prescribed by the plans and specifications; and in case the said Contractor shall fail or refuse to perform as provided within ten (10) days after proper written notifications have been furnished to him by the Owner, it is agreed that the Owner may do said work and supply such materials and the said Contractor and Sureties herein shall be subject to the liquidated damages mentioned in said Contract for each calendar day's failure on its part to comply with the terms of the said provision of said Contract and this Maintenance Bond.

NOW, THEREFORE, if the said Contractor shall keep and perform its said agreement to maintain said work and keep the same in good repair for the said maintenance period as provided above, then these presents shall be null and void and have no further effect, but if default shall be made by the said Contractor in the performance of its contract to do so maintain and repair damages in the premises, as provided, and it is further understood and agreed that this obligation shall be a continuing one against the principal and sureties hereon, and that successive recoveries may be had hereon for successive breaches until the full amount shall have been exhausted; and it is further understood that the obligation herein to maintain said work shall continue throughout said maintenance period, and the same shall not be changed, diminished, or in any manner affected from any clause during said time.

IN WITNESS WHEREOF, the said _____
(NAME OF CONTRACTOR)
has caused these presents to be executed by _____
(NAME OF CONTRACTOR'S AUTHORIZED SIGNER)
and the said _____
(NAME OF SURETY)
has caused these presents to be executed by its _____
(ATTORNEY-IN-FACT OR OFFICIAL)
and the said _____
(ATTORNEY-IN-FACT OR OFFICIAL)
has hereto set his hand this the _____ day of _____, 20____.

SURETY

PRINCIPAL

By _____
Signature

By _____

Print Name

ATTEST:

By _____
Witness Signature

SECRETARY

Print Name

NOTE: Date of Maintenance Bond must not be prior to date of Contract. Power of Attorney must be attached.

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the Controlling Law.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

A. Wherever used in the Contract Documents and printed with initial or all capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof.

1. *Addenda*--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between OWNER and CONTRACTOR covering the Work.

3. *Application for Payment*--The form acceptable to ENGINEER which is to be used by CONTRACTOR during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*--The offer or proposal of a bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidding Documents*--The Bidding Requirements and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

7. *Bidding Requirements*--The Advertisement or Invitation to Bid, Instructions to Bidders, Bid security form, if any, and the Bid form with any supplements.

8. *Bonds*--Performance and payment bonds and other instruments of security.

9. *Change Order*--A document recommended by ENGINEER which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*--A demand or assertion by OWNER or CONTRACTOR seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*--The entire and integrated written agreement between the OWNER and CONTRACTOR concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*--The Contract Documents establish the rights and obligations of the parties and include the Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders, and ENGINEER's written interpretations and clarifications issued on or after the Effective Date of the Agreement. Approved Shop Drawings and the reports and drawings of subsurface and physical conditions are not Contract Documents. Only printed or hard copies of the items listed in this paragraph are Contract Documents. Files in electronic media format of text, data, graphics, and the like that may be furnished by OWNER to CONTRACTOR are not Contract Documents.

13. *Contract Price*--The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*--The number of days or the dates stated in the Agreement to: (i) achieve Substantial Completion; and (ii) complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment.

15. *CONTRACTOR*--The individual or entity with whom OWNER has entered into the Agreement.

16. *Cost of the Work*--See paragraph 11.01.A for definition.

17. *Drawings*--That part of the Contract Documents prepared or approved by ENGINEER which graphically shows the scope, extent, and character of the Work to be performed by CONTRACTOR. Shop Drawings and other CONTRACTOR submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *ENGINEER*--The individual or entity named as such in the Agreement.

20. *ENGINEER's Consultant*--An individual or entity having a contract with ENGINEER to furnish services as ENGINEER's independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

21. *Field Order*--A written order issued by ENGINEER which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

22. *General Requirements*--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

23. *Hazardous Environmental Condition*--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

24. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

25. *Laws and Regulations; Laws or Regulations*--Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

27. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

28. *Notice of Award*--The written notice by OWNER to the apparent successful bidder stating that upon timely compliance by the apparent successful bidder with the conditions precedent listed therein, OWNER will sign and deliver the Agreement.

29. *Notice to Proceed*--A written notice given by OWNER to CONTRACTOR fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform the Work under the Contract Documents.

30. *OWNER*--The individual, entity, public body, or authority with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be performed.

31. *Partial Utilization*--Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

32. *PCBs*--Polychlorinated biphenyls.

33. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

34. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part as may be indicated elsewhere in the Contract Documents.

35. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

36. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

37. *Resident Project Representative*--The authorized representative of ENGINEER who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

40. *Site*--Lands or areas indicated in the Contract Documents as being furnished by OWNER upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by OWNER which are designated for the use of CONTRACTOR.

41. *Specifications*--That part of the Contract Documents consisting of written technical descriptions of materials, equipment, systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.

42. *Subcontractor*--An individual or entity having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the Site.

43. *Substantial Completion*--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

44. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

45. *Supplier*--A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

46. *Underground Facilities*--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

47. *Unit Price Work*--Work to be paid for on the basis of unit prices.

48. *Work*--The entire completed construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

49. *Work Change Directive*--A written statement to CONTRACTOR issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

50. *Written Amendment*--A written statement modifying the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

1.02 Terminology

A. *Intent of Certain Terms or Adjectives*

1. Whenever in the Contract Documents the terms "as allowed," "as approved," or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of ENGINEER as to the Work, it is intended that such action or determination will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.10 or any other provision of the Contract Documents.

B. *Day*

1. The word "day" shall constitute a calendar day of 24 hours measured from midnight to the next midnight.

C. *Defective*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.04 or 14.05).

D. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of CONTRACTOR, “provide” is implied.

E. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS

2.01 Delivery of Bonds

A. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish.

2.02 Copies of Documents

A. OWNER shall furnish to CONTRACTOR up to ten copies of the Contract Documents. Additional copies will be furnished upon request at the cost of reproduction.

2.03 Commencement of Contract Times; Notice to Proceed

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 Starting the Work

A. CONTRACTOR shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 Before Starting Construction

A. *CONTRACTOR's Review of Contract Documents:* Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity, or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless CONTRACTOR knew or reasonably should have known thereof.

B. *Preliminary Schedules:* Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for its timely review:

1. a preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary schedule of Shop Drawing and Sample submittals which will list each required submittal and the times for submitting, reviewing, and processing such submittal; and

3. a preliminary schedule of values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

C. *Evidence of Insurance:* Before any Work at the Site is started, CONTRACTOR and OWNER shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which CONTRACTOR and OWNER respectively are required to purchase and maintain in accordance with Article 5.

2.06 Preconstruction Conference

A. Within 20 days after the Contract Times start to run, but before any Work at the Site is started, a conference attended by CONTRACTOR, ENGINEER, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.05.B, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 Initial Acceptance of Schedules

A. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER, and others as appropriate will be held to review for acceptability to ENGINEER as provided below the schedules submitted in accordance with paragraph 2.05.B. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to CONTRACTOR until acceptable schedules are submitted to ENGINEER.

1. The progress schedule will be acceptable to ENGINEER if it provides an orderly progression of the Work to completion within any specified Milestones and the Contract Times. Such acceptance will not impose on ENGINEER responsibility for the progress schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefor.

2. CONTRACTOR's schedule of Shop Drawing and Sample submittals will be acceptable to ENGINEER if it provides a workable arrangement for reviewing and processing the required submittals.

3. CONTRACTOR's schedule of values will be acceptable to ENGINEER as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 Intent

A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to OWNER.

C. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in Article 9.

3.02 Reference Standards

A. *Standards, Specifications, Codes, Laws, and Regulations*

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of OWNER, CONTRACTOR, or ENGINEER, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to OWNER, ENGINEER, or any of ENGINEER's Consultants, agents, or employees any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 Reporting and Resolving Discrepancies

A. *Reporting Discrepancies*

1. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, CONTRACTOR shall report it to ENGINEER in writing at once. CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as required by paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.04; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity, or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Amending and Supplementing Contract Documents

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways: (i) a Written Amendment; (ii) a Change Order; or (iii) a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways: (i) a Field Order; (ii) ENGINEER's approval of a Shop Drawing or Sample; or (iii) ENGINEER's written interpretation or clarification.

3.05 Reuse of Documents

A. CONTRACTOR and any Subcontractor or Supplier or other individual or entity performing or furnishing any of the Work under a direct or indirect contract with OWNER: (i) shall not have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, including electronic media editions; and (ii) shall not reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaptation by ENGINEER. This prohibition will survive final payment, completion, and acceptance of the Work, or termination or completion of the Contract. Nothing herein shall preclude CONTRACTOR from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

4.01 Availability of Lands

A. OWNER shall furnish the Site. OWNER shall notify CONTRACTOR of any encumbrances or restrictions not of general application but specifically related to use of the Site with which CONTRACTOR must comply in performing the Work. OWNER will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If CONTRACTOR and OWNER are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in OWNER's furnishing the Site, CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

B. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 Subsurface and Physical Conditions

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that ENGINEER has used in preparing the Contract Documents; and
2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that ENGINEER has used in preparing the Contract Documents.

B. *Limited Reliance by CONTRACTOR on Technical Data Authorized:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER, or any of ENGINEER's Consultants with respect to:

1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 Differing Subsurface or Physical Conditions

A. *Notice:* If CONTRACTOR believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which CONTRACTOR is entitled to rely as provided in paragraph 4.02 is materially inaccurate; or
2. is of such a nature as to require a change in the Contract Documents; or
3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by paragraph 6.16.A), notify OWNER and ENGINEER in writing about such condition. CONTRACTOR shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *ENGINEER's Review:* After receipt of written notice as required by paragraph 4.03.A, ENGINEER will promptly review the pertinent condition, determine the necessity of OWNER's obtaining additional exploration or tests with respect thereto, and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

C. *Possible Price and Times Adjustments*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in CONTRACTOR's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must meet any one or more of the categories described in paragraph 4.03.A; and

b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of paragraphs 9.08 and 11.03.

2. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. CONTRACTOR knew of the existence of such conditions at the time CONTRACTOR made a final commitment to OWNER in respect of Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such final commitment; or

c. CONTRACTOR failed to give the written notice within the time and as required by paragraph 4.03.A.

3. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in paragraph 10.05. However, OWNER, ENGINEER, and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by CONTRACTOR on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities, including OWNER, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

2. the cost of all of the following will be included in the Contract Price, and CONTRACTOR shall have full responsibility for:

- a. reviewing and checking all such information and data,
- b. locating all Underground Facilities shown or indicated in the Contract Documents,
- c. coordination of the Work with the owners of such Underground Facilities, including OWNER, during construction, and
- d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility.

2. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price of Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, OWNER or CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

4.05 Reference Points

A. OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 Hazardous Environmental Condition at Site

A. *Reports and Drawings:* Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the ENGINEER in the preparation of the Contract Documents.

B. *Limited Reliance by CONTRACTOR on Technical Data Authorized:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

- 1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by CONTRACTOR and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. CONTRACTOR shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. CONTRACTOR shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by CONTRACTOR, Subcontractors, Suppliers, or anyone else for whom CONTRACTOR is responsible.

D. If CONTRACTOR encounters a Hazardous Environmental Condition or if CONTRACTOR or anyone for whom CONTRACTOR is responsible creates a Hazardous Environmental Condition, CONTRACTOR shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by paragraph 6.16); and (iii) notify OWNER and ENGINEER (and promptly thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. CONTRACTOR shall not be required to resume Work in connection with such condition or in any affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by CONTRACTOR, either party may make a Claim therefor as provided in paragraph 10.05.

F. If after receipt of such written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in paragraph 10.05. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by CONTRACTOR or by anyone for whom CONTRACTOR is responsible. Nothing in this paragraph 4.06.E shall obligate OWNER to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by CONTRACTOR or by anyone for whom CONTRACTOR is responsible. Nothing in this paragraph 4.06.F shall obligate CONTRACTOR to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of paragraphs 4.02, 4.03, and 4.04 are not intended to apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 Performance, Payment, and Other Bonds

A. CONTRACTOR shall furnish performance and payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Contract Documents.

B. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

C. If the surety on any Bond furnished by CONTRACTOR is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.01.B, CONTRACTOR shall within 20 days thereafter substitute another Bond and surety, both of which shall comply with the requirements of paragraphs 5.01.B and 5.02.

5.02 Licensed Sureties and Insurers

A. All Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 Certificates of Insurance

A. CONTRACTOR shall deliver to OWNER, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to purchase and maintain. OWNER shall deliver to CONTRACTOR, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by CONTRACTOR or any other additional insured) which OWNER is required to purchase and maintain.

5.04 CONTRACTOR's Liability Insurance

A. CONTRACTOR shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
2. claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;
3. claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;
4. claims for damages insured by reasonably available personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance so required by this paragraph 5.04 to be purchased and maintained shall:

1. with respect to insurance required by paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) OWNER, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.07, 6.11, and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least thirty days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing, or replacing defective Work in accordance with paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter).

5.05 OWNER's Liability Insurance

A. In addition to the insurance required to be provided by CONTRACTOR under paragraph 5.04, OWNER, at OWNER's option, may purchase and maintain at OWNER's expense OWNER's own liability insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

5.06 Property Insurance

A. Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER;

5. allow for partial utilization of the Work by OWNER;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR, and ENGINEER with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph 5.07.

D. OWNER shall not be responsible for purchasing and maintaining any property insurance specified in this paragraph 5.06 to protect the interests of CONTRACTOR, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by CONTRACTOR, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If CONTRACTOR requests in writing that other special insurance be included in the property insurance policies provided under paragraph 5.06, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the Site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.

5.07 Waiver of Rights

A. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraph 5.06 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or

resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

B. OWNER waives all rights against CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to OWNER's property or the Work caused by, arising out of, or resulting from fire or other peril whether or not insured by OWNER; and
2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by OWNER during partial utilization pursuant to paragraph 14.05, after Substantial Completion pursuant to paragraph 14.04, or after final payment pursuant to paragraph 14.07.

C. Any insurance policy maintained by OWNER covering any loss, damage or consequential loss referred to in paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against CONTRACTOR, Subcontractors, ENGINEER, or ENGINEER's Consultants and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them.

5.08 Receipt and Application of Insurance Proceeds

A. Any insured loss under the policies of insurance required by paragraph 5.06 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.08.B. OWNER shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

B. OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, OWNER as fiduciary shall give bond for the proper performance of such duties.

5.09 Acceptance of Bonds and Insurance; Option to Replace

A. If either OWNER or CONTRACTOR has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by paragraph 2.05.C. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 Partial Utilization, Acknowledgment of Property Insurer

A. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 Supervision and Superintendence

A. CONTRACTOR shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of OWNER or ENGINEER in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

B. At all times during the progress of the Work, CONTRACTOR shall assign a competent resident superintendent thereto who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the Site and shall have authority to act on behalf of CONTRACTOR. All communications given to or received from the superintendent shall be binding on CONTRACTOR.

6.02 Labor; Working Hours

A. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out, and construct the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday, or any legal holiday without OWNER's written consent (which will not be unreasonably withheld) given after prior written notice to ENGINEER.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the General Requirements, CONTRACTOR shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 Progress Schedule

- A. CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.07 as it may be adjusted from time to time as provided below.

1. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.07) proposed adjustments in the progress schedule that will not result in changing the Contract Times (or Milestones). Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the progress schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of Article 12. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.

6.05 Substitutes and "Or-Equals"

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to ENGINEER for review under the circumstances described below.

1. *"Or-Equal" Items:* If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is at least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

a. If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR.

c. The procedure for review by ENGINEER will be as set forth in paragraph 6.05.A.2.d, as supplemented in the General Requirements and as ENGINEER may decide is appropriate under the circumstances.

d. CONTRACTOR shall first make written application to ENGINEER for review of a proposed substitute item of material or equipment that CONTRACTOR seeks to furnish or use. The application shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute item will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not use of the proposed

substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute item and whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.05.A.2.

C. *Engineer's Evaluation:* ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.05.A and 6.05.B. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized until ENGINEER's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." ENGINEER will advise CONTRACTOR in writing of any negative determination.

D. *Special Guarantee:* OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute.

E. *ENGINEER's Cost Reimbursement:* ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.05.A.2 and 6.05.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluating each such proposed substitute.

F. *CONTRACTOR's Expense:* CONTRACTOR shall provide all data in support of any proposed substitute or "or-equal" at CONTRACTOR's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. CONTRACTOR shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to OWNER as indicated in paragraph 6.06.B), whether initially or as a replacement, against whom OWNER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to OWNER in advance for acceptance by OWNER by a specified date prior to the Effective Date of the Agreement, and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. CONTRACTOR shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of OWNER or ENGINEER to reject defective Work.

C. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as

CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other individual or entity, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR.

E. CONTRACTOR shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with ENGINEER through CONTRACTOR.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.06, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same.

6.07 Patent Fees and Royalties

A. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees or agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 Permits

A. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto, such as plant investment fees.

6.09 Laws and Regulations

A. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

B. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work may be the subject of an adjustment in Contract Price or Contract Times. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in paragraph 10.05.

6.10 Taxes

A. CONTRACTOR shall pay all sales, consumer, use, and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 Use of Site and Other Areas

A. *Limitation on Use of Site and Other Areas*

1. CONTRACTOR shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant, and the officers, directors, partners, employees, agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER, or any other party indemnified hereunder to the extent caused by or based upon CONTRACTOR's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work CONTRACTOR shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work CONTRACTOR shall clean the Site and make it ready for utilization by OWNER. At the completion of the Work CONTRACTOR shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures*: CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

A. CONTRACTOR shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to ENGINEER for OWNER.

6.13 *Safety and Protection*

A. CONTRACTOR shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;
2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. CONTRACTOR shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property. All damage, injury, or loss to any property referred to in paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant, or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them). CONTRACTOR's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. CONTRACTOR shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

A. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 Emergencies

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, CONTRACTOR is obligated to act to prevent threatened damage, injury, or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 Shop Drawings and Samples

A. CONTRACTOR shall submit Shop Drawings to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show ENGINEER the services, materials, and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.17.E.

B. CONTRACTOR shall also submit Samples to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers, and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.17.E. The numbers of each Sample to be submitted will be as specified in the Specifications.

C. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER as required by paragraph 2.07, any related Work performed prior to ENGINEER's review and approval of the pertinent submittal will be at the sole expense and responsibility of CONTRACTOR.

D. *Submittal Procedures*

1. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

a. all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incident thereto; and

d. CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to CONTRACTOR's review and approval of that submittal.

3. At the time of each submittal, CONTRACTOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

E. ENGINEER's Review

1. ENGINEER will timely review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. ENGINEER's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of each submittal as required by paragraph 6.17.D.3 and ENGINEER has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.17.D.1.

F. Resubmittal Procedures

1. CONTRACTOR shall make corrections required by ENGINEER and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.18 Continuing the Work

A. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.04 or as OWNER and CONTRACTOR may otherwise agree in writing.

6.19 CONTRACTOR's General Warranty and Guarantee

A. The CONTRACTOR warrants to the OWNER and ENGINEER that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defect not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors, Suppliers, or any other individual or entity for whom CONTRACTOR is responsible; or
2. normal wear and tear under normal usage.

B. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

1. observations by ENGINEER;
2. recommendation by ENGINEER or payment by OWNER of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by ENGINEER or any payment related thereto by OWNER;
4. use or occupancy of the Work or any part thereof by OWNER;
5. any acceptance by OWNER or any failure to do so;
6. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by ENGINEER;
7. any inspection, test, or approval by others; or
8. any correction of defective Work by OWNER.

6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ARCHITECT, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage:

1. is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom; and

2. is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such individual or entity.

B. In any and all claims against OWNER, ARCHITECT, ENGINEER or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of CONTRACTOR under paragraph 6.20.A shall not extend to the liability of ARCHITECT, ENGINEER and ENGINEER's Consultants or to the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

ARTICLE 7 - OTHER WORK

7.01 Related Work at Site

A. OWNER may perform other work related to the Project at the Site by OWNER's employees, or let other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to CONTRACTOR prior to starting any such other work; and
2. if OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in paragraph 10.05.

B. CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the other work with OWNER's employees) proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

C. If the proper execution or results of any part of CONTRACTOR's Work depends upon work performed by others under this Article 7, CONTRACTOR shall inspect such other work and promptly report to ENGINEER in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure to so report will constitute an acceptance of such other work as fit and proper for integration with CONTRACTOR's Work except for latent defects and deficiencies in such other work.

7.02 Coordination

A. If OWNER intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
2. the specific matters to be covered by such authority and responsibility will be itemized; and
3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility for such coordination.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 Communications to Contractor

A. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.02 Replacement of ENGINEER

A. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer to whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

8.03 Furnish Data

A. OWNER shall promptly furnish the data required of OWNER under the Contract Documents.

8.04 Pay Promptly When Due

A. OWNER shall make payments to CONTRACTOR promptly when they are due as provided in paragraphs 14.02.C and 14.07.C.

8.05 Lands and Easements; Reports and Tests

A. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.01 and 4.05. Paragraph 4.02 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by ENGINEER in preparing the Contract Documents.

8.06 Insurance

A. OWNER's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 Change Orders

A. OWNER is obligated to execute Change Orders as indicated in paragraph 10.03.

8.08 Inspections, Tests, and Approvals

A. OWNER's responsibility in respect to certain inspections, tests, and approvals is set forth in paragraph 13.03.B.

8.09 Limitations on OWNER's Responsibilities

A. The OWNER shall not supervise, direct, or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents.

8.10 Undisclosed Hazardous Environmental Condition

A. OWNER's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in paragraph 4.06.

8.11 Evidence of Financial Arrangements

A. If and to the extent OWNER has agreed to furnish CONTRACTOR reasonable evidence that financial arrangements have been made to satisfy OWNER's obligations under the Contract Documents, OWNER's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S Representative

A. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and will not be changed without written consent of OWNER and ENGINEER.

9.02 Visits to Site

A. ENGINEER will make visits to the Site at intervals appropriate to the various stages of construction as ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER, for the benefit of OWNER, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against defective Work.

B. ENGINEER's visits and observations are subject to all the limitations on ENGINEER's authority and responsibility set forth in paragraph 9.10, and particularly, but without limitation, during or as a result of ENGINEER's visits or observations of CONTRACTOR's Work ENGINEER will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work.

9.03 Project Representative

A. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more extensive observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants will be as provided in paragraph 9.10 and in the Supplementary Conditions. If OWNER designates another representative or agent to represent OWNER at the Site who is not ENGINEER's Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 Clarifications and Interpretations

A. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents as ENGINEER may determine necessary, which shall be consistent with the intent of and reasonably inferable from the Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a written clarification or interpretation, a Claim may be made therefor as provided in paragraph 10.05.

9.05 Authorized Variations in Work

A. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER and also on CONTRACTOR, who shall perform the Work involved promptly. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of a Field Order, a Claim may be made therefor as provided in paragraph 10.05.

9.06 Rejecting Defective Work

A. ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be defective, or that ENGINEER believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER will also have authority to require special inspection or testing of the Work as provided in paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.07 Shop Drawings, Change Orders and Payments

- A. In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraph 6.17.
- B. In connection with ENGINEER's authority as to Change Orders, see Articles 10, 11, and 12.
- C. In connection with ENGINEER's authority as to Applications for Payment, see Article 14.

9.08 *Determinations for Unit Price Work*

A. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding (except as modified by ENGINEER to reflect changed factual conditions or more accurate data) upon OWNER and CONTRACTOR, subject to the provisions of paragraph 10.05.

9.09 Decisions on Requirements of Contract Documents and Acceptability of Work

A. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work, the quantities and classifications of Unit Price Work, the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, and Claims seeking changes in the Contract Price or Contract Times will be referred initially to ENGINEER in writing, in accordance with the provisions of paragraph 10.05, with a request for a formal decision.

B. When functioning as interpreter and judge under this paragraph 9.09, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to this paragraph 9.09 with respect to any such Claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.07) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such Claim, dispute, or other matter.

9.10 Limitations on ENGINEER's Authority and Responsibilities

A. Neither ENGINEER's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by ENGINEER shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. ENGINEER will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents.

C. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. ENGINEER's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this paragraph 9.10 shall also apply to ENGINEER's Consultants, Resident Project Representative, and assistants.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 Authorized Changes in the Work

A. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved, which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If OWNER and CONTRACTOR are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in paragraph 10.05.

10.02 Unauthorized Changes in the Work

A. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in paragraph 3.04, except in the case of an emergency as provided in paragraph 6.16 or in the case of uncovering Work as provided in paragraph 13.04.B.

10.03 Execution of Change Orders

A. OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

1. changes in the Work which are: (i) ordered by OWNER pursuant to paragraph 10.01.A, (ii) required because of acceptance of defective Work under paragraph 13.08.A or OWNER's correction of defective Work under paragraph 13.09, or (iii) agreed to by the parties;
2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.18.A.

10.04 Notification to Surety

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility. The amount of each applicable Bond will be adjusted to reflect the effect of any such change.

10.05 Claims and Disputes

A. *Notice:* Written notice stating the general nature of each Claim, dispute, or other matter shall be delivered by the claimant to ENGINEER and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. Notice of the amount or extent of the Claim, dispute, or other matter with supporting data shall be delivered to the ENGINEER and the other party to the Contract within 60 days after the start of such event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of such Claim, dispute, or other matter). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to ENGINEER and the claimant within 30 days after receipt of the claimant's last submittal (unless ENGINEER allows additional time).

B. *ENGINEER's Decision:* ENGINEER will render a formal decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any. ENGINEER's written decision on such Claim, dispute, or other matter will be final and binding upon OWNER and CONTRACTOR unless:

1. an appeal from ENGINEER's decision is taken within the time limits and in accordance with the dispute resolution procedures set forth in Article 16; or

2. if no such dispute resolution procedures have been set forth in Article 16, a written notice of intention to appeal from ENGINEER's written decision is delivered by OWNER or CONTRACTOR to the other and to ENGINEER within 30 days after the date of such decision, and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction within 60 days after the date of such decision or within 60 days after Substantial Completion, whichever is later (unless otherwise agreed in writing by OWNER and CONTRACTOR), to exercise such rights or remedies as the appealing party may have with respect to such Claim, dispute, or other matter in accordance with applicable Laws and Regulations.

C. If ENGINEER does not render a formal decision in writing within the time stated in paragraph 10.05.B, a decision denying the Claim in its entirety shall be deemed to have been issued 31 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

D. No Claim for an adjustment in Contract Price or Contract Times (or Milestones) will be valid if not submitted in accordance with this paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK

11.01 Cost of the Work

A. *Costs Included:* The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to CONTRACTOR will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in paragraph 11.01.B.

1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include without limitation superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto.

The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by OWNER.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

3. Payments made by CONTRACTOR to Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER, who will then determine, with the advice of ENGINEER, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in this paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of CONTRACTOR.

c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expressage, and similar petty cash items in connection with the Work.

i. When the Cost of the Work is used to determine the value of a Change Order or of a Claim, the cost of premiums for additional Bonds and insurance required because of the changes in the Work or caused by the event giving rise to the Claim.

j. When all the Work is performed on the basis of cost-plus, the costs of premiums for all Bonds and insurance CONTRACTOR is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnerships and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by CONTRACTOR, whether at the Site or in CONTRACTOR's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.01.A.1 or specifically covered by paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the Site.

3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

4. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraphs 11.01.A and 11.01.B.

C. *CONTRACTOR's Fee:* When all the Work is performed on the basis of cost-plus, CONTRACTOR's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, CONTRACTOR's fee shall be determined as set forth in paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to paragraphs 11.01.A and 11.01.B, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

11.02 Cash Allowances

A. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums as may be acceptable to OWNER and ENGINEER. CONTRACTOR agrees that:

1. the allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. CONTRACTOR's costs for unloading and handling on the Site, labor, installation costs, overhead, profit, and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

B. Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 Unit Price Work

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER subject to the provisions of paragraph 9.08.

B. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

C. OWNER or CONTRACTOR may make a Claim for an adjustment in the Contract Price in accordance with paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
2. there is no corresponding adjustment with respect any other item of Work; and
3. if CONTRACTOR believes that CONTRACTOR is entitled to an increase in Contract Price as a result of having incurred additional expense or OWNER believes that OWNER is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 Change of Contract Price

A. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the ENGINEER and the other party to the Contract in accordance with the provisions of paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraph 11.03); or
2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 12.01.C.2); or
3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in paragraph 11.01) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 12.01.C).

C. *CONTRACTOR's Fee:* The CONTRACTOR's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under paragraphs 11.01.A.1 and 11.01.A.2, the CONTRACTOR's fee shall be 15 percent;

- b. for costs incurred under paragraph 11.01.A.3, the CONTRACTOR's fee shall be five percent;
- c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and CONTRACTOR will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
- d. no fee shall be payable on the basis of costs itemized under paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
- e. the amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to five percent of such net decrease; and
- f. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 Change of Contract Times

A. The Contract Times (or Milestones) may only be changed by a Change Order or by a Written Amendment. Any Claim for an adjustment in the Contract Times (or Milestones) shall be based on written notice submitted by the party making the claim to the ENGINEER and the other party to the Contract in accordance with the provisions of paragraph 10.05.

B. Any adjustment of the Contract Times (or Milestones) covered by a Change Order or of any Claim for an adjustment in the Contract Times (or Milestones) will be determined in accordance with the provisions of this Article 12.

12.03 Delays Beyond CONTRACTOR's Control

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Times (or Milestones) will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in paragraph 12.02.A. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

12.04 Delays Within CONTRACTOR's Control

A. The Contract Times (or Milestones) will not be extended due to delays within the control of CONTRACTOR. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.05 *Delays Beyond OWNER's and CONTRACTOR's Control*

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay.

12.06 Delay Damages

A. In no event shall OWNER or ENGINEER be liable to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from:

1. delays caused by or within the control of CONTRACTOR; or
2. delays beyond the control of both OWNER and CONTRACTOR including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

B. Nothing in this paragraph 12.06 bars a change in Contract Price pursuant to this Article 12 to compensate CONTRACTOR due to delay, interference, or disruption directly attributable to actions or inactions of OWNER or anyone for whom OWNER is responsible.

ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

A. Prompt notice of all defective Work of which OWNER or ENGINEER has actual knowledge will be given to CONTRACTOR. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 Access to Work

A. OWNER, ENGINEER, ENGINEER's Consultants, other representatives and personnel of OWNER, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR's Site safety procedures and programs so that they may comply therewith as applicable.

13.03 Tests and Inspections

A. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by paragraphs 13.03.C and 13.03.D below;
2. that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.04.B shall be paid as provided in said paragraph 13.04.B; and
3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection or approval.

D. CONTRACTOR shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for OWNER's and ENGINEER's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to OWNER and ENGINEER.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation.

F. Uncovering Work as provided in paragraph 13.03.E shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

13.04 Uncovering Work

A. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

B. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment. If it is found that such Work is defective, CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, OWNER may make a Claim therefor as provided in paragraph 10.05. If, however, such Work is not found to be defective, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

13.05 OWNER May Stop the Work

A. If the Work is defective, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 Correction or Removal of Defective Work

A. CONTRACTOR shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by ENGINEER, remove it from the Project and replace it with Work that is not defective. CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.07 Correction Period

A. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for CONTRACTOR's use by OWNER or permitted by Laws and Regulations as contemplated in paragraph 6.11.A is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions: (i) repair such defective land or areas, or (ii) correct such defective Work or, if the defective Work has been rejected by OWNER, remove it from the Project and replace it with Work that is not defective, and (iii) satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the defective Work corrected or repaired or may have the rejected Work removed and replaced, and all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such

correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR.

B. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

C. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

D. CONTRACTOR's obligations under this paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 Acceptance of Defective Work

A. If, instead of requiring correction or removal and replacement of defective Work, OWNER (and, prior to ENGINEER's recommendation of final payment, ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to OWNER's evaluation of and determination to accept such defective Work (such costs to be approved by ENGINEER as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by CONTRACTOR pursuant to this sentence. If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and OWNER shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, OWNER may make a Claim therefor as provided in paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

13.09 OWNER May Correct Defective Work

A. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct defective Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.06.A, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days written notice to CONTRACTOR, correct and remedy any such deficiency.

B. In exercising the rights and remedies under this paragraph, OWNER shall proceed expeditiously. In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the Site, take possession of all or part of the Work and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors, and ENGINEER and ENGINEER's Consultants access to the Site to enable OWNER to exercise the rights and remedies under this paragraph.

C. All Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by OWNER in exercising the rights and remedies under this paragraph 13.09 will be charged against CONTRACTOR, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, OWNER may make a Claim therefor as provided in paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of CONTRACTOR's defective Work.

D. CONTRACTOR shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies under this paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 Schedule of Values

A. The schedule of values established as provided in paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 Progress Payments

A. *Applications for Payments*

1. At least 20 days before the date established for each progress payment (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect OWNER's interest therein, all of which must be satisfactory to OWNER.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of CONTRACTOR stating that all previous progress payments received on account of the Work have been applied on account to discharge CONTRACTOR's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications*

1. ENGINEER will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application.

2. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's observations on the Site of the executed Work as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules, that to the best of ENGINEER's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.08, and to any other qualifications stated in the recommendation); and

c. the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work.

3. By recommending any such payment ENGINEER will not thereby be deemed to have represented that: (i) inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents; or (ii) that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

4. Neither ENGINEER's review of CONTRACTOR's Work for the purposes of recommending payments nor ENGINEER's recommendation of any payment, including final payment, will impose responsibility on ENGINEER to supervise, direct, or control the Work or for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for CONTRACTOR's failure to comply with Laws and Regulations applicable to CONTRACTOR's performance of the Work. Additionally, said review or recommendation will not impose responsibility on ENGINEER to make any examination to ascertain how or for what purposes CONTRACTOR has used the moneys paid on account of the Contract Price, or to determine that title to any of the Work, materials, or equipment has passed to OWNER free and clear of any Liens.

5. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make the representations to OWNER referred to in paragraph 14.02.B.2. ENGINEER may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
- b. the Contract Price has been reduced by Written Amendment or Change Orders;
- c. OWNER has been required to correct defective Work or complete Work in accordance with paragraph 13.09; or
- d. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraph 15.02.A.

C. Payment Becomes Due

1. Ten days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of paragraph 14.02.D) become due, and when due will be paid by OWNER to CONTRACTOR.

D. Reduction in Payment

- 1. OWNER may refuse to make payment of the full amount recommended by ENGINEER because:
 - a. claims have been made against OWNER on account of CONTRACTOR's performance or furnishing of the Work;
 - b. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific Bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens;
 - c. there are other items entitling OWNER to a set-off against the amount recommended; or
 - d. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.02.B.5.a through 14.02.B.5.c or paragraph 15.02.A.

2. If OWNER refuses to make payment of the full amount recommended by ENGINEER, OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR any amount remaining after deduction of the amount so withheld. OWNER

shall promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects to OWNER's satisfaction the reasons for such action.

3. If it is subsequently determined that OWNER's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by paragraph 14.02.C.1.

14.03 CONTRACTOR's Warranty of Title

A. CONTRACTOR warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

14.04 Substantial Completion

A. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Promptly thereafter, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within 14 days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said 14 days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER in writing prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

B. OWNER shall have the right to exclude CONTRACTOR from the Site after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

14.05 Partial Utilization

A. Use by OWNER at OWNER's option of any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which OWNER, ENGINEER, and CONTRACTOR agree constitutes a separately functioning and usable part of the Work that can be used by OWNER for its intended purpose without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following conditions.

1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees that such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that such part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR

in writing giving the reasons therefor. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

2. No occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of paragraph 5.10 regarding property insurance.

14.06 Final Inspection

A. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will promptly make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 Final Payment

A. *Application for Payment*

1. After CONTRACTOR has, in the opinion of ENGINEER, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in paragraph 6.12), and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by subparagraph 5.04.B.7; (ii) consent of the surety, if any, to final payment; and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in paragraph 14.07.A.2 and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full and an affidavit of CONTRACTOR that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

B. *Review of Application and Acceptance*

1. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application for Payment to OWNER for payment. At the same time ENGINEER will also give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.09. Otherwise, ENGINEER will return the Application for Payment to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application for Payment.

C. *Payment Becomes Due*

1. Thirty days after the presentation to OWNER of the Application for Payment and accompanying documentation, the amount recommended by ENGINEER will become due and, when due, will be paid by OWNER to CONTRACTOR.

14.08 *Final Completion Delayed*

A. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed, and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by OWNER against CONTRACTOR, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from CONTRACTOR's continuing obligations under the Contract Documents; and
2. a waiver of all Claims by CONTRACTOR against OWNER other than those previously made in writing which are still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 *OWNER May Suspend Work*

A. At any time and without cause, OWNER may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to CONTRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if CONTRACTOR makes a Claim therefor as provided in paragraph 10.05.

15.02 *OWNER May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. CONTRACTOR's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.07 as adjusted from time to time pursuant to paragraph 6.04);
2. CONTRACTOR's disregard of Laws or Regulations of any public body having jurisdiction;
3. CONTRACTOR's disregard of the authority of ENGINEER; or
4. CONTRACTOR's violation in any substantial way of any provisions of the Contract Documents.
5. CONTRACTOR'S failure to pay subcontractors in a timely fashion.

B. If one or more of the events identified in paragraph 15.02.A occur, OWNER may, after giving CONTRACTOR (and the surety, if any) seven days written notice, terminate the services of CONTRACTOR, exclude CONTRACTOR from the Site, and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the Site

or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case, CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by OWNER arising out of or relating to completing the Work, such excess will be paid to CONTRACTOR. If such claims, costs, losses, and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses, and damages incurred by OWNER will be reviewed by ENGINEER as to their reasonableness and, when so approved by ENGINEER, incorporated in a Change Order. When exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

C. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.03 OWNER May Terminate For Convenience

A. Upon seven days written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Contract. In such case, CONTRACTOR shall be paid (without duplication of any items):

1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
2. for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
3. for all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
4. for reasonable expenses directly attributable to termination.

B. CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 CONTRACTOR May Stop Work or Terminate

A. If, through no act or fault of CONTRACTOR, the Work is suspended for more than 90 consecutive days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within 30 days after it is submitted, or OWNER fails for 30 days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days written notice to OWNER and ENGINEER, and provided OWNER or ENGINEER do not remedy such suspension or failure within that time, terminate the Contract and recover from OWNER payment on the same terms as provided in paragraph 15.03. In lieu of terminating the Contract and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within 30 days after it is submitted, or OWNER has failed for 30 days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may, seven days after written notice to OWNER and ENGINEER, stop the Work until payment is made of all such amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.04 are not intended to preclude CONTRACTOR from making a Claim under paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to CONTRACTOR's stopping the Work as permitted by this paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 Methods and Procedures

A. Dispute resolution methods and procedures, if any, shall be as set forth in the Supplementary Conditions. If no method and procedure has been set forth, and subject to the provisions of paragraphs 9.09 and 10.05, OWNER and CONTRACTOR may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17 - MISCELLANEOUS

17.01 Giving Notice

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 Computation of Times

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 Cumulative Remedies

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 Survival of Obligations

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Agreement.

17.05 Controlling Law

A. This Contract is to be governed by the law of the state in which the Project is located.

SUPPLEMENTARY CONDITIONS
for
THE CITY OF KELLER, TEXAS
(Water System Capital Improvement Plan – Phase 3)

INDEX

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SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the General Conditions and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

SC-1.01 DEFINED TERMS:

The terms used in these Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions or as amended below.

Delete paragraphs 1.01.A.5 through 1.01.A.7 entirely and insert the following in their place:

"5. *Proposal* – The documents submitted by an Offeror to establish the proposed Contract Price and Contract Times and provide other information and certifications as required by the Proposal Requirements. The term "Bid" shall have the same meaning as "Proposal" when used elsewhere in these Contract Documents."

"6. *Proposal Documents* – The Proposal Requirements, the proposed Contract Documents, and Addenda. The term "Bidding Documents" shall have the same meaning as "Proposal Documents" when used elsewhere in these Contract Documents."

"7. *Proposal Requirements* – The Request for Proposals, Instructions to Offerors, Proposal Security, Proposal Form and attachments, and required certifications and affidavits. The term "Bidding Requirements" shall have the same meaning as "Proposal Requirements" when used elsewhere in these Contract Documents."

Add the following language to the end of the definition for PROJECT (1.01.A.34):

"The project consists of construction of Water System Capital Improvement Plan – Phase 3"

"The project is located in the City of Keller, Texas."

Add the following language to the end of the definition for OWNER (1.01.A.30):

"The words "Owner" or "City" in these documents shall be understood as referring to the City of Keller, Texas. 1100 Bear Creek Parkway, P.O. Box 770, Keller, TX 76244."

Add the following language to the end of the definition for ENGINEER (1.01.A.19):

"The word "Engineer" in these specifications shall be understood as referring to Teague Nall and Perkins, Inc., 5237 N. Riverside Drive, Suite 100, Fort Worth, Texas 76137, Engineer of the Owner, or such other representative as may be authorized by said Owner to act in any particular position."

Add the following language to the end of the definition for SPECIFICATIONS (1.01.A.41):

"Except as herein amended or supplemented, Divisions 100 through 800 of the Public Works Construction Standards, North Central Texas adopted by the North Central Texas Council of Governments (NCTCOG) dated November, 2017, with all amendments shall govern and shall constitute the specifications. They are not physically bound with these contract documents but are incorporated by reference. Where these NCTCOG specifications conflict with the specifications bound in this booklet or the construction plans, the bound specifications and the construction plans will govern."

Add the following language to the end of the definition for SUPPLEMENTARY CONDITIONS (1.01.A.44):

"Where in the Bonds and elsewhere in the contract, the terms "Special Provisions," and "Special Conditions" appear, they shall be read to mean "Supplementary Conditions""

Add the following paragraph to the end of section "1.01 Defined Terms":

"51. No Separate Pay Items—These items will be accomplished by the CONTRACTOR without the CONTRACTOR having a specific pay item for this work. The CONTRACTOR will have to include any costs for these work items in with the cost for pay items listed in Proposal Form Exhibit A."

SC-2.02 COPIES OF DOCUMENTS:

Delete the first sentence of paragraph 2.02 of the General Conditions and replace with the following sentence:

"OWNER shall furnish to CONTRACTOR up to five copies of the Contract Documents as are reasonably necessary for the execution of the Work."

SC-2.03 NOTICE TO PROCEED:

Delete paragraph 2.03 of the General Conditions in its entirety and replace with the following paragraph:

"The Contract Time will commence to run on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement."

SC-2.04 STARTING THE PROJECT:

Delete paragraph 2.04 of the General Conditions in its entirety and replace with the following paragraph:

"CONTRACTOR shall start to perform the Work within ten (10) calendar days of the date when the Contract Time commences to run, but no work shall be done at the site prior to the Effective Date of the Agreement."

SC-2.05.B SCHEDULES:

Amend the first sentence of paragraph 2.05.B of the General Conditions to read as follows:

"Within five (5) days after the Effective Date of the Agreement, CONTRACTOR shall submit to ENGINEER for review."

SC-3.01.A CONTRACT DRAWINGS AND SPECIFICATIONS:

Add to paragraph 3.01.A of the General Conditions the following:

"Should a discrepancy arise in the contract documents, the drawings shall take precedence over the specifications."

SC-4.02 SUBSURFACE AND PHYSICAL CONDITIONS:

Add to paragraph 4.02 of the General Conditions the following paragraph:

"Subsurface explorations or tests, to ascertain the nature of the subsurface conditions or physical conditions at, or contiguous to, the project site, including the amount of rock, if any, are to be the sole responsibility of the CONTRACTOR."

Whether prospective offerors perform this subsurface exploration jointly or independently shall be left to the discretion of such prospective offerors. Subsurface explorations and tests shall not be attempted without the approval of the OWNER."

The results of a geotechnical investigation performed by CMJ Engineering, Inc. (Report No. 131-22-193) are available for the offeror's information only in preparing a proposal for the project."

SC-4.03 DIFFERING SUBSURFACE OR PHYSICAL CONDITIONS:

Delete 4.03 in its entirety.

SC-4.05 REFERENCE POINTS:

Remove the first sentence of paragraph 4.05.A of the General Conditions and replace it with the following two sentences:

"The OWNER shall provide vertical and horizontal surveying control/reference points for construction which in the ENGINEER'S judgment are necessary to enable the CONTRACTOR to set his own specific line and grade construction stakes, but in no case closer than 400 linear feet apart. Construction staking by the CONTRACTOR is a no separate pay item."

SC-5.01 PERFORMANCE, PAYMENT, AND OTHER BONDS:

Remove the third sentence of paragraph 5.01.A of the General Conditions and replace it with the following two sentences:

" Contractor shall also furnish a Maintenance Bond in the amount at least equal to the Contract Price as security that the Contractor will maintain and keep in good repair the work covered by the Contract Documents. The Maintenance Bond shall remain in force for a period of two (2) years after the date of final acceptance of the work by the Owner."

Add the following paragraph 5.01.D:

"D. Insurance Requirements - CONTRACTOR and Subcontractors of any tier will be required, at their own expense, to maintain in affect at all times during the performance of the work, insurance coverage with limits not less than those set forth below, with insurers and under forms of policies satisfactory to the OWNER. It shall be the responsibility of the CONTRACTOR and Subcontractors to maintain adequate insurance coverage and to assure that all Subcontractors are adequately insured at all times. Failure of the CONTRACTOR and his Subcontractors to maintain adequate coverage shall not relieve CONTRACTOR of any contractual responsibility or obligation. Deductibles, of any type, are the responsibility of the CONTRACTOR."

SC-5.02 LICENSED SURETIES AND INSURERS:

Add the following language to the middle of the first sentence of paragraph 5.02.A of the General Conditions:

...duly licensed "*by the State of Texas to Provide surety bonds*" or authorized...

SC-5.03 CERTIFICATES OF INSURANCE

Add the following paragraph 5.03.B:

"B. Certificates of Insurance and Insurance Endorsements - At the time of the execution of this Contract and each Subcontract, the CONTRCATOR and his Subcontractors shall furnish Certificates of Insurance and Insurance Endorsements as evidence that the policies providing the required coverage and limits of insurance are in full force and effect. The Certificates of Insurance and Insurance Endorsements shall state the City, and the Engineer as Additional Insured where applicable. The Certificates of Insurance shall provide that any company issuing an insurance policy for the work under this Contract shall provide not less than 30 days advance notice in writing of cancellation, non-renewable, or material change in the policy of insurance. In addition, the contractor shall provide written notice to OWNER upon receipt of notice of cancellation of any insurance policy. All Certificates of Insurance and Insurance Endorsements shall clearly state that all applicable requirements have been satisfied including certification that the policies are of the "occurrence" type. Certificates of Insurance and Insurance Endorsements for CONTRACTOR and his Subcontractors, terminations, or alterations of such policies shall be mailed to Purchasing Technician, Finance Department, P.O. Box 770, Keller, TX 76244.

SC-5.04 CONTRACTOR'S LIABILITY INSURANCE:

The limits of liability for the insurance required by paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations: 5.04.A.1 and 5.04.A.2. Workers' Compensation, etc. under paragraphs 5.04.A.1 and 5.04.A.2 of the General Conditions:

(1)	State:	Statutory
(2)	Applicable Federal (e.g. Longshoreman's):	Statutory
(3)	Employer's Liability:	\$1,000,000

5.04.A.3, 5.04.A.4, 5.04.A.5, and 5.04.A.6. Comprehensive General Liability (under paragraphs 5.04.A.3 through 5.04.A.6 of the General Conditions):

This insurance shall be an occurrence type policy written in comprehensive form and shall protect the CONTRACTOR and his Subcontractors and the Additional Insured against all claims arising from bodily injury, sickness, disease, or death of any person other than the CONTRACTOR's employees or damage to property of the City of Keller and the Engineer arising out of the act or omission of the CONTRACTOR or his Subcontractors or their agents, employees, or Subcontractors. This policy shall also include protection against claims insured by usual personal injury liability coverage, a (protective liability) endorsed to insure the contractual liability assumed by the CONTRACTOR and his Subcontractors under the article entitle indemnification and completed operations, products liability, contractual liability, broad form property coverage, premises/operations, and independent contractors.

(1)	\$2,000,000	Each Occurrence
	\$4,000,000	General Aggregate
	\$4,000,000	Umbrella/Excess Liability
(2)	Property Damage liability insurance will provide Explosion, Collapse and Under-ground coverage where applicable.	

5.04.B.1. Comprehensive Automobile Liability:

This insurance shall be written in the comprehensive form and shall protect the CONTRACTOR and his Subcontractors and the Additional Insured against all claims for injuries to members of the public and damage to property of others arising from the use of motor vehicles, and shall cover operation on and off the site of all motor vehicles licensed for highway use, whether they were owned, non-owned, or hired, the liability shall not be less than:

\$1,000,000	Per Occurrence
\$2,000,000	Aggregate, or
\$2,000,000	Combined Single Limits

SC-5.04.B.4 CONTRACTUAL LIABILITY INSURANCE:

The Contractual Liability required by paragraph 5.04.B.4 of the General Conditions shall provide coverage for not less than the following amounts:

\$2,000,000	Each Occurrence
\$4,000,000	General Aggregate
\$4,000,000	Umbrella/Excess Liability

SC-5.04.B.8 WORKERS' COMPENSATION INSURANCE COVERAGE:

Add the following paragraphs to Article 5 of the General Conditions:

"5.04.B.8 Workers' Compensation Insurance Coverage.

In addition to other insurance requirements stipulated herein, the CONTRACTOR shall comply with all requirements of 28 TAC 110.110 and other requirements outlined in this section. Definitions contained in this section are for this section only.

5.04.B.8.1 Definitions:

Certificate of coverage ("certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or OWNER's employees providing services on a project, for the duration of the project.

Duration of the project - includes the time from the beginning of the work on the project until the CONTRACTOR's/person's work on the project has been completed and accepted by the OWNER.

Persons providing services on the project ("subcontractor") - includes all persons or entities performing all or part of the services the CONTRACTOR has undertaken to perform on the project regardless of whether that person contracted directly with the CONTRACTOR and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. Services include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

5.04.B.8.2 The CONTRACTOR shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the CONTRACTOR providing services on the project, for the duration of the project.

5.04.B.8.3 The CONTRACTOR must provide a certificate of coverage to the OWNER prior to being awarded the contract.

5.04.B.8.4 If the coverage period shown on the CONTRACTOR's current certificate of coverage ends during the duration of the project, the CONTRACTOR must, prior to the end of the coverage period, file a new certificate of coverage with the OWNER showing that coverage has been extended."

"5.04.B.8.5 The CONTRACTOR shall obtain from each person providing services on a project, and provide to the OWNER:

- (1) a certificate of coverage, prior to that person beginning work on the project, so the OWNER will have on file certificates of coverage showing coverage for all persons providing services on the project; and*
- (2) no later than seven days after receipt by the CONTRACTOR, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.*

5.04.B.8.6 The CONTRACTOR shall retain all required certificates of coverage for the duration of the project and for one year thereafter.

5.04.B.8.7 The CONTRACTOR shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the CONTRACTOR knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

5.04.B.8.8 The CONTRACTOR shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

5.04.B.8.9 The CONTRACTOR shall contractually require each person with whom it contracts to provide services on a project, to:

- (1) provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the project, for the duration of the project;*
- (2) provide to the CONTRACTOR, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project;*
- (3) provide the CONTRACTOR, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;*

- (4) obtain from each other person with whom it contracts, and provide to the CONTRACTOR:
 - (a) a certificate of coverage, prior to the other person beginning work on the project; and
 - (b) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;
- (5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;
- (6) notify the OWNER in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and
- (7) contractually require each person with whom it contracts, to perform as required by paragraphs (1) - (7), with the certificates of coverage to be provided to the person for whom they are providing services.

5.04.B.8.10 By signing this contract or providing or causing to be provided a certificate of coverage, the CONTRACTOR is representing to the OWNER that all employees of the CONTRACTOR who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the CONTRACTOR to administrative penalties, criminal penalties, civil penalties, or other civil actions."

5.04.B.8.11 The CONTRACTOR's failure to comply with any of these provisions is a breach of contract by the CONTRACTOR which entitles the OWNER to declare the contract void if the CONTRACTOR does not remedy the breach within ten days after receipt of the notice of breach from the OWNER.

5.04.B.8.12 The text for the notice prescribed in 5.04.B.8.8 shall read as follows:

REQUIRED WORKERS' COMPENSATION COVERAGE

The law requires that each person working on this site or providing services related to this construction project must be covered by workers' compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee."

Call the Texas Workers' Compensation Commission at 512-440-3789 to receive information on the legal requirement for coverage, to verify whether

your employer has provided the required coverage, or to report an employer's failure to provide coverage."

SC-5.05 OWNER'S LIABILITY INSURANCE:

Delete Paragraph 5.05 of the General Conditions in its entirety and replace with the following:

"The Contractor shall file with Owner a Certificate of Insurance naming the Owner as an additional insured with regard to the contract project and evidencing insurance coverage of limits not less than the limits indicated in SC-5.04 and SC-5.04.B.4."

SC-5.06 PROPERTY INSURANCE:

Delete Paragraph 5.06.A of the General Conditions in its entirety and insert the following in its place:

"5.06.A. CONTRACTOR shall purchase and maintain until final payment property insurance upon the Work at the site to the full insurable value of 100% of construction total (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER and Engineer's consultants in the Work (all of whom shall be listed as insured or additional insured parties), shall insure against the perils of fire and extended coverage, shall include "all-risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in these Supplementary Conditions, and shall include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals). If not covered under the "all-risk" insurance or otherwise provided in these Supplementary Conditions, CONTRACTOR shall purchase and maintain similar property insurance on portions of the Work stored on and off the site or in transit when such portions of the Work are to be included in an Application for Payment. The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with this paragraph 5.06.A shall comply with the requirements of GC-5.06.C."

SC-5.06.B PROPERTY INSURANCE:

Delete Paragraph 5.06.B of the General Conditions in its entirety.

SC-6.06.A SUBCONTRACTS:

Add the following sentence to paragraph 6.06.A of the General Conditions:

"CONTRACTOR shall not award Work under the Contract to a Subcontractor(s) that is (are) in excess of 50% of the total contract price without written approval of the OWNER."

SC-6.08.A STORMWATER DISCHARGE PERMIT:

Add the following paragraph to GC 6.08.A.

"State law prohibits discharges of pollutants into storm water from construction activities without a Texas Pollutant Discharge Elimination System Permit (TPDES). Operator(s) of construction sites where 1 or more acres are disturbed, smaller sites that are part of a larger common plan of development or sale where there is a cumulative disturbance of at least 1 acre, or any site designated by the Director, must submit an NOI to obtain coverage under an TPDES Storm Water Construction General Permit.

For the purpose of this project the contractor shall be the "OPERATOR". If required to submit a Notice of Intent (NOI) for storm water discharges associated with construction activities under the TPDES General Permit with the TCEQ, the contractor shall submit the NOI to the City and the TCEQ (if required) at least two (2) days prior to the preconstruction conference. In addition to submitting the NOI, the Contractor shall prepare, submit to the City, and retain on-site a Storm Water Pollution Prevention Plan in accordance with the TCEQ General Permit No. 150000 requirements."

SC-6.10.A TAXES:

Add the following paragraphs to paragraph 6.10.A of the General Conditions:

"The Contractor's attention is directed to Amendment No. 7 in Section 6a, Article 20.01, Chapter 20, Title 122A, Taxation-General of the Revised Civil Statutes of Texas and the recent amendments contained in H.B. 11 as passed by the Legislature of the State of Texas and enacted August 13, 1991.

These statutes provide that all items used by a Contractor, and incorporated into the project, can be purchased free of State and City sales tax when the project is being performed by an exempt agency. Excluded are equipment rentals and other items which are consumed by the Contractor but are not incorporated into the project.

This contract is issued by an organization which qualifies for exemption pursuant to the provisions of Article 20.04 (F) of the Texas Limited Sales, Excise and Use Tax Act.

The Contractor performing this contract may purchase all materials, supplies, equipment used in the performance of this contract by issuing to his supplier an exemption or resale certificate.

It shall be the sole responsibility of the Contractor under the terms of this agreement to determine the applicability of the revisions to the tax code and pay all applicable taxes associated with this project without additional or separate pay for the same from the Owner."

SC-6.12 RECORD DOCUMENTS:

Add the following sentence to paragraph 6.12.A. of the General Conditions:

"Drawings submitted upon completion of the project will be submitted by the CONTRACTOR on full size set of construction plans."

SC-6.13 SAFETY AND PROTECTION:

Revise paragraph 6.13.A.3 of the General Conditions to include lawn irrigation systems and read as follows:

...other property at the site or adjacent thereto, including trees, shrubs, lawns, "lawn irrigation systems." walks, pavements...

Add the following paragraphs to Article 6.13.B of the General Conditions:

"The Contractor shall comply with the provisions of the Occupational Safety and Health Act of 1970, and the standards and regulations issued thereunder and warrant that all work, materials, and products furnished under this contract will conform to and comply with said standards and regulations which are in existence on the date of this contract. The Contractor further agrees to indemnify and hold harmless the Owner and the Engineer for all damages suffered by the Owner and the Engineer as a result of the Contractor's failure to comply with the Act and the Standards issued thereunder and for the failure of any material and/or equipment furnished under this contract to so comply.

The Contractor shall also comply with all pertinent provisions of the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc., if not in conflict with those of the Occupational Safety and Health Act of 1970 and shall maintain an accurate record of all cases of death, occupational disease, and injury requiring medical attention or causing loss of time from work, arising out of and in the course of employment or work under the contract.

The Contractor alone shall be responsible for the safety, efficiency, and adequacy of his equipment and employees, and for any damage which may result from their failure or their improper construction, maintenance or operation.

Per Texas House Bill 1569 effective as of September 1, 1989, it shall be the responsibility of the contractor to provide and maintain a viable trench safety system at all times during construction activities. The contractor is directed to become knowledgeable and familiar with the standards as set forth by the Occupational Safety and Health Administration (OSHA) for trench safety that will be in effect during the period of construction of the project and the contract is responsible for conforming to such regulations as prescribed by OSHA standards. A bid item for trench excavation safety protection and shoring is included in Proposal Form Exhibit A."

SC-6.17 SHOP DRAWINGS AND SAMPLES:

Amend the first sentence of paragraph 6.17.A of the General Conditions to read as follows:

"After checking and verifying all field measurements and after complying with applicable procedures specified herein, CONTRACTOR shall submit to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawing Submissions, or for other appropriate action, if so indicated in the Supplementary Conditions, a number of copies such that the ENGINEER can retain five copies of all Shop Drawings, which will bear a stamp that CONTRACTOR has satisfied CONTRACTOR'S responsibility under the Contract Documents with respect to the review of the submission."

SC-12.03.A CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES:

Add to Paragraph 12.03.A. the following:

"Extensions of time due to weather delays shall be determined in accordance with the following formula:

$$E = R - P \text{ where } R > P \text{ and}$$

E = extra precipitation

P = average precipitation days

R = total precipitation days

Average Precipitation Days (P) are defined as those days of rain, sleet, hail, snow, or any combination thereof, and shall be based upon the average precipitation for each month of the year as defined in the Local Climatological Data Summaries issued by the National Climatic Center in Asheville, North Carolina, and for this contract shall be as follows:

AVERAGE PRECIPITATION

Month	J	F	M	A	M	J	J	A	S	O	N	D
No. of Days	7	7	7	8	9	6	5	5	7	6	6	6

Partial months shall be prorated uniformly for the entire month and the sum of all the months used will be rounded to the nearest whole number. This number shall be "P".

Total Precipitation Days (R) are defined as those days of rain, sleet, hail, snow, or any combination thereof, if determined by the Owner's Project Representative / City Inspector that the Contractor's construction can not progress substantially due to precipitation and thus be put in the Daily Inspection Log Book as a precipitation day. The sum of all the precipitation days shall be "R".

The total number of extra precipitation days (E) shall be granted to the Contractor as extension of time due to weather delays, and no additional time due to drying time for saturated soil will be allowed."

SC-13.03 TESTS AND INSPECTIONS:

Delete the paragraph 13.03.B of the General Conditions and replace with the following:

"13.03.B. CONTRACTOR shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests or approvals required by the Contract Documents."

SC-13.07 TWO YEAR CORRECTION PERIOD:

Revise the title of paragraph 13.07 of the General Conditions to read *"TWO YEAR CORRECTION PERIOD"* and revise the content of paragraphs 13.07, 13.07.A, 13.07.B, 13.07.C and 13.07.D to reflect *"two (2) years"* where one (1) year is indicated.

SC-14.01 SCHEDULE OF VALUES:

Delete paragraph 14.01 of the General Conditions in its entirety and replace with the following paragraph:

"The schedule of values submitted as provided in paragraph 2.05.B.3 will serve as the basis for progress payments, subject to acceptance by the ENGINEER, and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed."

SC-14.02.A.1 APPLICATIONS FOR PAYMENTS:

Add a new sentence to the end of paragraph 14.02.A.1 of the General Conditions to read as follows:

"Prior to submitting Application for Payment to Engineer for review, the Contractor shall obtain the Project Inspector's signature verifying that record documents have been updated to reflect variations from the "As Bid" drawings up to the date for which the Contractor seeks payment."

SC-14.02.C REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT:

Revise the last sentence of paragraph 14.02.C.1 of the General Conditions to read as follows:

"Thirty (30) days after presentation of the Application for Payment with Engineer's recommendation, the amount recommended will (subject to the provisions of paragraph 14.02.D) become due and when due will be paid by Owner to Contractor."

SC-17 MISCELLANEOUS:

Add the following paragraphs to Article 17 of the General Conditions:

"17.06 The use of explosives will not be allowed under this contract for the construction of the proposed facilities without approval of the ENGINEER and OWNER."

17.07 The Contractor is encouraged to abide by the Buy American Provision of Public Law 95-217 (Section 215) of Public Law 92-500 as amended) generally requiring

that preference be given to the use of domestic construction materials in the performance of this contract."

"17.08 The Contractor will not be required to furnish a field office on this contract."

SC-18 WAGE RATES:

Add a new Article entitled ARTICLE 18 - WAGE RATES to include the following:

"18.01 All offerors will be required to comply with Chapter 2258, Prevailing Wage Rates of Vernon's Texas Codes Annotated with respect to the payment of prevailing wage rates. This applies to the construction of a public work, including a building, highway, road, excavation, and repair work or other project development or improvement, paid for in whole or in part from public funds, without regard to whether the work is done under the public supervision or direction. A worker is employed on a public work if the worker is employed by the contractor or any subcontractor in the execution of the contract for the project.

A worker employed on a public work by or on behalf of the City shall be paid not less than the general prevailing rate of per diem wages for the work of a similar character in the locality in which the work is performed, and not less than the general prevailing rate of per diem wages for legal holiday and overtime work.

The State of Texas has adopted the Federal Davis-Bacon wage rates for the use in Texas and the City pursuant to and in accordance with the Texas Government Code, Section 2258.022. You may access the U. S. Department of Labor web site at the following web address to obtain these rates to be used in Tarrant County:

<http://www.gpo.gov/davisbacon/allstates.html>

It shall be the responsibility of the successful offeror to obtain the proper wage rates from this site for Tarrant County for the type of work defined in these bid specifications."

SC-19 ADDITIONAL CONTRACTOR'S RESPONSIBILITIES:

Add a new ARTICLE 19 – ADDITIONAL CONTRACTOR'S RESPONSIBILITIES to the General Conditions as follows:

"19.01 Revegetation of Unpaved Areas

The Contractor shall revegetate unpaved areas disturbed by construction prior to acceptance of the project. Revegetation shall consist of seed sowing, straw mulching, fertilizing and watering. Revegetation shall be acceptable when vegetation growth achieves one (1) inch in height, with 85% coverage, and no greater than 10 square feet bare. The cost for revegetation of unpaved areas shall be subsidiary to the various items bid in Proposal Form Exhibit A unless otherwise provided as a separate pay item.

19.02 Protection of Livestock

The Contractor is responsible for the protection of all livestock at the project site from harm or injury resulting directly or indirectly from the Contractor's operations. Temporary fencing shall be erected in place of the fencing removed whenever the work is not in progress and when the site is vacated overnight, and/or at all times to prevent livestock from entering the construction area. The cost for livestock protection shall be subsidiary to the various items bid in Proposal Form Exhibit A. Therefore, no separate payment shall be allowed for any service associated with this work.

19.03 Replacement of Fences

All fences encountered and removed during construction of this project shall be restored to the original or a better than original condition upon completion of this project. Where wire fencing, either wire mesh or barbed wire is to be crossed, the Contractor shall set cross-braced posts on each side of the permanent easement before the fence is cut. Should additional fence cuts be necessary, the Contractor shall provide cross-braced posts at each point of the proposed cuts in addition to the cross-braced posts provided at the permanent easement limits, before the fence is cut. The cost for fence removal, temporary closures and replacement shall be subsidiary to the various items bid in Proposal Form Exhibit A. Therefore, no separate payment shall be allowed for any service associated with this work.

19.04 Protection of Trees, Plants, and Soil

All property along and adjacent to the Contractor's operations, including lawns, yards, shrubs, trees, etc., shall be preserved or restored after completion of the work, to a condition equal to or better than existed prior to start of the work. Trees which are to remain are identified on the plans and boring may be required to preserve the designated trees.

Any trees or other landscaped features scarred or damaged by the Contractor's operations shall be restored or replaced at the Contractor's expense. Trimming or pruning to facilitate the work will be permitted only by experienced workmen in an approved manner and only with the property owner's permission. Pruned limbs of 1" (one) diameter or larger, shall be thoroughly treated as soon as possible with a tree wound dressing.

The Contractor shall take all precautions required to prevent soil erosion during construction. If excessive erosion occurs, the Contractor shall take immediate measures to prevent further erosion and restore the disturbed surface with topsoil at completion of the work. No separate payment will be made for this work.

19.05 Underground Facilities

All underground facilities along and adjacent to the Contractor's operations including septic tanks, drain fields, sprinkler systems, butane tanks, etc., shall be preserved or restored after completion of the work, to a condition equal to or better than existed prior to start of the work. No separate payment will be made for this work.

19.06 Confinement of Work

The Contractor shall confine his construction activity and storage of material and equipment to the limits of the City of Keller's public right-of-way, and permanent and temporary construction easements.

19.07 Impairment of Access

Contractor shall make every reasonable effort to assure that adequate access is maintained to adjacent properties during the project. If conditions exist, occur or are encountered by the Contractor that will result in or cause any delay in the Contractor's performance of any part of the work beyond the time specified in the Agreement, Contractor shall take all reasonable steps necessary to assure that such prolonged performance does not materially or substantially impair access to adjoining businesses and properties, whether such impairment is inherently caused by the nature of the work, by the placement of temporary barriers by the Contractor or by any other cause. Contractor covenants and agrees to indemnify, hold harmless and defend Owner, its officers, agents, servants and employees from and against any and all claims, damages, losses and expenses, including but not limited to attorney's fees and court costs and other incidental litigation expenses, occasioned by or arising out of any claim or lawsuit, whether real or asserted, relating to such unnecessary or unreasonable impairment of access, whether based upon inverse condemnation, unnecessary or illegal taking of property or any other cause of action.

19.08 Limit on Construction Activities

Contractor shall limit construction activities to a maximum of one single water line at any given time. Once work has begun at a site, it shall continue until the work is complete at that site. The Contractor shall not begin work at another site until work at the current site is complete. In order to be considered complete, the water line shall be installed, fully tested, and operational. All associated parkway restoration and pavement repair shall also be complete. The owner will reserve the right to allow the Contractor to proceed to a location at its direction, after progress and construction is assessed.

19.09 Working Days

Contractor shall limit construction activities to standard weekdays, from 7am to 4pm. Construction work will not be allowed off-hours, weekends, or holidays without City approval. City approval should be requested no later than the Wednesday before. The City reserves the right to allow off-hour, weekend, and holiday work at its discretion. An inspector will be required to be onsite for any work occurring outside of standard hours, on weekends, or on holidays. The Contractor will be responsible for all overtime wages of Inspectors for all work occurring outside of standard hours, on weekends, or on holidays, except for work directed by the City.

19.10 Pay Applications

Contractor shall submit monthly pay applications to the City for review. The Contractor shall provide an updated construction progress schedule with each monthly pay application. If a schedule is not provided or if multiple months pass between submission of pay applications, the City reserves the right to temporarily suspend construction activities. Additional working days will not be added to the contract time for suspension of work related to pay applications.

SC-20 REMOVAL AND DISPOSAL OF ASBESTOS CEMENT PIPE:

Add a new ARTICLE 20 – REMOVAL AND DISPOSAL OF ASBESTOS CEMENT PIPE to the General Conditions as follows:

- "20.01 It is the intent of the City of Keller to comply with the requirements of the Asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP) found at 40 CFR Part 61, Subpart M. This specification will establish procedures to be used by all Excavators in the removal and disposal of ACP in compliance with NESHAP. Nothing in this specification shall be construed to void any provision of a contract or other law, ordinance, regulation or policy whose requirements are more stringent.*
- 20.02 ACP is defined under NESHAP as a Category II, non-friable material in its intact state but which may become friable upon removal, demolition and/or disposal. Consequently, if the removal/ disposal process renders the ACP friable, it is regulated under the disposal requirements of 40 CFR 61.150. A NESHAP notification must be filed with the Texas Department of Health. The notification must be filed at least ten days prior to removal of the material. If it remains in its non - friable state, as defined by the NESHAP, it can be disposed as a conventional construction waste. EPA defines friable as material, when dry, which may be crumbled, pulverized or reduced to powder by hand pressures.*
- 20.03 The Generator of the hazardous material is responsible for the identification and proper handling, transportation, and disposal of the material. Therefore, it is the policy of the City of Keller that the Excavator is the Generator regardless of whether the pipe is friable or not.*
- 20.04 It is the intent of the City of Keller that all ACP shall be removed in such careful and prudent manner that it remains intact and does not become friable. The Excavator is responsible to employ those means, methods, techniques and sequences to ensure this result.*
- 20.05 Compliance with all aspects of worker safety and health regulations including but not limited to the OSHA Asbestos Standard is the responsibility of the Excavator. The City of Keller assumes no responsibility for compliance programs, which are the responsibility of the Excavator.*
- 20.06 The cost for removal and disposal of ACP shall be paid per the linear foot at the unit price bid in Proposal Form Exhibit A."*

20.07 *The Generator of the hazardous material must provide the City of Keller receipts documenting proper disposal activity and disposal location.*

SC-21 ENVIRONMENTAL ISSUES:

Add a new ARTICLE 21 – ENVIRONMENTAL ISSUES to the General Conditions as follows:

"21.01 If any line work occurs within areas that potentially qualify as waters of the U.S., the method of crossing will be selected to avoid activities under the jurisdiction of the U.S. Army Corps of Engineers or will be performed in compliance with the Nationwide Permit 58 for utility line activities.

21.02 Prior to construction activities within a 100-year floodplain, a floodplain permit from the local floodplain administrator (National Flood Insurance Program) must be obtained.

21.03 The replacement pipeline, located near Mount Gilead Cemetery, will be placed under road pavement or on the opposite side of the road from the cemetery. If the City decides that it is necessary to replace the pipeline on the same side of the road as the cemetery, then review and approval by the Texas Historical Commission will be required prior to construction."

SC-22 PAY ITEMS:

Add a new Article to the General Conditions entitled ARTICLE 22 - PAY ITEMS with the following paragraphs to be included:

Any and all Work specifically called for in the Contract Documents or which is required for the proper construction of items called for in the Contract Documents is to be performed by CONTRACTOR unless specifically indicated otherwise. The cost of all work for which there is no separate pay item in Proposal Form Exhibit A shall be included in the price for a related pay item such that work called for or required by the Contract Documents will be constructed for the Contract Price.

The following descriptions are intended to clarify the nature of the work required for this project, the provisions of the standard technical specifications shall apply, except as otherwise noted herein:

"Each pay item includes all labor, materials, equipment and incidentals necessary to construct that item. The contract shall be awarded based on the "TOTAL BID" or the "TOTAL BASE BID" and "TOTAL ALTERNATE BID" depending on whether the project can be constructed with the alternate bid items included, for the funding that the Owner has budgeted."

CONSTRUCTION NON-PAY ITEMS:

No direct payment will be made for the following non-pay items or any other item of work required for the completion of this project which is not specifically itemized in Proposal Form Exhibit A. These items will be considered subsidiary to the Contract

and the price of it shall be included in the prices for the various construction pay items in the proposal.

NON-PAY ITEM - **SPRINKLING FOR DUST CONTROL**: The Contractor shall sprinkle, as necessary, for dust control. However, no direct payment will be made for this item and it shall be considered incidental to this contract.

NON-PAY ITEM - **SAWCUTS**: All saw cutting required for the construction and/or removal of asphalt pavement, concrete pavement, sidewalks, driveways, curbs, curb & gutter, etc. shall be included in the price bid for the respective pay item.

NON-PAY ITEM – **CONSTRUCTION MATERIALS TESTING**: Contractor will be responsible for hiring an approved testing lab to perform all construction materials testing for the project, including trench/subgrade density tests, concrete compressions tests, concrete slump and mix design, and all other testing required by the City or the Technical Specifications. Construction materials testing shall be included in the price bid for the respective pay items.

CONSTRUCTION PAY ITEMS:

These items correspond to the items shown in Proposal Form Exhibit A. All construction and material pay items related to water, sanitary sewer, storm drainage and/or paving improvements shall be governed by the latest edition (Fifth Edition, 2017) of the Public Works Construction Standards as published by the North Central Texas Council of Governments, unless otherwise noted. The primary NCTCOG specification items have been referenced for certain bid items, as a matter of convenience. Such designation is not exclusive of other NCTCOG specifications which may be applicable to the pay item or which may be referenced from within the indicated specification.

These specifications are hereby included by reference and shall be treated as if they were bound to this contract. The Contractor shall be required to possess a copy of such specifications with the contract document.

Regardless of any stipulation for pay units in any referenced specifications, all pay items shall be measured and paid in the units shown on Proposal Form Exhibit A.

BASE BID ITEMS:

BID ITEM: Site Preparation/Mobilization

This item consists of furnishing all labor and materials necessary for the preparation of the site and those areas adjacent to or offsite as may be designated on the plans for construction operations. All work shall be performed per NCTCOG Item 203, Site Preparation. This work shall include the clearing and grubbing and the removal of all obstructions not designated on the plans to remain in place. Such items include, but are not limited to the following: tree removal, removing existing bushes, shrubs and vegetation, removing existing water meters and boxes identified in the plans, clearing of underbrush, stump removal, removal of topsoil, rock removal, miscellaneous debris removal, retaining wall removal, and removal of above ground and below ground utilities and structures, septic system and/or irrigation appurtenances, etc., including the relocation of any existing buildings or structures within the project limits not designated by a separate pay item. Any temporary fencing necessary for security or animal containment during construction shall be part of this pay item.

This item also includes all Contractor insurance, bonds and permits.

It is the Contractor's responsibility to verify all existing structures necessary to be relocated or removed that will conflict with construction and include the materials and labor necessary for this relocation and/or removal within this bid item. Unless otherwise noted, no separate payment will be made for the removal or relocation of existing structures within the limits of construction.

Prior to mobilization, Contractor shall schedule and attend a preconstruction meeting with the City Representative and Inspector for each of the water line project sites. The Contractor shall be prepared to present and discuss the traffic control plan, temporary water service plan, and related project elements before being given authorization to begin construction activities. The contractor will not be allowed to invoice for a percentage of this bid item until the preconstruction meeting has occurred.

Measurement and payment shall be made on the basis of the lump sum price bid for site preparation as shown in the construction plans and shall be full compensation for all labor, materials, equipment, and incidentals necessary to complete the work, including hauling and disposal of unwanted material. The lump sum price bid shall also include all Contractor insurance, bonds and permitting costs. Any damage to existing structures shall be repaired and/or replaced at or above original condition as directed by the City and shall be considered subsidiary to this pay item.

BID ITEM: Pre-Construction Video

The Contractor shall prepare a video of existing conditions to verify the condition and location of all existing structures prior to construction. A copy of this video shall be submitted to and approved by the City Representative prior to beginning construction. The contractor will not be permitted to begin construction activities until the preconstruction meeting and video are complete for each project site.

Measurement and payment shall be made on the basis of the lump sum price bid for pre-construction video. Payment shall be full compensation for all labor, materials, equipment, and incidentals necessary to complete the work.

BID ITEM: Electronic Message Board Signs

This item consists of furnishing all labor and materials necessary to maintain two electronic message board signs per project location (one at each end of the project corridor) beginning two weeks prior to construction activity. All work shall be performed per NCTCOG Item 801 "Barriers, Warnings and Detour Signs, and Fences". This work shall include installation, management of message, corrective action when notified, and removal.

Message boards shall be used to warn traveling public of potential construction impacts. Displayed message and location shall be approved by the City.

Measurement and payment shall be made on the basis of the unit price bid per day per sign and shall be total compensation for furnishing all labor, materials, equipment, and incidentals necessary to complete the work.

BID ITEM: 6" & 8" & 12" PVC Water Pipe by Open Cut

Water pipe shall be installed at the locations shown on the plans, in accordance with the plan details and the Technical Specifications. 6", 8", and 12" pipe shall conform to AWWA C900 DR-18. Pipe shall meet the requirements of NCTCOG Item 501.14 "Polyvinyl Chloride (PVC) Water Pipe". Open cut pipe shall be installed in accordance with NCTCOG Item 506 and the details in the construction plans.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of the linear foot unit price bid for each size of PVC Water Pipe installed via open cut and shall be total compensation for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work, and shall include excavation, backfill, and disposal of surplus material and backfill. **Ductile iron fittings shall be paid for under the corresponding bid item. Joint restraint shall be considered subsidiary to the bid price of ductile iron fittings.**

BID ITEM: 8" & 12" PVC Water Pipe by Cased or Uncased Bore

Water pipe shall be installed at the locations shown on the plans via boring, in accordance with the plan details and the Technical Specifications. Internally restrained

joint PVC water pipe shall be Eagle Loc 900 by JM Eagle, Certa-Lok, or approved equal. Pipe shall conform to AWWA C900 DR-18 and manufacturer's recommendations. Water pipe installed thru a casing pipe or via method other than open cut shall be installed in accordance with NCTCOG Items 503 "Trenchless Installation" and the details in the construction plans. Water pipe installed via horizontal directional boring, or pipe bursting shall be governed by the specifications for those methods, and shall be paid for under separate bid items. For cased bores, installation of steel casing pipe shall be paid for under the corresponding bid item.

Potholes associated with identifying possible conflicts between the proposed improvements and existing utilities are considered subsidiary to the various water pipe installation bid items.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of the linear foot unit price bid for each size of PVC Water Pipe installed via boring and shall be total compensation for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work. **Ductile iron fittings shall be paid for under the corresponding bid item. Joint restraint shall be considered subsidiary to the bid price.**

BID ITEM: 8" PVC Water Pipe by Pipe Bursting

PVC water pipe shall be installed via static pipe bursting at the locations shown on the plans. PVC water pipe shall conform to AWWA C900 DR-18 and details. Pipe shall be installed via static pipe bursting in accordance with Technical Specification TS-3 *Rehab of Existing Water Main by Pipe Bursting*.

Potholes associated with identifying possible conflicts between the proposed improvements and existing utilities are considered subsidiary to the various water pipe installation bid items.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of the linear foot unit price bid for each size of PVC Water Pipe installed via static pipe bursting, and shall be total compensation for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work. **Ductile iron fittings shall be paid for under the corresponding bid item. Joint restraint shall be considered subsidiary to the bid price.**

BID ITEM: 20" Steel Casing Pipe (for 8" PVC Carrier Pipe)

Steel casing pipe shall be installed at the locations shown on the plans in accordance with plan details. Casing pipe installed via open cut shall be installed in accordance with NCTCOG Items 505 "Open Cut- General Conduit Installation" and the details in the construction plans.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Minimum thickness for 20" steel casing pipe shall be 1/4".

Measurement and payment shall be made on the basis of the linear foot unit price bid for steel casing pipe and shall be the total compensation for the furnishing of all labor, material, tools, equipment, and incidentals necessary to complete the work including casing spacers for the carrier pipe. **Water line through the casing pipe shall be paid for under the appropriate water pipe bid item.**

BID ITEM: 24" Steel Casing Pipe (for 12" PVC Carrier Pipe)

Steel casing pipe shall be installed at the locations shown on the plans in accordance with plan details. Casing pipe installed via open cut shall be installed in accordance with NCTCOG Items 505 "Open Cut- General Conduit Installation" and the details in the construction plans.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Minimum thickness for 24" steel casing pipe shall be 1/4".

Measurement and payment shall be made on the basis of the linear foot unit price bid for steel casing pipe and shall be the total compensation for the furnishing of all labor, material, tools, equipment, and incidentals necessary to complete the work including casing spacers for the carrier pipe. **Water line through the casing pipe shall be paid for under the appropriate water pipe bid item.**

BID ITEM: 20" Steel Casing Pipe by Bore (for 8" PVC Carrier Pipe)

Steel casing pipe shall be installed at the locations shown on the plans. Steel casing pipe shall be installed via boring or method other than open cut, in accordance with NCTCOG Items 503 "Trenchless Installation", the details in the construction plans, and the requirements of any additional permits.

Minimum thickness for 20" steel casing pipe shall be 1/4".

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of the linear foot unit price bid for steel casing pipe for each size, and shall be the total compensation for the furnishing of all labor, material, tools, equipment, and incidentals necessary to complete the work including bore pit construction, dewatering, and casing spacers for the carrier pipe. **Water line through the casing pipe shall be paid for under the appropriate bid item.**

BID ITEM: Ductile Iron Water Fittings

Water line fittings shall be installed at the locations shown on the plans, in accordance with NCTCOG Item 501.14 "Polyvinyl Chloride (PVC) Water Pipe", Technical Specifications, and the details in the construction plans. Fittings shall include, but are not limited to, all bends, tees, crosses, plugs, reducers, and sleeves as directed in the plans.

Water line fittings shall be mechanically jointed ductile iron conforming to ANSI/AWWA, C110 or C153 (latest revision). All fittings shall have mortar lining with bituminous seal coat as specified in ANSI/AWWA C104 (latest revision), and an exterior bituminous coating in accordance with ASA A21 (outside coating).

Concrete thrust blocking shall be installed at all horizontal and vertical bends, tees, reducers and plugs per the standard details. Joint restraint shall also be provided as directed in the plans and in accordance with NCTCOG Item 502.4 "Thrust Restraint". All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of the ton unit price bid for all water line fittings installed and shall be total compensation for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work, including excavation, backfill, and disposal of surplus material and backfill. **Concrete thrust blocking shall be considered subsidiary to the bid price.**

BID ITEM: 1" Long Single Water Service (by Method Other than Open Cut) with Meter Box and Connection to Existing Meter

Long water services shall be installed on proposed water mains at the locations shown on the plans in accordance with NCTCOG Item 502.10 "Connections to Conduit for Service", and details in the construction plans. Long water services installed via method other than open cut shall be installed in accordance with NCTCOG Items 503 "Trenchless Installation". Service connections shall include tapping saddle, corporation stop, curb stop, meter box, and 1" polyethylene DR-9 service line. The existing water meter shall be reused unless otherwise specified by the City's representative. The

contractor is responsible for transferring the customer side of the service line to the new meter box location. Contractor is also responsible for adjusting meter box & meter assembly to final grade. A minimum of 24 hours advance notice shall be given when service interruption will be required. Temporary and permanent pavement repair, curb repair, and parkway restoration associated with installing services, including but not limited to repair/restoration of irrigation systems, landscaping, mailboxes, plantings, and solid block sodding of disturbed areas shall be considered subsidiary to the unit price for water service connection.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of unit price bid per each for all long water service connection furnished and installed via method other than open cut, including transfer and connection of service to new meter box, complete in place and shall include labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: 1" Short Single Water Service (by Open Cut) with Meter Box and Connection to Existing Meter

Short water services shall be installed on proposed water mains at the locations shown on the plans in accordance with NCTCOG Item 502.10 "Connections to Conduit for Service", and details in the construction plans. Service connections shall include tapping saddle, corporation stop, curb stop, meter box, and 1" polyethylene DR-9 service line. The existing water meter shall be reused unless otherwise specified by the City's representative. The contractor is responsible for transferring the customer side of the service line to the new meter box location. Contractor is also responsible for adjusting meter box & meter assembly to final grade. A minimum of 24 hours advance notice shall be given when service interruption will be required. Temporary and permanent pavement repair, curb repair, and parkway restoration associated with installing services, including but not limited to repair/restoration of irrigation systems, landscaping, mailboxes, plantings, and solid block sodding of disturbed areas, shall be considered subsidiary to the unit price for water service connection.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of unit price bid per each for short water service connection furnished and installed via open cut, including transfer and connection of service to new meter box, complete in place and shall include labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: 1" Short Single Water Service (by Open Cut) with Meter Box and Relocation of Existing Meter

Short water services shall be installed on proposed water mains at the locations shown on the plans in accordance with NCTCOG Item 502.10 "Connections to Conduit for Service", and details in the construction plans. Service connections shall include tapping saddle, corporation stop, curb stop, meter box, and 1" polyethylene DR-9 service line. The existing water meter shall be reused unless otherwise specified by the City's representative. Contractor is responsible for relocating meter box & meter assembly to location designated in the plans and for extending/transferring the customer side of the service line to the new meter box location. A minimum of 24 hours advance notice shall be given when service interruption will be required. Temporary and permanent pavement repair, curb repair, and parkway restoration associated with installing services, including but not limited to repair/restoration of irrigation systems, landscaping, mailboxes, plantings, and solid block sodding of disturbed areas, shall be considered subsidiary to the unit price for water service connection.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of each unit price bid for short water service connection furnished and installed via open cut, including transfer and connection of service to new meter box, complete in place and shall include labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: Private Water Service Reconnection

This item shall consist of the replacement and reconnection of up to five (5) linear feet of water service line on the private side of the meter, at the direction of the City. This item is intended for use when conditions are encountered outside of the scope of the standard water service line replacement. This item includes all labor, equipment, materials, and incidentals required to complete the work including replacement of water service line, and all necessary reconnections (including water service lines, meters, irrigation, and backflow devices).

Work shall be in compliance with requirements of the building and plumbing code or other applicable rules and regulations of the City. The final connection on the private side of the meter shall be completed by a Licensed Plumber.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment for this item shall be at the unit price bid for each and shall be full compensation for all material, labor, and equipment necessary for furnishing and installing water service lines (open cut), and shall include, but is not

limited to, all water service line pipe, reconnection to existing private service line and water meter, reconnection to irrigation and backflow device(s), special fittings, all necessary excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, embedment, backfill, flexible base, disposal of excess backfill and fill material (including backfill with special materials where specified), hauling and disposal of excess material, restoration, concrete pavement removal and replacement, curb and gutter removal and replacement, temporary backfill or steel plating, cleanup, restoration of any plantings, shrubs, planters, edging or any other landscaping items effected by the work, temporary/permanent relocation of mailboxes, effected by the work and all other items necessary to complete the job, whether specifically mentioned or implied. This item shall be used at the discretion of the City. This item will only pay for work performed at the direction of the City. Any work performed without the authorization of the City shall not be paid for under this bid item. The bidder shall include this amount within their bid and understand the intent is to not utilize this item. At the completion of the project, funds not utilized under this item shall be removed from the contract agreement via a construction change order.

BID ITEM: Fire Hydrant Assembly (Incl. 6" Gate Valve and Lead)

Fire hydrants shall meet the requirements of NCTCOG Item 502.3 "Fire Hydrants" and shall be installed at the locations shown on the plans in accordance with the City of Keller Standard Details and NCTCOG Item 502.3.2.

6" gate valves associated with fire hydrant assemblies are subsidiary to the cost of this item, but shall be governed by the same standards as the 8" valve and box pay item.

6" lead pipe associated with fire hydrant assemblies are subsidiary to the cost of this item, but shall be governed by the same standards as the 8" PVC water pipe pay item.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of the unit price bid per each fire hydrant, complete in place. The contract price shall be the total compensation for the furnishing of all labor, material, tools, equipment, embedment, lead pipe, gate valves, fittings and incidentals necessary to complete the work.

BID ITEM: 1" & 2" Combination Air Release Valve

Combination Air Release Valves shall conform to the AWWA Standard for Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service., ANSI/AWWA C512 (latest revision), and City of Keller standard details.

All fittings, embedment, structures, venting pipe, foundation, and appurtenances necessary to complete the work shall be considered subsidiary to the cost of the air release valve.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of the unit price bid per each for furnishing and installing the combination air release valve, complete in place. Pavement shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: 6" & 8" & 12" Gate Valve and Box

Gate valves shall conform to the AWWA Standard for "Resilient-Seated Gate Valves for Water Supply Service", ANSI/AWWA, C509 (latest revision), and City of Keller standard details. Gate valves shall be iron body, bronze mounted, wedged disc, resilient rubber seat, non-rising stem, internal wedging type 200 psi working pressure, U/L listed and FM approved. Gate valves shall be Mueller, CLOW, American Darling, M&H, or an approved equal per the City's Standard Specifications.

Unless otherwise specified, all Gate Valves shall turn counter-clockwise to open. Valves shall have wrench nuts for operation unless otherwise specified. All valves shall be for vertical installation.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of the unit price bid per each for furnishing and installing the valve, cast iron valve box, 2' square concrete pad and concrete support blocks, complete in place. **6" gate valves associated with fire hydrant assemblies are subsidiary to the cost of that item, but shall be governed by the same standards as the 8" valves.**

BID ITEM: Connect to Existing Water Line

This item consists of connecting to an existing water line at the locations shown on the plans in accordance with NCTCOG Item 506.6 "Connections to Existing Water Conduits" and the construction plans. The connection shall be made in such a manner

as to cause as little inconvenience to the public as possible. A minimum of 24 hours advance notice shall be given when service interruption will be required.

Connect to Existing Water Line locations have been identified in the construction plans. Any connections not identified separately shall be considered subsidiary to the bid item.

All potable water lines and related items shall be constructed in accordance with current AWWA standards per Texas Administrative Code 290.44. Contractor is responsible for meeting TCEQ requirements during construction, including hydrostatic testing and disinfection. All newly installed pipes and related products must conform to American National Standard Institute (ANSI)/NSF International Standard 61 and must be certified by an organization accredited by ANSI.

Measurement and payment shall be made on the basis of the unit price bid per each for connection furnished and installed, complete in place, including all blocking, fittings, bends, sleeves, materials, labor and incidentals necessary to complete the work.

BID ITEM: Cut and Plug Existing Water Line

This item consists of cutting and plugging existing water lines. For existing lines to remain active, the plug assembly shall consist of a ductile iron plug with concrete blocking. For existing lines to be abandoned, the plug assembly shall consist of a ductile iron plug only. The assembly shall be approved by the City prior to installation. The City shall approve the location of all plugs prior to placement.

Measurement and payment shall be made on the basis of the unit price bid per each plug installed. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: Abandon Existing Water Line (By Grouting)

This item consists of pressure grouting existing water pipe to be abandoned at the location(s) identified on the plans. Grout materials shall meet the requirements of NCTCOG Item 601.10.2.3 "Grouting". Cutting and plugging of abandoned sewer pipe shall be considered subsidiary to this item.

Measurement and payment shall be made on the basis of the linear foot unit price bid for abandoning existing AC pipe and shall be total compensation for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work.

BID ITEM: Remove & Dispose of Existing AC Pipe

This item consists of the proper removal and disposal of existing asbestos cement (AC) pipe. If construction activities necessitate the removal of existing AC pipe, the Contractor shall remove and dispose of the pipe in accordance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements, as described in SC-20 of these Supplemental Conditions, and NCTCOG Item 604 "Removal of Asbestos-Cement Pipe (ACP)". The Contractor shall provide the City of Keller receipts documenting proper disposal activity and disposal location. Only properly documented and adequate removal and disposal of pipe shall be considered for payment.

Measurement and payment shall be made on the basis of the linear foot unit price bid for AC pipe removed and disposed of. Payment shall be total compensation for the

furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work, including the transportation of AC pipe to an appropriate disposal location.

BID ITEM: Remove & Dispose of Existing Fire Hydrant Assembly

Existing fire hydrants denoted on the plans for removal shall be removed and transported to an appropriate location for disposal.

Measurement and payment shall be made on the basis of the unit price bid per each for fire hydrants removed. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work, including the transportation of said fire hydrants to a disposal location.

BID ITEM: Abandon/Remove Existing Gate Valve

Existing gate valves designated for abandonment shall be turned to the closed position and have the valve boxes, valve stems and covers removed. The remaining void shall be backfilled and the surface restored as shown on the City of Keller construction details for embedment and backfill of waterlines.

Existing gate valves designated for removal due to conflicts with proposed improvements shall be removed and transported to an appropriate location for disposal.

Measurement and payment shall be made on the basis of the unit price bid per each gate valve abandoned. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work including backfill and the proper disposal of the materials removed.

BID ITEM: Remove and Replace 4" Sanitary Sewer Service

Existing sanitary sewer service shall be removed and replaced to resolve conflicts with proposed improvements, at the locations shown on the plans and in accordance with the plan details and City of Keller standards. NCTCOG Item 502.10.4.1 "Connections to Conduit for Service", and details in the construction plans. Long water services installed via method other than open cut shall be installed in accordance with NCTCOG Items 503 "Trenchless Installation". Service connections shall include tapping saddle, corporation stop, curb stop, meter box, and 4" PVC service line. The existing cleanout shall be reused unless otherwise specified by the City's representative. The contractor is responsible for transferring the customer side of the service line to the new meter box location. Contractor is also responsible for adjusting meter box & meter assembly to final grade. A minimum of 24 hours advance notice shall be given when service interruption will be required. Temporary and permanent pavement repair, curb repair, and parkway restoration associated with installing services, including but not limited to repair/restoration of irrigation systems, landscaping, mailboxes, plantings, and solid block sodding of disturbed areas shall be considered subsidiary to the unit price bid for sanitary sewer service connection.

Measurement and payment shall be made on the basis of the linear foot unit price bid for sanitary sewer service connection furnished and installed via method other than open cut, including transfer and connection of service to new meter box, complete in place and shall include the total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: Concrete & Asphalt Pavement Repair

All sawcuts, removal and replacement of asphalt, concrete, and gravel pavement shall meet the requirements of NCTCOG Item 402 "Pavement Cut, Excavation, and Repair" and shall be performed at the locations shown on the plans in accordance with the plan notes and details. The width of repair shall be confirmed with the City Inspector prior to placing pavement, but in no case shall the repair width be less than three feet. This item shall include the reconstruction of any concrete curb and gutter disturbed during the construction process.

Measurement and payment shall be made on the basis of the square yard unit price bid for each repair type, complete in place. Payment to the Contractor for repair of pavement will be based on the actual measurements of pavement repaired. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: Concrete Sidewalk Repair

Concrete sidewalk repair shall be constructed at the locations shown in the plans, in accordance with plan details and NCTCOG Item 305.2 "Reinforced Concrete Sidewalk". Sidewalk shall be placed on a prepared base as indicated in the plan details. The prepared base, flex base, and necessary excavation shall be considered part of the sidewalk installation and included in this item. Thickness of sidewalk shall be noted on the plans.

Measurement and payment shall be made on the basis of the square yard unit price bid for sidewalk repair, complete in place, at the thickness measured in the field. Payment to the Contractor for repair of sidewalk will be based on the actual measurements of sidewalk repaired. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: Flowable Fill

Flowable fill shall be installed at the locations shown on the plans, in accordance with the plan details, standard city details, and in accordance with NCTCOG Item 504.2.3.5 "Modified Flowable Backfill". The anticipated quantity in cubic yards is shown on the plans.

Flowable fill shall have a compressive strength that will allow for the possibility of future utility excavation and shall be approved by the City prior to construction.

Measurement and payment shall be made on the basis of the cubic yard unit price bid for flowable fill. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: Temporary Asphalt Repair

Temporary asphalt pavement shall be installed at locations where existing asphalt or concrete pavement is removed to facilitate the construction of the project, and maintained until the permanent pavement repair is constructed. Temporary asphalt pavement shall be a minimum of 3" of cold mix asphalt on 6" of Grade 1 flexible base per NCTCOG Item 301.5, compacted to 95% standard proctor.

Measurement and payment shall be made on the basis of the square yard unit price bid for temporary asphalt pavement, complete in place. Payment to the Contractor for temporary pavement will be based on the actual measurements. The contract price shall be the total compensation for the furnishing of all labor, material, tools, equipment, and incidentals necessary to complete the work. **Removal of temporary asphalt prior to permanent pavement repair asphalt be subsidiary to the item.**

Where approved by the city, the Contractor may utilize steel road plates in lieu of temporary asphalt repair. If road plates are utilized, the contractor will be compensated based on the temporary asphalt repair unit price. In other words, no additional compensation will be provided if/when the contractor elects to utilize road plate lieu of temporary asphalt repair.

BID ITEM: Concrete Curb & Gutter Repair

All concrete curb construction shall be governed by the City standard details, NCTCOG Item 402 "Pavement Cut, Excavation, and Repair", and NCTCOG Item 305.1. Joints shall be sealed with a silicone joint sealant prior to opening to traffic. Joint Sealant used shall be self-leveling silicone sealant. There shall be no separate measurement or payment made for joint sealing or sealant.

Measurement and payment shall be made on the basis of the linear foot unit price bid for concrete curb and gutter installed. The contract price shall be the complete in place and accepted concrete curb and gutter, and shall be full compensation for all labor, material, equipment and incidentals necessary to complete this pay item.

BID ITEM: Temporary Water Lines and Connections

This item consists of furnishing all labor and materials necessary for the installation and maintenance of a 2" minimum diameter temporary water line along the street, in accordance with plan details. The temporary water lines shall be galvanized steel pipe per the plan details. This item shall also include the temporary transfer of all existing water services to the temporary water line to avoid disruptions during construction. A plan for the temporary water line and water service transfer shall be submitted to and approved by the City prior to construction.

The contractor shall phase construction and size the temporary line appropriately to maintain sufficient water pressure and service to affected properties. Each temporary water system must undergo a 24-hour demonstration period after transferring services to the temporary main and before the existing main is taken out of service. The contractor must demonstrate that a minimum pressure of 45 psi will be maintained to all service connections during construction. Construction shall be phased such that dead end mains will not be serviced by temporary water lines. In addition, construction must be phased such that no more than one fire hydrant is out of service at a given time.

This item will not be limited to pipe bursting applications. At the City's discretion, the City may require the Contractor to install and operate temporary water lines and connections to all customers affected by construction activities. All temporary water lines (including those serving fire suppression systems) and connections related to this construction project shall be considered subsidiary to this item.

This item shall also include disinfection and sampling of the temporary water lines.

The contractor shall coordinate with the City regarding notification to customers regarding disruptions to service. The contractor will be responsible for distributing water service notices to all affected customers a minimum of 24 hours in advance of disruption, as required by City inspector.

The contractor shall coordinate any construction and water line disruptions along Pate Orr Road with both the City and Keller ISD. The contractor shall only impact water service along Pate Orr Road during summer break for Keller ISD.

Measurement and payment shall be made on the basis of the lump sum unit price bid for temporary water lines and connections. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work including submittal and approval of the temporary water installation plan to the City.

BID ITEM: Trench Safety

This item will include the basic requirements to which the contractor must comply with in order to provide for the safety and health of workers in a trench. The contractor shall develop, design and implement the trench excavation safety protection system. The contractor shall bear the sole responsibility for the adequacy of the trench safety system and providing “a safe place to work” for the workman.

The trench excavation safety protection system shall be used for all trench excavations deeper than five (5) feet. The Excavating and Trenching Operation Manual of the Occupational Safety and Health Administration, U.S. Department of Labor, shall be the minimum governing requirement of this item and is hereby made a part of this specification. The contractor shall, in addition, comply with all other applicable Federal, State and local rules, regulations and ordinances, including NCTCOG Item 107.20.3 “Trench Safety”.

Measurement and payment shall be made on the basis of the linear foot unit price bid for trench safety. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: Traffic Control

Contractor shall provide a traffic control plan and ensure that the placement and location of traffic control and safety devices are in accordance with the latest edition of the Texas Manual on Uniform Traffic Control Devices, NCTCOG Item 801.1 “Barriers and Warning and Detour Signs”, and plan notes. This traffic control plan shall be submitted to the City for review and approval prior to implementation of the plan.

The Contractor is responsible for providing traffic control facilities that are adequate for his construction means and methods. The contractor shall coordinate all traffic control measures with the City Inspector.

Measurement and payment shall be made on the basis of the lump sum unit price bid for all traffic control measures including, but not limited to, signage, barricades, flagmen, and all other measures necessary to ensure public safety. Traffic control facilities shall remain in place until the completion of the project and all permanent signage is installed. The contract price shall be the total compensation for the furnishing

of all labor, material, tools, equipment, grading and incidentals necessary to complete the work, including proper hauling, setup, and removal of traffic control elements.

BID ITEM: Additional Traffic Control Flagger

This item consists of furnishing an additional traffic control flagger, at the City's discretion, at entry points to the work zone to stop or control traffic.

The additional traffic control flagger is intended to be above and beyond the scope of the approved traffic control plan submitted and included by the Contractor. The Contractor shall seek City Approval and guidance before deploying additional flaggers on project site during construction activities.

All traffic control flaggers must be courteous and be able to effectively communicate with the public. When directing traffic, flaggers must dress appropriately, wear high-visibility safety apparel, use flags, signs, stop/slow paddles, and other hand-signaling devices, and follow the flagging procedures set forth in the TMUTCD.

Measurement and payment shall be made on the basis of the daily unit price bid per flagger. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work, including flags, signs, and paddles.

BID ITEM: Surface Restoration and Sodding

Surface restoration and sodding shall be placed in accordance with NCTCOG Item 204.5 "Sodding" and shall be watered and maintained per NCTCOG Item 204.5.3.4 "Watering, and Finishing Sod". Contractor shall solid block sod parkway from curb or edge of pavement to limits of disturbed areas and water until final project acceptance.

A minimum of 4" of topsoil per NCTCOG Spec 204.5 shall be utilized prior to installation of block sod. Grading surface to smooth condition shall be considered subsidiary to this bid item.

In addition to sodding and grading, the unit price bid shall be full compensation for restoring the easement and right-of-way areas to their pre-project conditions or better, including but not limited to repair/restoration of irrigation systems, landscaping, mailboxes, plantings and shrubs. The contractor shall video tape all private easement areas prior to construction to establish the existing condition. The width of surface restoration and sodding shall correspond with the width of the area disturbed along the water line alignments within public parkways and utility easements.

Measurement and payment shall be made on the basis of the lump sum unit price bid for surface restoration and sodding. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: Erosion Control

The Contractor is responsible for providing any erosion control for the project. The erosion control pay item shall include any controls necessary to prevent the discharge of silt and sediment from the work area. Erosion control requirements include, but are not limited to, construction entrance, silt fence, inlet protection, erosion control mats, rock berms and preparation and implementation of a Storm Water Pollution Prevention

Plan if required by the Texas Commission on Environmental Quality. All erosion controls shall be constructed in accordance with NCTCOG Item 202 "Temporary Erosion, Sedimentation, and Water Pollution Prevention and Control". Contractor shall include removal of all temporary erosion controls upon completion of the project.

Measurement and payment shall be made on the basis of the lump sum unit price bid for erosion control. The contract price shall be the total compensation for the furnishing of all labor, material, tools, equipment, grading and incidentals necessary to complete the work.

BID ITEM: Exploratory Excavation

In some locations, the exact limits of the existing asbestos cement (AC) water pipe is unknown. At the City's discretion, the Contractor shall perform exploratory excavation in order to verify and/or identify the limits of the water main replacement. This item shall include the work necessary to locate the ends of the AC pipe via potholing and locate segments of pipe as directed by the City in the preconstruction meeting.

Measurement and payment shall be made on the basis of the unit price bid per each per each Exploratory Excavation pothole dug, 3 per main water line. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work. **Potholes associated with identifying possible conflicts between the proposed improvements and existing utilities are not included with this item but are considered subsidiary to the various water pipe installation bid items.**

BID ITEM: 3" Traditional Mill and Asphalt Overlay

Street shall be "full width milled" a 3" minimum thickness over the full width of existing asphalt from concrete lip to concrete lip, or edge to edge or asphalt, as directed by the City's Inspector. Where the edge of milled asphalt abuts existing asphalt surfaces, except where specifically directed otherwise, the joint line shall be straight and perpendicular to the centerline of the existing asphalt pavement. A 3" minimum Type "D" HMAC Surface Course with tack coat shall be installed for all overlays in accordance with the plan details, NCTCOG Item 302, and these contract documents. This pavement will be used to replace and improve existing HMAC pavement that has been previously prepared by milling and provide a smooth transition to the existing asphalt pavement.

Proper disposal of all millings shall be subsidiary to this bid item.

Measurement and payment shall be made on the basis of the square yard unit price bid for traditional mill and asphalt overlay operations. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work.

BID ITEM: Full Depth Spot Repair

Full depth spot repair shall meet the requirements of NCTCOG Item 301 "Subgrade, Subbase, and Base Preparation", NCTCOG Item 302 "Asphalt Pavement", and shall be performed at the locations shown on the plans in accordance with the plan notes and details. The locations of repairs shall be confirmed with the City Inspector prior to construction. The quantity provided in the proposal is an allowance to be authorized at the City's discretion.

The Contractor shall construct TY B asphalt pavement underlayment with prime coat over restabilized subgrade, per plan details. This pay item shall include stabilizing the subgrade, including providing hydrated lime material, as necessary. The application rate for lime shall be as determined by the Lime Series. Full Depth Spot Repair shall be prepared, graded, and prepped for overlay operations. The mill and overlay operations will be considered separate and paid for under the corresponding pay items.

If authorized and approved by the City prior to construction, the Contractor may utilize a minimum 6" flexible subgrade in lieu of a stabilized subgrade.

Measurement and payment shall be made on the basis of the square yard unit price bid for full depth spot repair, complete in place. Payment shall be total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work, including proper hauling and disposal of unwanted material.

BID ITEM: Pavement Markings

Pavement Markings shall include reflectorized pavement markings & prefabricated pavement markings and shall be installed in accordance with City of Keller Standard Details and the applicable provisions of NCTCOG Item 804. 2 "Painting and Marking".

Measurement and payment shall be made on the basis of the linear foot unit price for all pavement markings including, but not limited to, rounded shoulder reflectors, and thermoplastic pavement markings. The contract price shall be total compensation for the furnishing of all labor, material, tools, equipment, and incidentals necessary to complete the work.

ALTERNATE BID ITEMS

BID ITEM NO. A-1: Cost Adjustment for US Iron and Steel Requirements

This item is included for data collection purposes only for the Texas Water Development Board and will not be considered during evaluation of bids for award of the project.

The contractor shall quantify the total project cost adjustment necessary (additive, deductive, or zero) that would be required in order to comply with the US Iron and Steel Requirements found in Texas Water Code Section 17.183.

Measurement shall be made on the basis of the unit price bid per lump sum cost adjustment and bid amount shall include all costs associated with compliance to the above referenced requirements.

PROJECT ALLOWANCE

Projects of this type may require modifications to the contract and/or additional work which cannot be foreseen prior to construction. The cost for these modifications and/or additions will be reimbursed from this allowance if approved prior to performing the work. There is no guarantee that this allowance will be used at all. If used, it may be used in part or in whole at the City's discretion.

A project allowance of \$150,000 shall be given for any additional work associated with the project. Additional work shall be determined by the Owner. This work excludes any work listed on the bid proposal or work associated to complete the bid items.

Measurement and Payment shall be on approved invoices and an agreed upon amount of profit and overhead expenses and will include full compensation to complete the work as specified.



Texas Water Development Board
Supplemental Contract Conditions and
Instructions

For Construction Services for
Projects Funded through State Programs

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Forms and Guidance:

The Texas Water Development Board (TWDB) forms and guidance documents noted in this instruction document may be accessed through the TWDB's Financial Assistance web site at:

<http://www.twdb.texas.gov/financial/instructions/index.asp>

Search by either the document number or name.

I. INSTRUCTIONS TO APPLICANT

1. Applicability

These Supplemental Conditions contain provisions that are worded to comply with certain statutes and regulations which specifically relate to projects receiving state funds only. Except as noted, these supplemental conditions apply to projects funded by the following financial assistance programs:

- ✓ Agricultural Water Conservation Fund (AWCF)
- ✓ Economically Distressed Areas Program (EDAP)
- ✓ Rural Water Assistance Fund (RWAFF)
- ✓ State Participation (SP)
- ✓ State Water Implementation Fund for Texas (SWIFT)
- ✓ Texas Water Development Fund II (WDF)

Provisions that are applicable to the project's funding source or dollar value of the contract are so noted within these provisions.

NOTES:

- Per Section 17.183(c)(4), Texas Water Code (TWC), U.S. Iron and Steel requirements do not apply to SWIFT projects funded prior to May 1, 2019.
- Effective September 1, 2017, TWC §17.183 eliminated the requirement for *Manufactured Goods*. Thus, projects approved for funding after September 1, 2013 and which are not currently under construction, will only need to meet the requirements of TWC §17.183 as amended by S.B. 1289, 85th Legislative Session, and as outlined in these Contract Conditions.
- Texas Water Code § 17.183 does not apply to the Agricultural Water Conservation Fund; however, the US I&S provisions in Texas Government Code, Chapter 2252, Subchapter F may apply to certain conservation projects funded through the Agricultural Water Conservation Fund. See Attachment 1 for supplemental guidance regarding Agricultural Water Conservation Fund projects.

2. Use of Conditions

The language and conditions listed under ***Section II: Instructions to Bidders*** are to be included in the instructions to bidders for construction services. The provisions listed under ***Section III: Supplemental Contract Conditions*** shall be included in their entirety with the other general and special conditions that are typically included in the construction contract documents by the design engineer.

3. Modifications to Provisions

These provisions shall be included as a stand-alone section in the contract documents. The Applicant and the consulting engineer (Engineer) should carefully study these provisions before incorporating them into the construction contract documents. In particular, Water Districts and other types of districts should be aware of statutes relating to their creation and operation which may affect the application of these conditions. **The TWDB Project Engineer/Reviewer should be consulted if the Applicant thinks there is a need to modify parts of these provisions.**

Supplemental Condition #13 (Archeological Discoveries and Cultural Resources) and #14 (Endangered Species) may be superseded or modified by project specific conditions established during the environmental review process.

These documents may confer certain duties and responsibilities on the Engineer that are beyond, or short of, what the Applicant intends to delegate. The Applicant should ensure that the contractual agreement with the Engineer provides for the appropriate services. Otherwise the Applicant should revise the wording in these special conditions to agree with actually delegated functions.

4. Good Business Practices

There are other contract provisions that the Applicant (Owner) and Engineer should include as a matter of good business practices. It is recommended that provisions addressing the following matters be included in the construction contract.

- (a) Specifying the time frame for accomplishing the construction of the project, and the consequences of not completing on time, including liquidation damages.
- (b) Specifying the type, dollar value, and documentation of insurance the contractor is to carry. At a minimum the contractor should carry worker's compensation, liability and builder's risk insurance.
- (c) Identifying the responsibility of the contractor – Responsibility and Warranty of Work.
- (d) Price reduction for defective pricing of negotiated costs.
- (e) Differing site conditions - notice and claims regarding site conditions differing from indicated conditions.
- (f) Covenants against contingent fees - prohibit contingent fees for securing business.
- (g) Gratuities - prohibitions against offering and accepting gratuities.
- (h) Audit and access to records.
- (i) Suspension of work - conditions under which the Owner may suspend work.
- (j) Termination - conditions under which the Owner may terminate the contract.
- (k) Remedies - procedures for resolving disputes.

5. Other Requirements

There may be other local government requirements and applicable Federal and State statutes and regulations that are not accommodated by these conditions. It is the Applicant's responsibility to ensure that the project and all contract provisions are consistent with the relevant statutes and regulations.

6. Advertisements for Bids

State procurement statutes require advertising a contract for bids for at least two (2) consecutive weeks. By not following this requirement, the project may need to be re-advertised. The official advertisement for bids that is published in newspapers shall include certain information such as, but not limited to, the following:

- (a) A clear description of what is being procured.
- (b) How to obtain plans and specifications (P&S) and necessary forms and information.
- (c) The date and time by which bids are to be submitted (deadline).
- (d) The address where bids are to be provided.
- (e) This contract is contingent upon release of funds from the Texas Water Development Board (TWDB).
- (f) Any contract(s) awarded under this Invitation for Bids is/are subject to the United States Iron and Steel (US I&S) requirements of Texas Water Code §17.183 and/or Texas Government Code, Chapter 2252, Subchapter F, as amended by SB 1289, 85th Legislative Session, as applicable. (NOTE: does not apply to SWIFT projects funded prior to May 1, 2019).
- (g) Acknowledgement of any special requirements such as mandatory pre-bid conference.
- (h) Right to reject any and all bids.
- (i) General bond requirements.

Bid Proposal

The Bid Proposal form should account for the following:

- (a) If lump sum bid, include a list of the materials used and associated costs.
- (b) Distinguish eligible and ineligible items.
- (c) Accommodate trench safety requirements with separate per unit pay item for trench excavation safety protection, Health and Safety Code Chapter 756, Subchapter C.
- (d) Include space for the Contractor to acknowledge receipt of each Addendum issued during the bidding process.

7. Bidding Process

The Plans and Specifications (P&S) should include an explanation of how the bids will be processed. The explanation should include the following components:

- (a) Whether a pre-bid conference will be held, whether it is optional or mandatory, where and when it will be held.
- (b) Specify the criteria and process for determining responsiveness and responsibility of the bidder.
- (c) Specify the method of determining the successful bidder and award (e.g., award to the lowest responsive, responsible bidder, accounting for any multiple parts to bids) and accounting for non-resident bidder reciprocity requirements.
- (d) Allow for withdrawal of a bid due to a material mistake.
- (e) Identify the time frame that the bids may be held by the Applicant before awarding a contract (e.g., typically for 60 or 90 days).
- (f) Acknowledge right of the Applicant to reject any and all bids.

8. Release of Funds

- (a) Submittal of Bid Documents to TWDB Project Engineer/Reviewer to allow contingent award of contract:
 - (1) Advertisement and affidavit of advertisement.
 - (2) Bid tabulation.
 - (3) All addenda submitted and approved for the contract.
 - (4) Bid proposal of apparent low bidder (or chosen bidder, with explanation) with bid bond.
 - (5) Site certificate (ED-101).
 - (6) Consulting engineer's recommendation to award letter.
 - (7) A description of any bidding irregularities.
 - (8) Construction inspection proposal.
 - (9) Vendor Compliance with Reciprocity of Non-Resident Bidders Form (TWDB-0459).

(b) Following contingent award of the contract, TWDB Project Engineer/Reviewer should receive a bound copy of the executed contract documents (including specifications). This document should include:

- (1) Executed agreement.
- (2) Contractor's act of assurance (ED-103).
- (3) Contractor's act of assurance resolution (ED-104).
- (4) Payment and Performance bond (must be executed on or after the date of execution of the contract).
- (5) Contractor's Certificate of Insurance.
- (6) Sufficiency of funds letter (if the project is not 100% funded with TWDB funds).

After reviewing and approving the executed bid documents, the TWDB will issue an authorization for the Applicant to issue a notice to proceed. At this time, TWDB staff can begin releasing construction funds, in accordance with program specific requirements.

For any questions or proposed modifications to these conditions, please contact your TWDB Project Engineer/Reviewer.

II. INSTRUCTIONS TO BIDDERS

The language and conditions listed in this section shall be included in the “Instructions to Bidders” section of the construction contract document.

1. Contingent Award of Contract

This contract is contingent upon release of funds from the Texas Water Development Board. Any contract or contracts awarded under this Invitation for Bids is/are expected to be funded in part by a loan or grant from the Texas Water Development Board. Neither the state of Texas, nor any of its departments, agencies, or employees are or will be a party to this Invitation for Bids or any resulting contract.

2. U.S. Iron and Steel (Does not apply to SWIFT Projects funded prior to May 1, 2019)

Any contract(s) awarded under this Invitation for Bids is/are subject to the United States Iron and Steel requirements of Texas Water Code §17.183 and/or Texas Government Code, Chapter 2252, Subchapter F, as amended by SB 1289, 85th Legislative Session. The contractor must complete the statement of understanding regarding this requirement, found in the Supplemental Contract Conditions, Item No. 9. Refer to TWDB-1105 – United States Iron and Steel (US I&S) Guidance.

3. Bid Guarantee

Each bidder shall furnish a bid guarantee equivalent to five percent of the bid price (Water Code §17.183). If a bid bond is provided, the Contractor shall utilize a surety company which is authorized to do business in Texas in accordance with Surety Bonds and Related Instruments, Chapter 3503 of the Insurance Code.

4. Award of Contract to Nonresident Bidder

A governmental entity may not award a governmental contract to a nonresident bidder unless the nonresident underbids the lowest bid submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresident's principal place of business is located. A non-resident bidder is a Contractor whose corporate offices or principal place of business is outside of the state of Texas (Source: Texas Government Code, Chapter 2252, Subchapter A, Nonresident Bidders, §2252.002).

The bidder will complete form TWDB-0459, Vendor Compliance with Reciprocity on Non-Resident Bidders, **which must be submitted with the bid.**

III. SUPPLEMENTAL CONTRACT CONDITIONS

1. Supersession

The Owner and the Contractor agree that the TWDB Supplemental Conditions apply to the work eligible for Texas Water Development Board assistance to be performed under this contract and these clauses supersede any conflicting provisions of this contract.

2. Privity of Contract

Funding for this project is expected to be provided in part by a loan or grant from the Texas Water Development Board. Neither the state of Texas, nor any of its departments, agencies or employees is, or will be, a party to this contract or any lower tier contract. This contract is subject to applicable provisions in 31 TAC Chapter 363 in effect on the date of the assistance award for this project.

3. Definitions

- (a) The term "Owner" means the local entity contracting for the construction services.
- (b) The term "TWDB" means the Executive Administrator of the Texas Water Development Board, or other person who may be at the time acting in the capacity or authorized to perform the functions of such Executive Administrator, or the authorized representative thereof.
- (c) The term "Engineer" means the Owner's authorized consulting engineer for the project.

4. Laws to be Observed

In the execution of the contract, the Contractor must comply with all applicable local, state and federal laws, including but not limited to laws concerned with labor, safety, minimum wages, and the environment. The Contractor shall be familiar with and at all times shall observe and comply with all federal, state, and local laws, ordinances and regulations which in any manner affect the conduct of the work, and shall indemnify and save harmless the Owner, Texas Water Development Board, and their representatives against any claim arising from violation of any such law, ordinance or regulation by the Contractor, their Subcontractor or their employees.

5. Review by Owner and TWDB

- (a) The Owner, authorized representatives and agents of the Owner, and the TWDB shall, at all times have access to and be permitted to observe and review all work, materials, equipment, payrolls, personnel records, employment conditions, material invoices, and other relevant data and records pertaining to this contract, provided, however that all instructions and approval with respect to the work will be given to the Contractor only by the Owner through authorized representatives or agents.
- (b) Any such inspection or review by the TWDB shall not subject the state of Texas, or its representatives, to any action for damages.

6. Performance and Payment Bonds

Each Contractor awarded a construction contract must furnish performance and payment bonds:

- (a) the performance bond shall include without limitation guarantees that work done under the contract will be completed and performed according to approved plans and specifications and in accordance with sound construction principles and practices;
- (b) the performance and payment bonds shall be in a penal sum of not less than 100 percent of the contract price and remain in effect for one year beyond the date of approval by the Engineer of the political subdivision; and
- (c) the Contractor shall utilize a surety company that is authorized to do business in Texas in accordance with Surety Bonds and Related Instruments, Chapter 3503 of the Insurance Code.

7. Payments Schedule and Cost Breakdown

- (a) The Contractor shall submit for approval immediately after execution of the Agreement, a carefully prepared Progress Schedule, showing the proposed dates of starting and completing each of the various sections of the work, the anticipated monthly payments to become due to the Contractor, and the accumulated percent of progress each month.

- (b) The following paragraph applies only to contracts awarded on a lump sum contract price:

COST BREAKDOWN - The Contractor shall submit to the Owner a detailed breakdown of the estimated cost of all work to be accomplished under the contract, so arranged and itemized as to meet the approval of the Owner or funding agencies. This breakdown shall be submitted promptly after execution of the agreement and before any payment is made to the Contractor for the work performed under the contract. After approval by the Owner the unit prices established in the breakdown shall be used in estimating the amount of partial payments to be made to the Contractor.

8. Workers' Compensation Insurance Coverage (as applicable, consistent with Texas Labor Code § 406.096)

- (a) The Contractor shall certify in writing that they provide workers' compensation insurance coverage for each employee of the Contractor employed on the public project.
- (b) Each Subcontractor on the public project shall provide such a certificate relating to coverage of the Subcontractor's employees to the general Contractor, who shall provide the Subcontractor's certificate to the governmental entity.
- (c) A Contractor who has a contract that requires workers' compensation insurance coverage may provide the coverage through a group plan or other method satisfactory to the governing body of the governmental entity.
- (d) The employment of a maintenance employee by an employer who is not engaging in building or construction as the employer's primary business does not constitute engaging in building or construction.

(e) In this section:

(1) "Building or construction" includes:

- i. erecting or preparing to erect a structure, including a building, bridge, roadway, public utility facility, or related appurtenance;
- ii. remodeling, extending, repairing, or demolishing a structure; or
- iii. otherwise improving real property or an appurtenance to real property through similar activities.

(2) "Governmental entity" means this state or a political subdivision of this state. The term includes a municipality.

9. U.S. Iron and Steel (Does not apply to SWIFT Projects funded prior to May 1, 2019)

The following statement must be completed by the Contractor and made a part of the agreement between the Owner and the Contractor.

The Contractor acknowledges to and for the benefit of the Applicant ("Purchaser") and the Texas Water Development Board ("TWDB") that it understands the goods and services under this Agreement are being funded with monies made available by the Water Development Fund, Rural Water Assistance Fund, Economically Distressed Areas, State Participation Fund and/or Agricultural Water Conservation Fund. That these funds have statutory requirements commonly known as "United States Iron and Steel" that requires all of the iron and steel products used in the project to be produced in the United States ("United States Iron and Steel Requirement") including iron and steel products provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the TWDB that (a) the Contractor has reviewed and understands the United States Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the United States Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the United States Iron and Steel Requirement, as may be requested by the Purchaser or the TWDB. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser to enforce this Agreement and recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the TWDB or any damages owed to the TWDB by the Purchaser). Neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the TWDB.

In the execution of the Contract, the Contractor shall be familiar with and at all times shall observe and comply with all applicable federal, state, and local laws, ordinances and regulations concerned with the use of iron and steel made in the United States which in any manner affect the conduct of the work, and shall indemnify and save harmless the Texas Water Development Board against any claim arising from violation of any such law, ordinance or regulation by the Contractor or by their Subcontractor or their employees.

Additional information on the United States Iron and Steel (US I&S) and its applicability to this contract can be found in the TWDB-11005 guidance.

It is recommended the Owner receive and maintain files documenting the Contractor's use of US I&S. Compliance with US I&S will be verified by the Owner through the submittal of the TWDB form TWDB-1105-A.

10. Prevailing Wage Rates

This contract is subject to Government Code Chapter 2258 concerning payment of Prevailing Wage Rates. The Owner will determine what the general prevailing rates are in accordance with the statute. The applicable provisions include, but are not limited to the following:

§2258.021. Right to be Paid Prevailing Wage Rates

- (a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:
 - (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
 - (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.
- (b) Subsection (a) does not apply to maintenance work.
- (c) A worker is employed on a public work for the purposes of this section if the worker is employed by a Contractor or Subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

§2258.023. Prevailing Wage Rates to be Paid by Contractor and Subcontractor; Penalty

- (a) The Contractor who is awarded a contract by a public body or a Subcontractor of the Contractor shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.
- (b) A Contractor or Subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.
- (c) A Contractor or Subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section 2258.022.
- (d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.
- (e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

§2258. 024. Records

- (a) A Contractor and Subcontractor shall keep a record showing:
 - (1) the name and occupation of each worker employed by the Contractor or Subcontractor in the construction of the public work; and
 - (2) the actual per diem wages paid to each worker.
- (b) The record shall be open at all reasonable hours to inspection by the officers and agents of the public body.

§2258. 025. Payment Greater Than Prevailing Rate Not Prohibited

This chapter does not prohibit the payment to a worker employed on a public work an amount greater than the general prevailing rate of per diem wages.

11. Employment of Local Labor (only applicable to projects funded by EDAP)

The Contractor shall, to the maximum feasible extent, employ local labor for construction of the project. The Contractor and every Subcontractor undertaking to do work on the project which is, or reasonably may be done as on-site work, shall employ qualified persons who regularly reside within the political subdivision boundary of the Owner and the economically distressed area where the project is located (Texas Water Code, Section 17.183).

12. Payments

- (a) Progress Payments:
 - (1) The Contractor shall prepare their requisition for progress payment as of the last day of the month and submit it, with the required number of copies, to the Engineer for review. Except as provided in paragraph (3) of this subsection, the amount of the payment due the Contractor shall be determined by adding to the total value of work completed to date, the value of materials properly stored on the site and deducting: (1) five percent (5%) minimum of the total amount, as a retainage and (2) the amount of all previous payments. The total value of work completed to date shall be based on the actual or estimated quantities of work completed and on the unit prices contained in the agreement (or cost breakdown approved pursuant to section 7b relating to lump sum bids) and adjusted by approved change orders. The value of materials properly stored on the site shall be based upon the estimated quantities of such materials and the invoice prices. Copies of all invoices shall be available for inspection by the Engineer.
 - (2) The Contractor shall be responsible for the care and protection of all materials and work upon which payments have been made until final acceptance of such work and materials by the Owner. Such payments shall not constitute a waiver of the right of the Owner to require the fulfillment of all terms of the Contract and the delivery of all improvements embraced in this contract complete and satisfactory to the Owner in all details.

- (3) This clause applies to contracts when the Owner is a District or Authority. The retainage shall be ten percent of the amount otherwise due until at least fifty percent of the work has been completed. After the project is fifty percent completed, and if the District or Authority's Board finds that satisfactory progress is being made, then the District may authorize any of the remaining progress payments to be made in full. The District is not obligated to pay interest earned on the first 50% of work completed (Texas Water Code Sec. 49.276(d)).
 - (4) The five percent (5%) retainage of the progress payments due to the Contractor may not be reduced until the building of the project is substantially complete and a reduction in the retainage has been authorized by the TWDB.
- (b) Withholding Payments. The Owner may withhold from any payment otherwise due the Contractor so much as may be necessary to protect the Owner and if so elects may also withhold any amounts due from the Contractor to any Subcontractors or material dealers, for work performed or material furnished by them. The foregoing provisions shall be construed solely for the benefit of the Owner and will not require the Owner to determine or adjust any claims or disputes between the Contractor and their Subcontractors or Material dealers, or to withhold any monies for their protection unless the Owner elects to do so. The failure or refusal of the Owner to withhold any monies from the Contractor shall in no way impair the obligations of any surety or sureties under any bond or bonds furnished under this contract.
- (c) Payments Subject to Submission of Certificates. Each payment to the Contractor by the Owner shall be made subject to submission by the Contractor of all written certifications required of the Contractor, their Subcontractors and other general and special conditions elsewhere in this contract.
- (d) Final Payment.
- (1) Upon satisfactory completion of the work performed under this contract, as a condition before final payment under this contract or as a termination settlement under this contract the Contractor shall execute and deliver to the Owner a release of all claims against the Owner arising under, or by virtue of, this contract, except claims which are specifically exempted by the Contractor to be set forth therein. Unless otherwise provided in this contract, by state law or otherwise expressly agreed to by the parties to this contract, final payment under this contract or settlement upon termination of this contract shall not constitute a waiver of the Owner's claims against the Contractor or their sureties under this contract or applicable performance and payment bonds.
 - (2) After final inspection and acceptance by the Owner of all work under the Contract, the Contractor shall prepare their requisition for final payment which shall be based upon the carefully measured or computed quantity of each item of work at the applicable unit prices stipulated in the Agreement or cost breakdown (if lump sum), as adjusted by approved change orders. The total amount of the final payment due to the Contractor under this contract shall be the amount computed as described above less all previous payments.

- (3) The retainage and its interest earnings, if any, shall not be paid to the Contractor until the TWDB has authorized a reduction in, or release of, retainage on the contract work.
- (4) Withholding of any amount due to the Owner, under general and/or special conditions regarding "Liquidated Damages" shall be deducted from the final payment due the Contractor.

13. Archaeological Discoveries and Cultural Resources

No activity which may affect properties listed or properties eligible for listing in the National Register of Historic Places or eligible for designation as a State Archeological Landmark is authorized until the Owner has complied with the provisions of the National Historic Preservation Act and the Antiquities Code of Texas. The Owner has previously coordinated with the appropriate agencies and impacts to known cultural or archeological deposits have been avoided or mitigated. However, the Contractor may encounter unanticipated cultural or archeological deposits during construction.

If archeological sites or historic structures which may qualify for designation as a State Archeological Landmark according to the criteria in 13 TAC Chapter 26, or that may be eligible for listing on the National Register of Historic Places in accordance with 36 CFR Part 800, are discovered after construction operations are begun, the Contractor shall immediately cease operations in that particular area and notify the Owner, the TWDB, and the Texas Historical Commission, 1511 N. Colorado St. , P. O. Box 12276, Capitol Station, Austin, Texas 78711-2276. The Contractor shall take reasonable steps to protect and preserve the discoveries until they have been inspected by the Owner's representative and the TWDB. The Owner will promptly coordinate with the State Historic Preservation Officer and any other appropriate agencies to obtain any necessary approvals or permits to enable the work to continue. The Contractor shall not resume work in the area of the discovery until authorized to do so by the Owner.

14. Endangered Species

No activity is authorized that is likely to jeopardize the continued existence of a threatened or endangered species as listed or proposed for listing under the Federal Endangered Species Act (ESA), and/or the State of Texas Parks and Wildlife Code on Endangered Species, or to destroy or adversely modify the habitat of such species.

If a threatened or endangered species is encountered during construction, the Contractor shall immediately cease work in the area of the encounter and notify the Owner, who will immediately implement actions in accordance with the ESA and applicable State statutes. These actions shall include reporting the encounter to the TWDB, the U.S. Fish and Wildlife Service, and the Texas Parks and Wildlife Department, obtaining any necessary approvals or permits to enable the work to continue, or implement other mitigation actions. The Contractor shall not resume construction in the area of the encounter until authorized to do so by the Owner.

15. Hazardous Materials

Materials utilized in the project shall be free of any hazardous materials, except as may be specifically provided for in the specifications.

If the Contractor encounters existing material on sites owned or controlled by the Owner or in material sources that are suspected by visual observation or smell to contain hazardous materials, the Contractor shall immediately notify the Engineer and the Owner. The Owner will be responsible for the testing and removal or disposal of hazardous materials on sites owned or controlled by the Owner. The Owner may suspend the work, wholly or in part during the testing, removal or disposal of hazardous materials on sites owned or controlled by the Owner.

16. Changes

*Provisions identified with an asterisk below are consistent with Local Government Code 271.060. Counties and Municipalities may modify the identified provisions, when applicable, to conform to Local Government Code 262.031 (Counties) or 252.048 (Municipalities).

- (a) The Owner may at any time, without notice to any surety, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including but not limited to changes:
 - (1) In the specifications (including drawings and designs);
 - (2) In the time, method or manner of performance of the work;
 - (3) To decrease or increase the quantity of work to be performed or materials, equipment or supplies to be furnished;
- (b) *The total price of a contract may not be increased by a change order unless provision has been made for the payment of the added cost by the appropriation of current funds or bond funds for that purpose, by the authorization of the issuance of certificates, or by a combination of those procedures.
- (c) *A contract with an original contract price of \$1 million or more may not be increased by more than 25 percent. If a change order for a contract, with an original contract price of less than \$1 million, increases the contract amount to \$1 million or more, subsequent change orders may not increase the revised contract amount by more than 25 percent.
- (d) *A governing body may grant authority to an official or employee responsible for purchasing or for administering a contract to approve a change order that involves an increase or decrease of \$50,000 or less.
- (e) Changes that involve an increase in price will be supported by documentation of the cost components. For projects funded through the EDAP program, or with grant proceeds, TWDB staff may request this information to be provided in a format equivalent to the Cost and Pricing Information form (No. WRD-277).
- (f) Any change orders involving a change in the project requiring a relocation of project components, sizing, or process may require additional environmental approval. A map and description of the proposed changes should be sent to the TWDB Environmental

Reviewer for coordination and approval as soon as possible to avoid any delay.

17. Operation and Maintenance Manuals and Training

- (a) The Contractor shall obtain installation, operation, and maintenance manuals from manufacturers and suppliers for equipment furnished under the contract. The Contractor shall submit three copies of each complete manual to the Engineer within 90 days after approval of shop drawings, product data, and samples, and not later than the date of shipment of each item of equipment to the project site or storage location.
- (b) The Owner shall require the Engineer to promptly review each manual submitted, noting necessary corrections and revisions. If the Engineer rejects the manual, the Contractor shall correct and resubmit the manual until it is acceptable to the Engineer as being in conformance with the design concept of the project and for compliance with information given in the contract documents. Owner may assess Contractor a charge for reviews of same items in excess of three (3) times. Such procedure shall not be considered cause for delay.
- (c) Acceptance of manuals by Engineer does not relieve Contractor of any requirements of terms of Contract.
- (d) The Contractor shall provide the services of trained, qualified technicians to check final equipment installation, to assist as required in placing same in operation, and to instruct operating personnel in the proper manner of performing routine operation and maintenance of the equipment.
- (e) Operations and maintenance manuals specified hereinafter are in addition to any operation, maintenance, or installation instructions required by the Contractor to install, test, and start-up the equipment.
- (f) Each manual is to be bound in a folder and labeled to identify the contents and project to which it applies. The manual shall contain the following applicable items:
 - (1) A listing of the manufacturer's identification, including order number, model, serial number, and location of parts and service centers.
 - (2) A list of recommended stock of parts, including part number and quantity.
 - (3) Complete replacement parts list.
 - (4) Performance data and rating tables.
 - (5) Specific instructions for installation, operation, adjustment, and maintenance.
 - (6) Exploded view drawings for major equipment items.
 - (7) Lubrication requirements.
 - (8) Complete equipment wiring diagrams and control schematics with terminal identification.

18. As-built Dimensions and Drawings

- (a) Contractor shall make appropriate daily measurements of facilities constructed and keep accurate records of location (horizontal and vertical) of all facilities.

- (b) Upon completion of each facility, the Contractor shall furnish the Owner with one set of direct prints, marked with red pencil, to show as-built dimensions and locations of all work constructed. As a minimum, the final drawings shall include the following:
- (1) Horizontal and vertical locations of work.
 - (2) Changes in equipment and dimensions due to substitutions.
 - (3) "Nameplate" data on all installed equipment.
 - (4) Deletions, additions, and changes to scope of work.
 - (5) Any other changes made.

19. Close-Out Procedures

To close-out the contract and release final retainage, the following steps must be completed:

- (a) TWDB Staff must conduct a construction contract final inspection (CCFI).
- (b) The following submittals must be received, reviewed, and accepted by TWDB:
- (1) The final change order, adjustment of quantities, or a statement that all change orders have previously been submitted and there will be no more change orders;
 - (2) The final pay request from the Contractor;
 - (3) An affidavit by the Contractor that all bills have been paid;
 - (4) Certification by the consulting Engineer that the work has been completed and was constructed in accordance with the approved plans and specifications and sound engineering principles and construction practices;
 - (5) Acceptance of the project by the Owner in the form of a written resolution or other formal action;
 - (6) Notification of the beginning date of the warranty period for the contract; and
 - (7) Confirmation that the Owner has received as-built drawings from the Contractor.
 - (8) Certificate of Compliance with U.S. Iron and Steel Requirements (TWDB-1105A)
- (c) TWDB will issue a Certificate of Approval allowing the release of retainage.

IV. FORMS AND GUIDANCE LIST

The following documents, mentioned throughout this guidance are available on the TWDB website at: <http://www.twdb.texas.gov/financial/instructions/index.asp>

Forms:

The following forms must be included in the bid documents:

- Contractor's Act of Assurance (ED-103)
- Contractor's Act of Assurance Resolution (ED-104)
- Certificate of Compliance with U.S. Iron and Steel Requirements (TWDB-1105A)
- Site Certificate (ED-101)
- Vendor Compliance with Reciprocity of Non-Resident Bidders (TWDB-0459).

Guidance Document:

- United States Iron and Steel Guidance (TWDB-1105)

STATE OF TEXAS

§

§

COUNTY OF _____

§

**SITE
CERTIFICATE**

Before me, the undersigned notary, on this day personally appeared

_____, a person whose identity is known to me or who has presented to me a satisfactory proof of identity. After I administered an oath, this person swore to the following:

(1) My name is _____. I am over 18 years of age and I am of sound mind, and capable of swearing to the facts contained in this Site Certificate. The facts stated in this certificate are within my personal knowledge and are true and correct.

(2) I am an authorized representative of _____, an entity that has filed an application for financial assistance with the Texas Water Development Board for a (water) (wastewater) project.

Please complete only those sections that apply to your project:

LEGAL CERTIFICATION – LEASE/CONTRACT

I certify that: _____
(Legal Name of Applicant, i.e., City, District, etc.)

has executed a written lease or other contractual agreement to use the property needed for this (water)(wastewater) project that extends through _____ (date), the life of the Texas Water Development Board loan or grant that will be used to finance this project, either in whole or in part. A copy of this lease or agreement is attached hereto.

LEGAL CERTIFICATION – PROPERTY EASEMENT

I certify that: _____
(Legal Name of Applicant, i.e., City, District, etc.)

has executed an express easement to use the property needed for this (water) (wastewater) project that extends through the life of the Texas Water Development Board loan or grant that will be used to finance this project, either in whole or in part. The express easement to use the property needed for this (water) (wastewater) project extends through _____ (date). A copy of the express easement agreement is attached hereto.

LEGAL CERTIFICATION – OWNERSHIP INTEREST

I certify that _____
(Legal Name of Applicant, e.g. City, District, etc.)

☐ Option A: has acquired the necessary real property interest, as evidenced by fee simple purchase, deed, fully executed earnest money contracts, or completion of eminent domain proceedings; that such acquisition will guarantee access and egress; and such interest will contain the necessary easements, rights of way, or unrestricted use as is required for the project being financed by the Texas Water Development Board. The legal description is referenced below.

☐ Option B: is in the process of acquiring the necessary real property interest, as evidenced by earnest money contracts, contracts for sale, firm option agreements to purchase the subject property, or the initiation of eminent domain procedures; that such acquisition will guarantee access and egress; and such interest will contain the necessary easements, rights of way, or unrestricted use as is required for the project being financed by the Texas Water Development Board. The legal description is referenced below. The anticipated date of acquisition is: _____.

The property has been/will be acquired with the use of eminent domain: ☐ True ☐ False

Location and Description of Property Interests acquired for Project:

Any deeds or other instruments required to be recorded to protect the title(s) held by _____ (Legal Name of Applicant) have been recorded or filed for the record in the County deed records or other required location. The following documents are attached hereto:

Description of documents that were used or will be used to acquire the property:

EXECUTED this _____ day of _____, 20_____.

_____ (Signature)

_____ (Print Name)

_____ (Title)

Sworn to and subscribed before me by _____ on this _____ day
of _____, 20_____.

_____ (Notary Public in and for the State of Texas)

[SEAL]



City of Keller
1100 Bear Creek Parkway,
Keller, TX 76248

Permit

Permit NO.: CIVIL-2407-0007

Permit Type: **Civil Construction**

Work Classification: **City**

Permit Status: **Issued**

Issue Date: **07/09/2024**

Expiration: 01/05/2025

Location Address

Parcel Number

860 KELLER SMITHFIELD RD, KELLER, TX

40023435

Contacts

City of Keller
1100 Bear Creek, Keller, TX 76248

Owner

City of Keller
1100 Bear Creek, Keller, TX 76248

Developer

Description: Floodplain Permit for SWIFT Phase 3 Project

Valuation: \$0.00

Total Sq Feet: 0.00

Inspection Requests:

www.cityofkeller.com/css

Fees	Amount

Total:

Payments	Amt Paid

Total Fees

Amount Due:

Inspections:

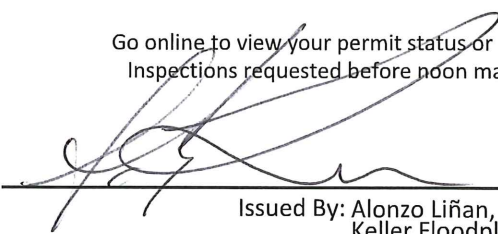
Inspection Type	

Erosion Control	

Daily Inspection	

Final Walkthrough Inspection	

Go online to view your permit status or request inspections, www.cityofkeller.com/css. Same day inspections are not available.
Inspections requested before noon may be accommodated the next business day. Inspections requested after noon may be accommodated within two business days.


Issued By: Alonzo Liñan, P.E.,
Keller Floodplain Administrator

July 09, 2024

Date



PERMIT DETAILED REPORT (CIVIL-2407-0007) FOR CITY OF KELLER

Permit Type	Civil Construction	Project:		App Date:	07/09/2024
Work Class:	City	District:	Keller	Issue Date:	07/09/2024
Status:	Issued	Square Feet:	0.00	Exp Date:	01/05/2025
Description:	Floodplain Permit for SWIFT Phase 3 Project	Valuation:	\$0.00	Final Date:	NOT FINALED

PERMIT DETAILED REPORT (CIVIL-2407-0007)

Parcel: 40023435	Main	Address: 860 Keller Smithfield Rd	Main	Zone: SF-36 (Single Family Residential - Main
06931502		Keller, TX		36,000 S.F. Lots)
04988116		601 Rhonda Rd		
03853144		Keller, TX 76248		
00642444		407 S Pate Orr Rd		
00642452		Keller, TX 76248		
05647924		1409 Johnson Rd		
00972193		Keller, TX 76248		
06569862		1756 Johnson Rd		
03853233		Keller, TX 76248		
04463862		900 Keller Pkwy		
06931480		Keller, TX		
41472500		350 Rufe Snow Dr		
03724263		Keller, TX 76248		
04075331		1663 Johnson Rd		
04070003		Keller, TX 76248		
41535375		602 Rhonda Rd		
42675632		Keller, TX 76248		
41442768		240 Rufe Snow Dr		
04436377		Keller, TX		
41005325		1408 Johnson Rd		
06958966		Keller, TX 76248		
		1767 Johnson Rd		
		Keller, TX 76248		
		801 Bear Creek Pkwy		
		Keller, TX 76248		
		1664 Johnson Rd		
		Keller, TX 76248		
		1732 Johnson Rd		
		Keller, TX 76248		
		601 Bobbi Ct		
		Keller, TX 76248		
		825 Silver Lake Dr		
		Keller, TX 76248		
		904 Bear Creek Pkwy		
		Keller, TX		
		905 Bear Creek Pkwy		
		Keller, TX		
		1650 Johnson Rd		
		Keller, TX 76248		
		1739 Johnson Rd		
		Keller, TX 76248		

Developer

City Of Keller
1100 Bear Creek
Keller, TX 76248
Home:
Business:
Mobile:

Owner

City Of Keller
1100 Bear Creek
Keller, TX 76248
Home:
Business:
Mobile:

PERMIT DETAILED REPORT (CIVIL-2407-0007)

Activity Type	Activity Number	Name	User	Created On
PreConstruction Meeting Results	000011-2024		Rick Hardcopf	7/9/2024 2:43:50PM

TECHNICAL SPECIFICATIONS

TS-1 NCTCOG Technical Specifications

For this contract, Division 200 through Division 800 of the NCTCOG Public Works Construction Standards, 2017 with latest amendments (as published by the North Central Texas Council of Governments), shall govern and shall constitute the Technical Specifications, except as herein amended or supplemented. They will be referred to as the Standard Specifications and will not be physically bound with the other contract documents. The following list is provided as a reference of applicable items for this project, but does not exclude unlisted items from the project. Copies of these standard specifications may be obtained from the North Central Texas Council of Governments, 616 Six Flags Drive, Suite 200, Arlington, Texas 76005-5888, and (817) 640-3300.

- Item 107. Legal Relations and Contract Responsibilities
- Item 201. Site Protection
- Item 202. Temporary Erosion, Sedimentation, and Water Pollution Prevention and Control
- Item 203. Site Preparation
- Item 204. Landscaping
- Item 301. Subgrade, Subbase, and Base Preparation
- Item 302. Asphalt Pavement
- Item 303. Portland Cement Concrete Pavement
- Item 305. Miscellaneous Roadway Construction
- Item 402. Pavement Cut, Excavation, and Repair
- Item 403. Asphaltic Pavement Repair
- Item 404. Surface Treatment
- Item 501. Underground Conduit Materials
- Item 502. Appurtenances
- Item 503. Trenchless Installation
- Item 504. Open Cut – Backfill
- Item 505. Open Cut – General Conduit Installation
- Item 506. Open Cut – Water Conduit Installation
- Item 508. Open Cut – Storm Water Conduit Installation
- Item 601. Pipeline Rehabilitation
- Item 604. Removal of Asbestos-Cement Pipe (ACP)
- Item 702. Concrete Structures
- Item 801. Barriers, Warning and Detour Signs, and Fences
- Item 804. Painting and Other Protective Treatments; Pavement Marking

ITEM 107. LEGAL RELATIONS AND CONTRACTOR RESPONSIBILITIES

107.1. CONTRACTOR INDEPENDENCE

While engaged in carrying out and complying with the terms and conditions of this Contract the CONTRACTOR is, and shall be, an independent CONTRACTOR and shall not, with respect to its acts or omissions, be deemed an officer, employee or agent of the OWNER. The CONTRACTOR shall not at any time or in any manner represent that it or any of its agents or employees are in any manner agents or employees of the OWNER.

CONTRACTOR is, and shall remain, an independent CONTRACTOR, with full, complete and exclusive power and authority to direct, supervise, and control its own employees and SUBCONTRACTORS and to determine the method of the performance of the work covered under this Contract. The fact that the OWNER or the Engineer shall have the right to inspect or observe CONTRACTOR'S work during performance and to exercise the other rights and prerogatives expressly reserved to the OWNER or the Engineer under this Contract is not intended to, and shall not any time, change or affect the status of the CONTRACTOR as an independent CONTRACTOR with respect to the OWNER, the CONTRACTOR'S own employees or any other person, firm or corporation.

Nothing contained in the Contract documents shall create any contractual or agency relationship between the Engineer and the CONTRACTOR.

107.2. NO THIRD PARTY CONTRACTUAL RIGHTS

This Contract is solely for the benefit of the parties to this Contract and are not intended to create or grant any rights, contractual or otherwise, to any other person or entity.

107.3. INDEMNIFICATION

CONTRACTOR covenants and agrees to and does hereby indemnify, hold harmless and defend, at its own expense, OWNER, its officers, officials, agents and employees, from and against any and all claims or suits, judgments and costs and expenses for property loss or damage and/or personal injury, including death, to any and all persons, of whatsoever kind or character, whether real or asserted, arising out of the work and services to be performed hereunder by CONTRACTOR, its officers, officials, agents, employees, SUBCONTRACTORS, licensees or invitees, whether or not caused, in whole or in part, by the alleged negligence of the officers, agents, and employees, of the OWNER. CONTRACTOR likewise covenants and agrees to, and does hereby, indemnify and hold harmless OWNER from and against any and all injuries, damage, loss or destruction to property of OWNER during the performance of any of the terms and conditions of this contract, whether arising out of in whole or in part, any and all alleged acts or omissions of officers, agents, or employees of OWNER.

The provisions of this paragraph are solely for the benefit of the parties hereto and not intended to create or grant any rights, contractual or otherwise, to any other person or entity.

107.4. OWNER'S OFFICERS, EMPLOYEES OR AGENTS

107.4.1. Claim Against Officers, Employees or Agent of the OWNER. No claim whatsoever shall be made by the CONTRACTOR against any officer, employee, or agent of the OWNER for or on account of, anything done or omitted to be done in connection with this Contract.

107.4.2. Financial Interest in Any Contract by OWNER'S Officers, Employees or Agents. CONTRACTOR is hereby advised to comply with the OWNER'S financial interest or comparable policy. If OWNER does not implement a financial interest or comparable policy of its own, provisions of this Item shall govern matters of financial interest.

No officer, employee, or agent of the OWNER shall have a financial interest, direct or indirect, in any contract with the OWNER or be financially interested, directly or indirectly, in the sale to the OWNER of any land, materials, supplies or services, except on behalf of the OWNER as an officer or employee. Any violation of this article with the knowledge, expressed or implied, of the persons, partnership, company, firm, association or corporation contracting with the OWNER shall render the Contract involved voidable by the OWNER.

107.4.3. Conflict of Interest. CONTRACTOR shall complete and submit the State of Texas Conflict of Interest Questionnaire, form CIQ as required by Texas Local Government Code, Chapter 176.

107.5. VENUE AND GOVERNING LAW

The parties herein agree that this Contract shall be performed in the county in which the OWNER's principal office is located, and if legal action is necessary in connection therewith, exclusive venue shall lie in this county. The terms and provisions of the Contract documents shall be construed in accordance with the laws and court decisions of the State of Texas.

107.6. NO WAIVER OF LEGAL RIGHTS

Inspection by the OWNER; any order, measurement, quantity or certificate by the OWNER; any order by the OWNER for payment of money; any payment for or acceptance of any work; or any extension of time or any possession taken by the OWNER shall not operate as a waiver of any provisions of the Contract or any power therein reserved to the OWNER of any rights or damages therein provided. Any waiver of any breach of Contract shall not be held to be a waiver of any other or subsequent breach. The OWNER reserves the right to correct any error that may be discovered in any estimate that may have been paid and to adjust the same to meet the requirements of the Contract documents. The OWNER reserves the right to recover by process of law sums as may be sufficient to correct any error or make good any deficiency in the work resulting from such error, dishonesty or collusion by the CONTRACTOR or its agents that is discovered in the work by the OWNER after the final payment has been made.

Neither final acceptance of the work nor final payment shall relieve the CONTRACTOR of responsibility for faulty materials or workmanship, and the CONTRACTOR shall promptly remedy any defects due thereto and pay for any damage to other work resulting therefrom. Likewise, neither final acceptance nor final payment, nor partial or entire use or occupancy of the work by the OWNER shall constitute acceptance of work not done in accordance with the Contract documents or relieve CONTRACTOR of liability with respect to any expressed or implied warranties or responsibility for faulty materials or workmanship, whether same be patently or latently defective.

The OWNER, or any officer or agent thereof, shall not be precluded at any time, either before or after final completion and acceptance of the work and final payment therefrom:

- (1) showing the true and correct amount, classifications, quality and character of the work done and materials furnished by the CONTRACTOR or any other person under this Contract, or
- (2) from showing at any time that any determination, return, decision, approval, order, letter, payment or certification is untrue and incorrect or improperly made in any particular, or
- (3) that the work or the materials or any parts thereof do not in fact conform to the Contract requirements; and
- (4) demanding the recovery from the CONTRACTOR of any overpayments made to it, or such damages as the OWNER may sustain by reason of the CONTRACTOR's failure to perform each and every part of this Contract in strict accordance with its terms; or both.

107.7. SEVERABILITY

In the event a term, condition, or provision in this Contract is determined to be void, unenforceable, or unlawful by a court of competent jurisdiction, then that term, condition or provision, shall be deleted and the remainder of the Contract shall remain in full force and effect.

107.8. HEADINGS

The title and headings contained in the Contract documents and the subject organization are used only to facilitate reference, and in no way define or limit the scope of intent of any of the provisions of this Contract.

107.9. OBLIGATIONS TO PERFORM FUNCTIONS

Any failure or neglect on the part of OWNER, Engineer or inspectors to enforce provisions herein dealing with supervision, control, inspection, testing or acceptance and approval of the work shall never operate to relieve CONTRACTOR from full compliance with the Contract documents nor render OWNER liable to CONTRACTOR for money damages, extensions of time or increased compensation of any kind.

107.10. PERFORMANCE OF THE WORK

In addition to those matters elsewhere expressly made the responsibility of the CONTRACTOR, the CONTRACTOR shall have the full and direct responsibility for the performance and completion of the work under this Contract and for any act or neglect of the CONTRACTOR, its agents, employees or SUBCONTRACTORS. CONTRACTOR shall bear all losses, if any, resulting on account of the amount and character of the work, or because the conditions under

which the work must be done are different from what CONTRACTOR estimated or anticipated, or because of weather, floods, elements or other causes, regardless of the expected completion date set forth in the Contract Documents.

107.11. SUCCESSORS AND ASSIGNS

Subject to the limitations upon assignment and transfer herein contained, this Contract shall be binding upon and inure to the benefit of the parties hereto, their respective successors and assigns.

107.12. SUPERVISION AND CONSTRUCTION PROCEDURES

The CONTRACTOR shall supervise and direct all the work, using its best skill and attention. CONTRACTOR shall be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the work under the Contract.

The CONTRACTOR shall carefully study and compare the Contract documents and shall at once report to the OWNER any error, inconsistency or omission it may discover. The CONTRACTOR shall perform no portion of the work at any time without Contract documents or, where required, approved shop drawings, product data or samples for such portion of the work.

The CONTRACTOR shall be responsible to the OWNER for the acts and omissions of the OWNER's employees, SUBCONTRACTORS, and agents, as well as the CONTRACTOR's employees and SUBCONTRACTORS performing any of the work under a contract with the CONTRACTOR. The CONTRACTOR shall at all times enforce strict discipline and good order among its employees and shall not employ on the work site any unfit person or anyone not skilled in the task assigned to him or her.

The CONTRACTOR shall not be relieved from its obligations to perform the work in accordance with the Contract documents either by the activities or duties of the OWNER in its administration of the Contract, or by inspections, tests or approvals required or performed by persons other than the CONTRACTOR.

The CONTRACTOR shall give to the work the consistent attention necessary to facilitate the progress thereof, and the CONTRACTOR shall cooperate with the OWNER, and with other CONTRACTORS in every way possible.

The OWNER and the OWNER's representatives shall at all times have free access to the work whenever it is in preparation or progress and the CONTRACTOR shall provide safe, convenient and proper facilities for such access and inspection.

107.13. LABOR AND MATERIALS

Unless otherwise provided in the Contract documents, the CONTRACTOR shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation and other facilities and services necessary for the proper execution and completion of the work, whether temporary or permanent and whether or not incorporated or to be incorporated into the work.

107.14. EQUAL EMPLOYMENT OPPORTUNITY

During the performance of this Contract the CONTRACTOR agrees as follows:

107.14.1. Nondiscrimination Toward Employees. The CONTRACTOR shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, age, military or veteran status, disability unrelated to job performance, or national origin. The CONTRACTOR shall take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to their race, color, sex, religion, age or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination, rates of pay or other forms of compensation; and selection for training, including apprenticeship. The CONTRACTOR agrees to post in conspicuous places, available to employees or applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

107.14.2. Nondiscrimination Employment Practices. The CONTRACTOR shall, in all solicitations or advertisements for employees placed by or on behalf of the CONTRACTOR, state that all qualified applicants shall receive consideration for employment without regard to race, color, religion, sex, national origin or age.

107.14.3. Labor Unions. The CONTRACTOR shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a notice to be provided, advising the said labor union or workers' representatives of the CONTRACTOR's commitments under this

section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

107.14.4. Provisions in Subcontracts. The CONTRACTOR shall include the provisions of this section in all subcontracts pertaining to the work.

107.14.5. Reports. During the course of the work, the CONTRACTOR shall submit to the OWNER, on a monthly basis, a breakdown by minority group of all employees at the site of the work.

107.15. STATE AND LOCAL SALES AND USE TAXES

The OWNER qualifies for exemption from the state and local sales and use taxes, pursuant to the provisions of Section 151.309 of the Texas Limited Sales, Excise and Use Tax Act. Therefore, the CONTRACTOR shall not pay such taxes which would otherwise be payable in connection with the performance of this Contract.

The CONTRACTOR shall issue an exemption certificate in lieu of the tax on the purchase of:

- (1) all materials, supplies, equipment and other tangible personal property incorporated into the real property being improved; and
- (2) all materials, supplies and other tangible personal property, other than machinery or equipment and its accessories and repair and replacement parts, necessary and essential for the performance of the Contract with the OWNER which is to be completely consumed at the job site.

Tangible personal property necessary and essential for the performance of the Contract includes only such materials, tools and supplies specifically needed and directly used to incorporate tangible personal property into the real estate being improved under the Contract. Overhead supplies and supplies used indirectly or only incidental to the performance of the Contract with the OWNER are not included in the exemption. Tangible personal property is "completely consumed" if after being used once for its intended purpose it is used up or destroyed. Any exemption certificate issued by the CONTRACTOR is subject to the existing rules and interpretation governing the exemption issued by the Comptroller of Public Accounts of the State of Texas. The OWNER will not make interpretations of the extent or applicability of the exemption in a particular case; if the CONTRACTOR, or any SUBCONTRACTOR or supplier of the CONTRACTOR, has any questions about the extent or applicability of the exemption in specific circumstances, guidance should be sought from the State Comptroller's Office.

Under "reasons said purchaser is claiming this exemption" in the exemption certificate, the CONTRACTOR must name the OWNER and the project for which the equipment, material and supplies are being purchased, leased or rented.

107.16. PATENTS

The CONTRACTOR shall pay all royalties and license fees and shall provide, by suitable legal agreement with the patentee or OWNER, for the use of any design, device, material or process covered by letters, patent or any copyright. The CONTRACTOR shall indemnify, defend, hold and save the OWNER and its officers, employees and agents harmless from all liability and claims for infringement of any patent, copyright, mark or license.

In the event that any claims, suit or action at law or in equity of any kind whatsoever is brought against the OWNER, or its officers, employees or agents involving any such patents, copyrights or license rights, then the OWNER shall have the right to and may retain from any money due or to become due to the CONTRACTOR such sum deemed necessary by the OWNER for its protection until such claim or suit shall have been settled and satisfactory evidence to that effect shall have been furnished the OWNER.

107.17. COMPLIANCE WITH LAWS

The CONTRACTOR shall fully comply with all local, state and federal laws, including all codes, ordinances and regulations applicable to this Contract and the work to be done thereunder, which exist or which may be enacted later by governmental bodies having jurisdiction or authority for such enactment. CONTRACTOR shall correct any work not in compliance with local, state or federal laws.

The CONTRACTOR shall secure and pay for all permits and licenses necessary for the execution of the work and shall fully comply with all their terms and conditions.

All work required under this Contract shall comply with all requirements of law, regulation, permit or license. If the CONTRACTOR finds that there is a variance, it shall immediately report this to the OWNER for resolution.

107.17.1. Pleas of Misunderstanding. No pleas of misunderstanding or ignorance thereof will be considered. The CONTRACTOR and the CONTRACTOR'S Sureties shall indemnify and save harmless the OWNER

against any claims or liability arising from or based on the violation of any such law, ordinance, regulation or order whether by the CONTRACTOR, its employees, or SUBCONTRACTORS.

All work required under this contract shall comply with all required documents of law, regulation, permit or license, if the CONTRACTOR finds that there is a variance, the CONTRACTOR shall immediately report such to the OWNER for resolution.

OWNER shall not be liable for interest on any progress or final payment to be made under this Contract, except as may be provided by the applicable provisions of the Prompt Payment Act, Chapter 2251, Texas Government Code, as amended.

107.18. SANITARY PROVISIONS

The CONTRACTOR shall establish and enforce among its employees such regulations in regard to cleanliness and disposal of garbage and waste as shall tend to prevent the inception and spread of infectious or contagious diseases and to prevent effectively the creation of a nuisance about the work on any property either public or private, and such regulations as are required by the OWNER shall be put into immediate force and effect by the CONTRACTOR. The necessary sanitary conveniences for the use of laborers on the work, properly secluded from public observation, shall be constructed and maintained by the CONTRACTOR in such a manner and at such points as shall be approved by the OWNER, and their use shall be strictly enforced by the CONTRACTOR. All sanitary laws and regulations of the State of Texas and the OWNER'S jurisdiction shall be strictly complied with.

107.19. PUBLIC CONVENIENCE AND SAFETY

Materials stored about the work site shall be so placed, and the work shall at all times be so conducted, as to cause no greater obstruction to the traveling public than is considered necessary by the OWNER. The CONTRACTOR shall make provisions by bridges or otherwise at all cross streets, highways, sidewalks and private driveways for the free passage of pedestrians and vehicles, provided that where bridging is impracticable or unnecessary, in the opinion of the OWNER, the CONTRACTOR may make arrangements satisfactory to the OWNER for the diversion of traffic and shall, per the Contract, provide all material and perform all work necessary for the construction and maintenance of roadways and bridges for the diversion of traffic. Sidewalks must not be obstructed except by special permission of the OWNER. The materials excavated, and the construction materials or plant used in the construction of the work, shall be placed so as not to endanger the work or prevent free access to all fire hydrants, water valves, gas valves, manholes for the telephone, telegraph signal or electric conduits, sanitary sewers and fire alarm or police call boxes in the vicinity.

The OWNER reserves the right to remedy any neglect on the part of the CONTRACTOR as regards to the public convenience and safety which may come to its attention, after 24 hours' notice in writing to the CONTRACTOR, save in cases of emergency, when it shall have the right to remedy any neglect without notice; and in either case, the cost of such work done by the OWNER shall be deducted from the monies due or to become due the CONTRACTOR. The CONTRACTOR shall notify the OWNER when any street is to be closed or obstructed; such notice shall in the case of major thoroughfares or streets upon which transit lines operate be made 48 hours in advance. The CONTRACTOR shall, when directed by the OWNER, keep any street or streets in condition for unobstructed use by emergency services. Where the CONTRACTOR is required to construct temporary bridges or to make other arrangements for crossing over ditches or streams, its responsibility for accidents shall include the roadway approaches as well as the structures of such crossings.

Where the work passes over or through private property, the OWNER shall provide such right-of-way. The CONTRACTOR shall notify the proper representatives of any public utility, corporation, any company or individual, not less than 48 hours in advance of any work which might damage or interfere with the operation of property along or adjacent to the work. The CONTRACTOR shall be responsible for all damage or injury to property of any character (except such as may be required by the provisions of the Contract documents or caused by agents or employees of the OWNER) by reason of any negligent act or omission on the part of the CONTRACTOR, its employees, agents or SUBCONTRACTORS, or at any time due to defective work or materials, or due to its failure to reasonably or properly prosecute the work, and said responsibility shall not be released by the fact that the work shall have been completed and accepted.

When and where any such damage or injury is done to public or private property on the part of the CONTRACTOR, restoration shall be completed according to [Item 107.27](#). Restoration of Property.

107.20. PROTECTION OF WORK AND PERSONS AND PROPERTY

107.20.1. Protection of Work. During performance and up to date of final acceptance, the CONTRACTOR shall be under the absolute obligation to protect all work against any damage, loss or injury. In the event of damage, loss or injury, the CONTRACTOR shall promptly replace or repair the work, whichever the OWNER shall determine to be preferable. The obligation to deliver finished work in strict accordance with the Contract prior to final acceptance shall be absolute and shall not be affected by the OWNER's approval of or failure to prohibit means and methods of construction used by the CONTRACTOR. All risk of loss or damage to the work shall be borne solely by the CONTRACTOR until final completion and acceptance of all work by the OWNER, as evidenced by the OWNER's issuance of a certificate of acceptance.

107.20.2. Protection of Persons and Property. The CONTRACTOR shall have the responsibility to provide and maintain all warning devices and take all precautionary measures required by law or otherwise to protect persons and property while said persons or property are approaching, leaving or within the work site or any area adjacent to said work site. Compensation shall be paid to the CONTRACTOR for the installation or maintenance of any warning devices, barricades, lights, signs or any other precautionary measures required by law or otherwise for the protection of persons or property according to [Item 801.1](#). Barriers and Warning and Detour Signs.

The CONTRACTOR shall assume all duties owed by the OWNER to the general public in connection with the general public's immediate approach to and travel through the work site and the area adjacent to said work site.

Where the work is carried on, in or adjacent to any street, alley, sidewalk, public right-of-way or public place, the CONTRACTOR shall at its own cost and expense provide such flagmen and watchmen in addition to its responsibility to furnish, erect and maintain such warning devices, barricades, lights, signs, and other precautionary measures for the protection of persons or property as are required by law. During periods when schools are in session, the CONTRACTOR will be required during the construction of the Work to:

- (1) Maintain a suitable all-weather footpath across the Work at all designated school crosswalks.
- (2) Move and reinstall pedestrian crossing warning signs as construction and routing of traffic lanes require.

The CONTRACTOR's responsibility for providing and maintaining flagmen, watchmen, warning devices, barricades, signs, and lights, and other precautionary measures shall not cease until directed in writing by the OWNER or until final payment, whichever occurs first. If the OWNER discovers that the CONTRACTOR has failed to comply with the applicable federal and state law by failing to furnish the necessary flagmen, warning devices, barricades, lights, signs or other precautionary measures for the protection of persons or property, the OWNER may order such additional precautionary measures as required by law to be taken to protect persons and property. The CONTRACTOR shall reimburse the OWNER for any expense incurred by the OWNER in taking any additional precautionary measures as a result of the CONTRACTOR's failure to do so.

In addition, the CONTRACTOR will be held responsible for all damage to the work and other public or private property due to the failure of warning devices, barricades, signs, lights, or other precautionary measures in protecting said property, and whenever evidence is found of such damage, the OWNER may order the damaged portion immediately removed and replaced by and at the cost and expense of the CONTRACTOR.

Minimum standards for safeguarding pedestrian and vehicular traffic are contained in the current *Texas Manual of Uniform Traffic Control Devices*, as amended, Texas Department of Transportation. Signage, barricades and other traffic control devices for detouring and maintenance of traffic on this Contract shall be as provided in above said manual and as directed by the OWNER. Costs associated with the acquisition and removal of required traffic control devices shall be considered incidental to the Work.

107.20.3. Trench Safety.

107.20.3.1. Regulations. The CONTRACTOR shall be responsible for complying with state laws and federal regulations relating to trench safety, including those which may be enacted during the performance under this Contract. The CONTRACTOR is advised that Federal Regulations 29 C.F.R. 1926.650-1926.652 have been, in their most recent version as amended, in effect since January 2, 1990.

The CONTRACTOR shall fully comply with the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations pertaining to excavations, trenching, and shoring and shall provide and familiarize its employees involved in excavation and trenching with the provisions in OSHA pamphlet number 2226, excavation and trenching operations.

107.20.3.2. Indemnification. In addition to any other indemnification, CONTRACTOR agrees to defend, indemnify and hold OWNER, its officers, agents and employees, completely harmless from any claims, lawsuits, judgments, costs and expenses (including attorney's fees, if any) for any personal injury (including death), property damage or other harm for which recovery of damages is sought (including any injury, death or damage suffered by the CONTRACTOR'S own employees) arising out of or occasioned by the use of any trench excavation plans, regardless of their origin, or by any negligent, grossly negligent, strictly liable or intentional act of the CONTRACTOR, a SUBCONTRACTOR or any individual employee or laborer (whether or not an employee of the CONTRACTOR or a SUBCONTRACTOR) in the performance or supervision of actual trench excavation under the contract. This indemnity applies regardless of whether OWNER'S or consulting engineer's negligence or fault in the administration of this contract or in the preparation, review or approval of the OWNER'S or CONTRACTOR'S trench excavation plan contributed to the injury, death or damage. OWNER accepts no liability whatsoever as a result of its preparation, review or approval of any trench excavation plan under this contract; OWNER makes no warranty, express or implied, concerning the adequacy or correctness of any trench excavation plan.

(The provisions of this paragraph are solely for the benefit of the parties to the contract and are not intended to create or grant any rights, contractual or otherwise, to any other person or entity. This paragraph shall not be construed to waive any governmental immunity of the OWNER. This paragraph controls in the event of a conflict with any other indemnity or OWNER-warranty provision in the specifications).

107.20.3.3. Trench Safety Plan. The CONTRACTOR shall be responsible for providing to the OWNER an acceptable trench safety plan signed and sealed by a Professional Engineer qualified to do such work and licensed/registered in the State of Texas. The CONTRACTOR shall be responsible for selecting an appropriate method of providing trench safety after due consideration of the job conditions, location of utilities, pavement conditions and other relevant factors. Slope-back methods which may result in unnecessary displacement of utilities and/or destruction of pavement shall not be used without permission from the OWNER. Plans for devices used to provide trench safety such as trench shields and shoring systems will be likewise certified by Professional Engineers licensed/registered in the State of Texas or by a Professional Engineer licensed/registered in the state of manufacture of the shield or shoring system.

107.20.3.4. Shoring and Sheet piling. The sides of all excavation shall be supported in accordance with the trench safety plan. Where bracing or sheet piling and bracing are used, the trench width shall be increased accordingly, shall be considered as incidental work, and shall not be paid for as a separate item. In wet, saturated or flowing materials where it is necessary to install tight sheet piling or cofferdams, wood or steel sheet piling of a design and type approved by the OWNER shall be used. All sheet piling, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted, to maintain the sides of the excavation properly in place, and to protect all persons or property from injury or damage. When excavations are made adjacent to existing buildings or other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of or settlement beneath the structures or pavement. Underpinning of adjacent structures or pavement shall be done at the CONTRACTOR'S own cost and expense and in a manner satisfactory to the OWNER, or, when required by the OWNER, the pavement shall be removed, the void satisfactorily filled, compacted and the pavement replaced by the CONTRACTOR. The entire expense of such removal and subsequent replacement thereof shall be borne by the CONTRACTOR. Wooden sheet piling, shoring and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill.

The removal of all sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, or private or public properties; and so as to avoid cave-ins or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the CONTRACTOR, with the approval of the OWNER, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place unless ordered by the OWNER to be left in place.

107.20.3.5. Inspection. The CONTRACTOR shall cause all shoring or bracing to be inspected by an OSHA competent person. According to OSHA regulations, a competent person is defined as one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

107.20.3.6. Payment for Trench Safety and Shoring. Payment for trench safety shall be by the lineal feet of trench exceeding a depth of 4-ft. unless otherwise specified in the Contract. Excavation for slope-back methods shall be subsidiary to the trench safety pay item including replacement and re-compaction. Excess excavation for other trench safety methods is also subsidiary to the trench safety pay item. Costs relating to the preparation of the trench safety plan including geotechnical investigation, testing and report preparation fees are all subsidiary to the pay item for trench safety. Should trench safety measures be required during Contract performance where no pay item has been provided, then the CONTRACTOR shall immediately notify the OWNER and, if directed to do so, provide trench safety under the provisions of [Item 104.2.3](#). Extra Work and/or [Item 109.3](#). Payment for Extra Work. Should the OWNER fail to authorize the work as provided for in [Item 104.2.3](#). Extra Work and [Item 109.3](#). Payment for Extra Work, then the CONTRACTOR shall proceed under the provisions of [Item 104.3](#). Disputed Work and Claims for Additional Compensation and [Item 104.4](#). Performance of Extra or Disputed Work. Trench safety requirements are mandatory and shall not be waived.

107.21. PROJECT SIGNS

Project signs shall be furnished, constructed, and erected by the CONTRACTOR as directed by the OWNER. Signs shall be placed in a location selected by the OWNER and maintained in good condition until the completion of the project. Project signs shall be removed by the CONTRACTOR upon the completion and acceptance of the project by the OWNER.

107.22. WORKING AREA

The CONTRACTOR shall confine its equipment, storage of materials and construction operations to the area shown on the Contract drawings or stated in the specifications, prescribed by ordinance, laws, or permits or as may be directed by the OWNER, and shall not unreasonably encumber the site or public right-of-way with its construction equipment, plant or materials.

Such area shall not be deemed for the exclusive use of the CONTRACTOR. Other CONTRACTORS of the OWNER may enter upon and use such portions of the area and for such items as determined by the OWNER are necessary for all purposes required by its contracts. The CONTRACTOR shall give to such other CONTRACTORS all reasonable facilities and assistance to the end that the work on this and other contracts shall not be unduly or unreasonably delayed. Any additional areas desired by the CONTRACTOR for its use shall be provided at its own effort, cost and expense.

All rights-of-way and easements shown on the plans for construction will be provided by the OWNER. If private property is leased or occupied by the CONTRACTOR for use in conjunction with the Work, the CONTRACTOR shall provide to the OWNER, in writing prior to final acceptance of the Work, a release of the CONTRACTOR and OWNER from any and all claims the private property OWNER has or may have as a result of the CONTRACTOR'S use of the private property during the course of the Work. The release shall be signed by the private property OWNER or the private property OWNER'S agent.

107.23. RAILWAY CROSSINGS

Where the work encroaches upon any right-of-way of any railway, the OWNER shall secure the necessary easement for the work. Where railway tracks are to be crossed, the CONTRACTOR shall observe all the regulations and instructions of the railway company as to methods of doing the work or precautions for safety of property and the public. All negotiations with the railway company, except for right-of-way, shall be made by the CONTRACTOR. The railway company shall be notified by the CONTRACTOR not less than five days prior to commencing the work. The CONTRACTOR shall not be paid separate compensation for such railway crossing but shall receive only the compensation as set out in the proposal.

Prior to crossing or working on Railroad Right-of-Way, the CONTRACTOR will be required to contact the railroad company, or companies, and to execute CONTRACTOR'S Agreements as may be required by each railroad company involved. No work shall be permitted where railroads are involved until the OWNER is furnished sufficient correspondence from the railroad company involved to ascertain that either the agreement has been executed or a certified copy of the insurance policy furnished, or that no such action is required.

107.24. EXISTING STRUCTURES, FACILITIES AND APPURTENANCES

107.24.1. General. This [Item 107.24](#). Existing Structures, Facilities and Appurtenances addresses only matters arising from certain existing, man-made surface and subsurface structures, facilities and appurtenances, not naturally occurring conditions. **AS PROVIDED IN [ITEM 103.1](#). CONTRACTOR'S WARRANTIES AND UNDERSTANDING, THE OWNER SHALL HAVE NO LIABILITY WHATSOEVER FOR ANY CLAIM ARISING FROM A DIFFERING, NATURALLY OCCURRING SURFACE OR SUBSURFACE CONDITION, OR FROM ANY MAN-MADE CONDITION THAT IS NOT A SURFACE OR SUBSURFACE STRUCTURE, FACILITY OR APPURTENANCE.** The OWNER'S responsibility for any claim arising from existing, man-made surface and subsurface structures, facilities and appurtenances is governed solely by this [Item 107.24](#). Existing Structures, Facilities and Appurtenances, and any situation involving a differing subsurface condition not included herein shall be governed solely by [Item 103.1](#). CONTRACTOR'S Warranties and Understanding.

107.24.2. Showing Locations. The plans show the general locations of all known, existing man-made surface and subsurface structures, facilities and appurtenances. The locations of many gas mains, water and wastewater mains, storm sewers, drains, culverts, conduits and other man-made utility structures, facilities and appurtenances, however, are unknown. **THE OWNER DOES NOT WARRANT THE PLANS TO SHOW THE EXACT LOCATIONS OF ANY AND ALL KNOWN, EXISTING MAN-MADE SURFACE AND SUBSURFACE STRUCTURES, FACILITIES AND APPURTENANCES, AND DOES NOT WARRANT THAT IT KNOWS OF THE EXISTENCE OF ALL POSSIBLE EXISTING MAN-MADE SURFACE AND SUBSURFACE STRUCTURES, FACILITIES AND APPURTENANCES.** The OWNER assumes no responsibility, except as provided below, for any failure to show any or all of these structures on the plans or to show them in their exact locations.

Wherever the OWNER has caused certain test borings to be made on the site, or when any information pertaining to the character or depth of materials is found from observations, records or otherwise, such information revealed thereby may be indicated on the plans. The action of the OWNER in revealing such information shall not in any manner be construed as conclusive or as a warranty on the part of the OWNER of the exact nature of the subsurface conditions that shall be encountered during construction of the work. Although the information is shown as accurately as possible, the OWNER does not guarantee that any materials to be encountered at any point or points are even approximately the same, either in character or elevations, as those shown on the plans. The information thus furnished by the OWNER is intended only as a guide to the CONTRACTOR'S own investigations preliminary to submitting a bid for the work.

107.24.2.1. Soil Borings. Soil Borings are to be used for information only and are not warranted accurate or conclusive in any way. The OWNER accepts no responsibility for any deviation from or variance in soil types and/or depths shown on the borings.

107.24.3. Conditions for Increases to Work or Payment. The CONTRACTOR and OWNER mutually, expressly agree that the failure of the OWNER to show any existing, man-made surface or subsurface structure, facility or appurtenance on the plans, or the failure to show them on the plans in their exact locations, shall not be considered as a basis of a claim for Extra Work, damages or other compensation of

any kind, nor shall it be considered as a basis for increasing the quantities of work or unit prices on any bid item, unless:

- (1) The CONTRACTOR could not have discovered the existing, man-made surface or subsurface structure, facility or appurtenance by a reasonable review of the plans and specifications and a reasonable, careful inspection of the work site prior to bid opening or award of the Contract; and
- (2) The existing, man-made surface or subsurface structure, facility or appurtenance is in a location that necessitates a substantial change in the alignment, depth or hydraulic gradient of the work to be constructed under the Contract because the CONTRACTOR cannot, by the use of reasonable skill or care, place the work in accordance with the original alignment, depth or hydraulic gradient; or
- (3) The existing surface or subsurface structure, facility or appurtenance requires the construction of a special structure, facility, appurtenance or other special work, provisions for which are not already made in the plans and specifications, to protect either the existing, man-made surface or subsurface structure, facility or appurtenance or the work to be constructed under the Contract from damage.

If the elements of (1) and either (2) or (3) occur, the provisions of the specifications regarding claims for Extra Work apply. Otherwise, the condition is considered part of the Contract work and OWNER shall not be liable for extra compensation. Provided, however, that the OWNER will not be liable for payment of Extra Work claims under this subsection that are not timely filed in accordance with other provisions of the specifications, nor shall the OWNER be liable to pay for any additional work or additional costs arising solely from a decision of the CONTRACTOR to change the original means or methods of construction chosen because an existing, man-made surface or subsurface structure, facility or appurtenance is encountered.

107.24.4. Utility Coordination and Protection. It is the intention of the OWNER that all known conflicts between utility-owned facilities and the proposed construction will be cleared prior to the issuance of the work order. Utility information shown on the plans must be confirmed by actual field check in advance of construction. Table 107.24.4.(a) Utility Coordination lists the most frequently needed contacts.

Table 107.24.4.(a) Utility Coordination

Entity	Contact Information
Texas One Call system	811
Municipal, Governmental, or Quasi-Governmental Utility OWNER	CONTRACTOR shall contact the respective entity

It will be the CONTRACTOR'S responsibility to locate and report all utility conflicts to the OWNER promptly in order to avoid unnecessary delays, and the CONTRACTOR will cooperate with utility OWNER s in making the adjustment(s). Conflicts that are found during construction will be resolved as expeditiously as possible.

The CONTRACTOR will be required to protect adequately all utility-owned facilities from damage or displacement by its operations.

The adjustment or location of any utility-owned facility which the CONTRACTOR may desire for its own convenience or ease of construction will be its responsibility to coordinate and will be at its own expense.

CONTRACTOR shall further abide by the provisions of [Item 201.2](#). Determining Location and Protection of Existing Structures and Utilities.

107.25. PROJECT CLEAN-UP

The CONTRACTOR shall keep the project site in a neat and orderly condition as an integral part of the contracted work and as such shall be considered subsidiary to the appropriate bid items. Clean up work shall be done as needed or as directed by the OWNER as the work progresses. Clean-up shall be done on a daily basis. Clean up work shall include, but not be limited to:

- (1) Removing the trash, paper, rubbish and debris resulting from operations
- (2) Sweeping streets clean of dirt or debris
- (3) Alleviating any dust nuisance in the work area
- (4) Storing excess material in appropriate and organized manner
- (5) Keeping trash of any kind off of residents' property

The CONTRACTOR, prior to utilizing any private property, shall provide a written agreement between the CONTRACTOR and the Property OWNER to the Project Manager or Construction Superintendent. The agreement shall state what uses are allowed for the property, the length of time the CONTRACTOR is allowed to use it and the final condition the property shall be returned to once all work is completed. CONTRACTOR shall provide a written release from the Property OWNER once the area has been restored.

The work shall be so conducted as to create a minimum amount of inconveniences to the public. At any time when in the judgment of the OWNER the CONTRACTOR has obstructed or closed or is carrying on operations in a greater portion of a park, street or public way than is necessary for the proper execution of the work, the OWNER may require the CONTRACTOR to finish the sections on which work is in progress before operations are started on any additional section.

The CONTRACTOR will be required to remove spoil from the job site in a timely manner. If, in the opinion of the OWNER, the spoil is not being removed as required, the CONTRACTOR will be directed to remove the spoil. The CONTRACTOR must comply with this directive within 24 hours. There will be no additional compensation to the CONTRACTOR for removing this spoil at a time other than as planned. CONTRACTOR shall comply with all requirements and regulations for any spoil removed from the project.

The CONTRACTOR shall perform such cleanup work as deemed necessary by the OWNER. Failure of the CONTRACTOR to maintain the site in a neat and orderly condition will be cause for withholding an additional ten percent (10%) of the total payments until said condition is corrected. Storage areas, either fenced or open, shall be kept free of weeds, tall grass, and other debris. In instances of large scale irrigation and planting installation, the entire site shall be kept neat and orderly with no tall grass or weed growth allowed. It shall be the CONTRACTOR'S responsibility to see that the turf areas are kept mowed during entire progress of the work. If the CONTRACTOR fails to alleviate poorly maintained conditions upon written notice by the OWNER, the OWNER will take necessary steps to correct the poor conditions with cost of such corrections to be deducted from the Contract.

Upon completion of the work and before final acceptance and final payment shall be made, the CONTRACTOR shall completely clean and remove from the site of the work all equipment, construction materials, surplus and discarded materials, temporary structures and debris of every kind. CONTRACTOR shall leave the site of the work in a neat and orderly condition equal to that which originally existed, or as called for in the Contract documents. Surplus and waste materials removed from the site of the work shall be disposed of at locations satisfactory to the OWNER, and at the CONTRACTOR'S sole cost.

107.26. DISPOSAL OF MATERIALS

Surplus excavation and other materials removed as a part of the construction may be deposited at a legal disposal site in accordance with all applicable federal, state and local laws and regulations. In addition, if the materials are disposed of within private property, a release from the property OWNER must be obtained before final acceptance of the Work as described in [Item 107.22. Working Area](#).

Surplus excavation and other materials must not be deposited in areas designated as flood plain or along natural drainage ways. Material so deposited will be required to be removed at the CONTRACTOR'S expense and the area restored to its natural condition.

Failure to comply promptly with the requirements of this special provision will result in withholding of payments due.

107.27. RESTORATION OF PROPERTY

When and where any damage or injury is done to public or private property on the part of the CONTRACTOR, it shall restore or have restored at its own cost and expense such property to a condition equal (or improved) to that existing before such damage was done by repairing, rebuilding or otherwise restoring as may be directed, or it shall make good such damage or injury in a manner acceptable to the property OWNER or the OWNER. Replacement of previously constructed items, such as curb, gutter, sidewalks, driveways, paving, etc., shall conform to the specifications for new construction, unless directed otherwise by the OWNER.

In case of failure on the part of the CONTRACTOR to restore such property or make good such damage or injury, the OWNER may, upon 48 hours written notice, under ordinary circumstances, and without notice when a nuisance or hazardous condition results, proceed to repair, rebuild or otherwise restore such property as may be determined necessary, and the cost thereof shall be deducted from any monies due or to become due the

CONTRACTOR under its Contract; or where sufficient Contract funds are unavailable for this purpose the CONTRACTOR or its surety shall reimburse the OWNER for all such costs.

107.28. ENVIRONMENTAL COMPLIANCE

The CONTRACTOR and its SUBCONTRACTORS are deemed to have made themselves familiar with and at all times shall comply with any and all applicable federal, state or local laws, rules, regulations, ordinances, and rules of common law now in effect (including any amendments now in effect), relating to the environment, Hazardous Substances or exposure to Hazardous Substances, including but not limited to the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C.A. §§ 9601, et seq.; the Hazardous Materials Transportation Act, 49 U.S.C.A. §§ 1801, et seq.; the Resource Conservation and Recovery Act of 1976, 42 U.S.C.A. §§ 6901, et seq.; the Federal Water Pollution Control Act, 33 U.S.C.A §§ 1201, et seq.; the Clean Water Act, 33 U.S.C. § 1251, et seq., the Toxic Substances Control Act, 15 U.S.C.A. §§ 2601, et seq.; the Clean Air Act, 42 U.S.C.A. §§ 7401, et seq.; the Safe Drinking Water Act, 42 U.S.C.A. §§ 3808, et seq., and the latest judicial or administrative interpretation of these laws, rules, regulations, ordinances, or rules of common law, including but not limited to any judicial or administrative order, consent decree, or judgment affecting the Project.

In the event the CONTRACTOR encounters on the site materials reasonably believed to be a Hazardous Substance that have not been rendered harmless, and removal of such materials is not a part of the scope of work required under the contract documents, the CONTRACTOR shall immediately stop work in the affected area and report in writing the facts of such encounter to the OWNER. Work in the affected area shall not thereafter be resumed except by written order of the OWNER unless and until the material is determined not to be a Hazardous Substance or the Hazardous Substance is remediated. The OWNER may choose to remediate the Hazardous Substance with a separate CONTRACTOR or through a Change Order with the CONTRACTOR. If the OWNER determines that the Hazardous Substance exists in the affected area due to the fault or negligence of the CONTRACTOR or any of its SUBCONTRACTORS, the CONTRACTOR shall be responsible for remediating the condition at the sole expense of the CONTRACTOR in accordance with the CONTRACTOR'S Spill Prevention and Response Plan. An extension of working time for any delay in the progress schedule caused as a result of the discovery and remediation of a hazardous substance may be granted by the OWNER only if all remaining work on the project must be suspended and the delay cannot be made up elsewhere in the progress schedule. Any claim or request for an extension of working time by the CONTRACTOR in connection with the discovery and remediation of a hazardous substance is subject to the provisions of NCTCOG.

The CONTRACTOR shall be responsible for identification, abatement, cleanup, control, removal, remediation, and disposal of any Hazardous Substance brought into or upon the site by the CONTRACTOR or any SUBCONTRACTOR or supplier. The CONTRACTOR shall obtain any and all permits necessary for the legal and proper handling, transportation, and disposal of the Hazardous Substance and shall, prior to undertaking any abatement, cleanup, control, removal, remediation, and disposal, notify the OWNER so that they may observe the activities; provided, however, that it shall be the CONTRACTOR'S sole responsibility to comply with all applicable laws, rules, regulations, or ordinances governing the activities.

The CONTRACTOR shall deposit surplus or waste excavation or other materials removed as part of the work at a legal disposal site in accordance with all applicable state, federal, and local laws, rules, regulations, and ordinances. The CONTRACTOR shall submit to the OWNER for review and approval all planned disposal sites or proposed uses for the surplus or waste excavation or other materials prior to removal of any excavation or other material from the Project site. A copy of all transport manifests for surplus or waste excavation or other materials shall be obtained and retained in the CONTRACTOR'S records for reference purposes, to be provided upon request to the OWNER or any governmental regulatory agency with jurisdiction over the matter.

107.28.1. Spill Prevention Plan. At least seventy-two (72) hours prior to commencing performance of any of the work at the Project site, the CONTRACTOR shall submit to the OWNER for review and approval a Spill Prevention and Response Plan (SPRP) meeting the requirements of federal and state law, rules, and regulations. The SPRP shall be specially designed for the CONTRACTOR'S planned work methods and procedures. The SPRP shall be designed to complement all applicable safety standards, fire prevention regulations, and pollution prevention policies and procedures. The SPRP shall include estimates of the quantity and rate of flow should equipment fail, and detail containment or diversionary structures to prevent spills from leaving the site or migrating into adjacent properties or navigable waters. The SPRP shall include

methods of recovery of spilled materials and all applicable twenty-four (24) hour emergency phone numbers, including without limitation that of the OWNER. The CONTRACTOR shall not commence any fieldwork prior to approval of such plan by the OWNER. The following additional rules shall apply with respect to spills caused by the CONTRACTOR or a SUBCONTRACTOR:

- (1) The CONTRACTOR shall immediately report any spill or release at the Project site, whether or not it is associated with this contract, to the OWNER or other designated representative. Thereafter, within two (2) working days after the occurrence of such event, the CONTRACTOR shall submit a written report describing such event in a degree of detail reasonably acceptable to the OWNER.
- (2) The CONTRACTOR shall immediately respond in accordance with the SPRP in the event of a spill.
- (3) The CONTRACTOR shall dispose of spilled materials in accordance with EPA and Texas Commission on Environmental Quality (TCEQ) regulations and any other applicable federal, state, or local laws, rules, or regulations. In connection with such disposals, the CONTRACTOR shall use only those transporters and disposal facilities that are approved in advance in writing by the OWNER. A copy of all transport manifests for the spilled materials shall be obtained and retained in the CONTRACTOR'S records for reference purposes, to be provided upon request of the OWNER or any governmental regulatory agency with jurisdiction over the matter. All costs of collection, containment, and disposal of spilled materials shall be the sole responsibility of the CONTRACTOR.
- (4) The term spill includes any kind of environmental discharge or release.

107.28.2. Texas Pollutant Discharge Elimination System. The CONTRACTOR is responsible for obtaining coverage under the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit from TCEQ for construction of the Project under regulations contained in 40 CFR Part 122, as amended, pursuant to the Clean Water Act, 33 U.S.C.A. §§1251 et seq. and Chapter 26 of the Texas Administrative Code. These regulations require the filing of a Notice of Intent (NOI) to obtain and abide by the general stormwater permit for construction activities promulgated by EPA as administered by the TCEQ, including but not limited to demolition, clearing, grading, embankment, and excavation that disturb the applicable amount of total land area. In addition, the CONTRACTOR shall comply with all regulations of the OWNER relating to stormwater and stormwater runoff management at the Project site.

107.28.3. Stormwater Permit. The CONTRACTOR shall provide a Storm Water Pollution Prevention Plan (SWPPP) in accordance with the requirements of the TPDES Construction General Permit, and Storm Water Pollution Prevention Plan, of these Specifications. The CONTRACTOR is responsible for obtaining an Storm Water Discharge Permit that may be required for construction of this project under regulations contained in 40 CFR Part 122, as amended, under the authority of the Clean Water Act, 33 U.S.C. 1251 et seq. These regulations require the filing of a notice of intent to obtain and abide by the general storm water permit for construction activities, including cleaning, grading, and excavation, that disturb the applicable amount of total land area. For permitting information and requirements, contact USEPA Region VI, Fountain Place 12th Floor, Suite 1200, 1445 Ross Ave., Suite 1200, Dallas, Texas 75202-2733, (214) 665-2200 and Texas Commission on Environmental Quality.

If a permit is required, the CONTRACTOR shall provide measures to control soil erosion sediment and water pollution created by construction operations for the duration of the Contract as directed by the OWNER. These measures shall be in addition to those required of the CONTRACTOR under [Item 202](#). Temporary Erosion, Sedimentation, and Water Pollution Prevention and Control of these specifications.

107.28.4. Asbestos-Related Materials. The CONTRACTOR shall not install any materials in the performance of the work that contain asbestos or asbestos-related material such as hydrated mineral silicate, including chrysolite, amosite, crocidolite, trifoliate, anthophyllite or actinolite, whether friable or non-friable.

107.28.5. Failure to Comply. The OWNER reserves the right in its sole option to exercise the following remedies (without waiving the right to pursue the imposition of any civil or criminal fines or penalties that may be imposed under state, federal, or local laws or ordinances), at no additional cost to the OWNER and without an extension of time, in the event the CONTRACTOR fails or refuses after seven (7) days advance written notice from the OWNER to comply with these provisions, the terms of the SPRP, any environmental permit or submittal issued in connection with the work, or any applicable environmental law, rule, regulation, or ordinance:

- (1) suspend all or any portion of the work until the noncompliance is corrected, or until a detailed plan to achieve compliance within a reasonably prompt period of time is prepared by the CONTRACTOR and approved by the OWNER;
- (2) if the CONTRACTOR fails to properly address the noncompliance within the time stipulated by the OWNER, perform the necessary remediation or correction work and back charge the CONTRACTOR for the cost of the remediation or correction; or
- (3) terminate the contract for default as provided in the General Conditions and the Addendum.

ITEM 201. SITE PROTECTION

201.1. REMOVAL, PROTECTION, AND REPLACEMENT OF TREES, SHRUBBERY, PLANTS, SOD, AND OTHER VEGETATION

No trees shall be removed unless so noted on the plans or upon the specific approval of the OWNER. Where trees, plants, shrubbery, etc., are adjacent to the line of the work and are not to be removed or are designated on the plans to be removed and replanted, the CONTRACTOR shall protect such trees, plants, shrubbery, and etc. in accordance to the contract documents. If, in the opinion of the OWNER, such trees, plants, shrubbery, etc., would be damaged by machinery, etc., hand excavation may be required. Shrubby, plants, etc. to be relocated or reused shall be removed with a ball of dirt about their roots and shall be carefully stored and given proper attention.

Sod shall be removed in squares cut out with a sharp spade and of such sizes that they may be handled conveniently without breaking. They shall be carefully stored and given proper attention. During hot, dry weather, the stored sod shall be protected by covering with canvas or burlap.

Tree roots shall be protected by installing temporary construction fencing outside the tree's drip line. Other tree protection may be required by OWNER. No operating, parking, or storing of equipment and/or materials is allowed within the tree protection zone. The CONTRACTOR shall be responsible for all damage to trees, plants, shrubbery, etc., and any such damage shall be remedied to the satisfaction of the OWNER at the expense of the CONTRACTOR. All damaged limbs over 1-inch in diameter shall be sawed clean adjacent to the damaged area or at the trunk and dressed with acceptable tree wound treatment material, unless dressing is waived by the OWNER.

The cost of removal shall be paid for as a separate contract pay item if a separate pay item is provided; otherwise, the costs thereof shall be included in such pay items as are provided in the proposal and contract. The cost of protection shall not be paid for as a separate contract pay item; the costs thereof shall be included in such pay items as are provided for in the proposal and contract.

Where sod, shrubbery, plants, etc., are designated for removal and replacement, such areas shall have sod, shrubbery, plants, etc., of the same kind and in good condition, placed in OWNER approved locations. Trees that are to be removed and subsequently replaced shall be designated on the plans. When backfilling is completed, the sod, shrubbery, plants, etc. shall be carefully placed in OWNER approved locations and the area thoroughly wet down.

The cost of such replacement shall be paid for as a separate contract pay item if a separate pay item is provided; otherwise, the costs thereof shall be included in such pay items as are provided in the proposal and contract.

201.2. DETERMINING LOCATION AND PROTECTION OF EXISTING STRUCTURES AND UTILITIES

Determining location and protection of existing structures and utilities shall comply with this [Item 201.2](#), and with the provisions of [Item 107.24](#), Existing Structures, Facilities and Appurtenances and [Item 103.1](#), Contractor's Warranties and Understanding.

201.2.1. Determining Location. Determining the location of existing structures, utilities and appurtenances shall proceed according to the specifications herein and the provisions of [Item 107.24](#), Existing Structures, Facilities and Appurtenances.

BIDDERS must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location and sizes of pipe or conduits of various kinds in place. Where the exact depth of any utility or obstruction is not shown on a plan, excavation shall be made prior to reaching the obstruction in order to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary. Extra compensation shall not be paid for such delays.

201.2.1.1. Subsurface Utility Engineering. If provided by CONTRACTOR, subsurface utility engineering shall be in conformance with CI/ASCE 38-02, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, or as currently revised.

201.2.2. Protection. All existing structures, improvement and utilities designated to remain shall be adequately protected, at the expense of the CONTRACTOR, from damage that might otherwise occur due to construction operations. Where construction comes in close proximity to existing structures, utilities or

appurtenances, or if it becomes necessary to move services, poles, guy wires, pipe lines or other obstructions, the CONTRACTOR shall notify and cooperate with the owner of the utility, structure, or appurtenance. The utility lines and other existing structures shown on the plans are for information only and are not guaranteed by the OWNER to be complete or accurate as to location and/or depth. The CONTRACTOR shall be liable for damage to any utilities resulting from the CONTRACTOR'S operations. During construction, all fire hydrants, valve boxes, water meters/vaults, manholes, emergency call boxes and/or other existing utility controls shall be left intact, unobstructed and accessible unless noted on the plan.

All water mains, wastewater collection mains, wastewater collection laterals, storm drains, power conduits, gas mains, gas service laterals, irrigation systems, and other lines or appurtenances encountered during construction shall be supported or replaced as detailed on the plans. Water service lines shall not be removed during excavation, and the CONTRACTOR shall provide adequate support for the services across the open ditch.

201.2.2.1. Temporary Utility Supports. CONTRACTOR shall provide temporary utility support to protect existing utility lines exposed during construction. Method and type of temporary utility supports, if required, shall be approved by the utility owner.

201.2.3. Relocating or Replacing Structures, Utilities or Appurtenances. Utility locations shall be obtained prior to the commencement of work according to [Item 107.24](#), Existing Structures, Facilities and Appurtenances. Unless noted on plans that utilities are to be moved by others, any cost of temporarily or permanently relocating utilities shall be borne by the CONTRACTOR. The cost of these replacements shall be included in the CONTRACTOR'S bid price for the various items of work, and no separate payment shall be made. The OWNER shall approve all shut downs and may assist in the shut down operations.

If it is necessary to adjust another utility, a representative of that utility shall be notified to decide method and work to be done. The CONTRACTOR shall make satisfactory arrangements with the OWNER or other utilities for the required adjustments at the CONTRACTOR'S own expense, other than for items that may be provided in the contract for such work. No extra compensation shall be paid due to delays caused by removal of public utility structures.

201.2.3.1. Interrupted Utility Services. In case damage to an existing utility occurs, the CONTRACTOR shall notify the OWNER and utility owner immediately. The CONTRACTOR shall be responsible for the cost to restore the structure or utility to its original condition and position without extra compensation. Restoration of utility services shall be made as soon as practicable as directed and approved by the utility owner.

The CONTRACTOR shall notify the OWNER of any spill of wastewater. Remediation of the spill is the responsibility of the CONTRACTOR and shall be at no additional cost to the OWNER. Spill and remediation will be reported by the OWNER to the TCEQ, USEPA, or other appropriate regulatory agencies. The CONTRACTOR shall be responsible for notifying customers of temporary interruption of service.

201.2.3.2. Street Sign Posts and Signs. The CONTRACTOR shall be responsible for all damage to street sign posts and signs within the limits of the CONTRACTOR'S operations that remain in place or are removed and replaced. In the event that street sign posts and signs are damaged or destroyed by the CONTRACTOR'S operations, they shall be replaced at the CONTRACTOR'S expense.

201.2.3.3. Methods of Removal and Disposal. Materials or parts of structures which are to be broken up, dismantled or removed, and which are to be salvaged, shall be removed, loaded, cleaned and unloaded at sites designated by the OWNER. Materials that are not salvageable shall become the property of the CONTRACTOR. Disposal of such materials, in accordance with applicable local, state, and federal regulations, shall be at the CONTRACTOR'S expense.

201.2.4. Measurement and Payment. No measurement shall be made for the removal and replacement of utility pipe even if the utility pipe is replaced with a different pipe. No payment shall be made except as provided for under certain conditions in [Item 107.24](#), Existing Structures, Facilities and Appurtenances and Item 203.1.4.1. Measurement and Payment for Utility Supports, unless otherwise provided in the Contract.

201.2.4.1. Measurement and Payment for Temporary Utility Supports. No separate measurement or payment shall be made for temporary utility supports unless a separate bid item is established in the Contract. If a separate bid item for temporary utility supports is established in the Contract, it shall include all necessary labor, tools, materials, equipment and incidentals necessary to complete the work, including removal and cleanup.

201.3. MAINTENANCE OF STREETS AND RIGHTS OF WAY DURING CONSTRUCTION

The CONTRACTOR shall at all times maintain vehicular and pedestrian traffic through and adjacent to work zones in accordance with [Item 107](#). Legal Relations and Contractor Responsibilities. The maintenance required shall include but not be limited to the filling of potholes; blading or otherwise smoothing of the paved surfaces (particularly in a trench area); cleaning and removal of surplus excavation material, rubbish, etc.; and the maintenance of safe and efficient vehicular and pedestrian access. Dust control shall be in accordance with 203.6 Dust Control.

ITEM 202. TEMPORARY EROSION, SEDIMENTATION, AND WATER POLLUTION PREVENTION AND CONTROL

202.1. DESCRIPTION

This Item shall govern the use of temporary control measures necessary to prevent and control soil erosion, sedimentation, and water pollution that may degrade the MS4, adjacent properties, and/or receiving waters including rivers, streams, lakes, reservoirs, groundwater, and wetlands. The temporary control measures contained herein shall be installed and maintained throughout the construction contract and coordinated with any permanent or temporary pollution control features specified elsewhere on the plans and in the specifications to assure effective and continuous water pollution control throughout the construction and post construction periods. These control measures shall not be used as a substitute for the permanent pollution control measures unless otherwise directed by the OWNER in writing. The controls may include any of the devices listed in this item. Additional information regarding these and other controls can be found in NCTCOG's *integrated* Storm Water Management iSWM Program Manuals. In the event of conflict between these specifications and applicable Federal, State and Local laws, rules and regulations, the more restrictive requirement shall apply.

Measurement and payment for all measures called for within [Item 202](#), shall be per [Item 202.19](#) Measurement and Payment.

202.2. ITEMS OF WORK AND MATERIALS

The items, estimated quantities, and locations of the control measures will be shown on the plans; however, the OWNER may revise these items as needs arise. The materials will be shown on the plans and in the specifications. The OWNER may allow, in writing, the use of other materials and work methods as the need arises.

202.3. PRECONSTRUCTION SUBMITTALS

Prior to the start of construction, the CONTRACTOR shall submit to the OWNER a copy of the Storm Water Pollution Prevention Plan (SWPPP) and any documentation required by the Construction General Permit. Work on the project shall not begin until the submittals have been accepted by the OWNER. The CONTRACTOR shall provide the OWNER, for information purposes, proposed methods of storm water pollution control for CONTRACTOR operations in areas which are outside the limits of the erosion control plan or the SWPPP (such as construction and haul roads, field offices, equipment and supply storage areas, portable process plants, and source material storage), as well as a plan for disposal of waste materials.

202.4. CONSTRUCTION REQUIREMENTS

202.4.1. General. The CONTRACTOR shall provide control measures to prevent or minimize the impact of the CONTRACTOR'S operations to receiving waters as required by the plans or Storm Water Pollution Prevention Plan (SWPPP) and/or as directed by the OWNER in writing.

In any disturbed area where construction activities have ceased, permanently or temporarily, the CONTRACTOR shall initiate stabilization of the area by the use of seeding, mulching, soil retention blankets or other appropriate measures within 14-days, except in areas where construction activities are scheduled to resume within 21-days. The CONTRACTOR shall effectively prevent and control erosion and sedimentation on the site at the earliest practicable time as outlined in the approved schedule. Control measures, where applicable, will be implemented prior to the commencement of each construction operation. The CONTRACTOR shall limit the amount of disturbed earth to the area(s) shown on the plans or as directed by the OWNER. The OWNER has the authority to limit the disturbed surface area exposed by construction operations. If, in the opinion of the OWNER, the CONTRACTOR is not able to effectively control soil erosion and sedimentation resulting from construction operations, the OWNER will limit the amount of disturbed area to that which the CONTRACTOR is able to control.

Should the control measures fail to function effectively, the CONTRACTOR shall act immediately to bring the erosion and sedimentation under control by maintaining existing controls or by providing additional controls as directed by the OWNER. When, in the opinion of the OWNER, the site is adequately stabilized, the control measures, except mulches and soil retention blankets, will be removed and properly disposed of by the CONTRACTOR. Soil retention blankets shall be removed only when, in the opinion of the OWNER, final

permanent perennial seeding would be adversely affected by the presence of an existing soil retention blanket.

All erosion, sediment, and water pollution controls will be maintained in good working order. The CONTRACTOR and OWNER will inspect the entire project to determine the condition of the control measures using one of the following inspection schedules:

- (1) A rain gauge provided by the CONTRACTOR will be located at the project site. Inspection will occur every fourteen (14) calendar days, and also within 24-hours of a rainfall event of 0.5-in. or more as measured by the project rain gauge.
- (2) Inspection will occur at least once every seven (7) calendar days on a specifically defined day, regardless of whether or not there has been a rainfall event since the previous inspection.

Sediment will be removed and devices repaired as soon as practicable but no later than seven (7) calendar days after the surrounding exposed ground has dried sufficiently to prevent further damage from equipment operations needed for repairs.

In the event of continuous rainfall over a 24-hour period, or other circumstances that preclude equipment operation in the area, the CONTRACTOR will install additional backup devices, as determined by the OWNER, by other appropriate methods. The CONTRACTOR will remove silt accumulations and deposit the spoils in an area approved by the OWNER as soon as practical. Any corrective action needed for the control measures will be accomplished in the sequence directed by the OWNER; however, areas adjacent to receiving waters shall generally have priority, followed by devices protecting storm sewer inlets.

In the event of conflict between these requirements and storm water pollution control laws, rules or regulations of other Federal, State, or Local agencies, the more restrictive laws, rules or regulations shall apply.

202.4.2. Other Practices and Controls. The CONTRACTOR shall also conform to the following practices and controls.

202.4.2.1. Location and Construction of CONTRACTOR'S Auxiliary Areas. Disposal areas, stockpiles, and haul roads shall be constructed in a manner that will minimize and control the amount of sediment that may enter receiving waters. Disposal areas shall not be located in any floodplain or receiving waters. Construction roads may not be located in or cross any receiving waters without prior approval of the OWNER and shall be done in compliance with applicable rules and regulations. Staging areas and vehicle maintenance areas shall be constructed by the CONTRACTOR in a manner to minimize the runoff of pollutants and at a location approved by the OWNER. The CONTRACTOR shall prevent pollution of receiving waters with petroleum products or other hazardous or regulated substances.

202.4.2.2. Activity In or Near Waters. Construction operations in receiving waters shall be restricted to those areas where it is necessary to perform the work shown on the plans. Wherever streams are crossed, temporary bridges, timber mats, or other structures shall be used and approved by the OWNER. When work areas or material sources are located adjacent to a receiving water, control measures such as diversion dikes or rock berms shall be used to keep sediment and other contaminants from entering the adjacent receiving water. Care shall be taken during the construction and removal of such barriers to minimize down-gradient sedimentation.

All receiving waters shall be cleared as soon as practicable of temporary embankment, temporary bridges, matting, falsework, piling, debris, or other obstructions placed during construction operations that are not a part of the finished work.

202.4.2.3. Materials Storage. Protected storage for paints, chemicals, solvents, fertilizers, and other potentially toxic materials will be provided by the CONTRACTOR at a location approved by the OWNER.

202.4.2.4. Vegetation. Disturbance of vegetation shall be minimized and limited to only what is shown on the construction plans or as directed by the OWNER in writing. Operations shall be in accordance with [Item 204](#), Landscaping.

202.4.2.5. Keeping Roadways Clean. The CONTRACTOR shall clean paved surfaces, as necessary, to remove sediment that has accumulated on the roadway.

202.4.3. Cleaning and Stabilizing Project Area. The project will not be accepted until the CONTRACTOR has cleaned up as described in [Item 107.25](#), Project Clean-up to the satisfaction of the OWNER. The project will

also not be accepted until the CONTRACTOR provides a uniform perennial vegetative cover with a density of 70-percent of the native background vegetative cover or, if in the opinion of the OWNER, permanent measures (such as riprap, gabions, geotextiles, or other stabilization methods approved by the OWNER), supplemented by temporary measures (such as mulching with seed, silt fences, earth dams, etc.) have been employed that will control erosion, sedimentation, and water pollution until sufficient vegetative cover can be established.

202.5. SILT FENCE

202.5.1. Description. Silt Fence is a barrier consisting of geotextile fabric, steel wire fence fabric and supported by steel posts to prevent soil and sediment loss from a site. This includes all labor and materials associated with installation, maintenance, and ultimate removal of the silt fence as shown in the construction drawings or similar document.

The purpose of a silt fence is to intercept and detain water-borne sediment from unprotected areas to a limited extent. Silt fence is used during the period of construction near the perimeter of a disturbed area to intercept sediment while allowing water to percolate through. This fence shall remain in place until the disturbed area is permanently stabilized. Silt fences are to be constructed along a line of constant elevation (along contour line) where possible. Silt fence shall not be used where there is a concentration of water in a channel or drainage way or where soil conditions prevent a minimum toe-in depth of 6-inches or installation of support post to depth of 12-inches. If concentrated flow occurs after installation, corrective action shall be taken such as placing a stone overflow in the areas of concentrated flow or replacing the silt fence with a more appropriate control measure.

202.5.2. Materials.

202.5.2.1. Geotextile. Silt Fence fabric must meet the following minimum criteria:

- (1) Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 90-lbs.
- (2) Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 60-lbs.
- (3) Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 280-psi.
- (4) Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 40 (max) to 80 (min).
- (5) Ultraviolet Resistance, ASTM D4355 standard Test Method for Deterioration of Geotextiles by Exposure to light, Moisture, and Heat in a Xenon Arc Type Apparatus, Minimum 70 percent.

202.5.2.2. Posts. Fence posts shall be steel and may be T-section or L-section, 1.3 pounds per linear foot minimum, and 4 feet in length minimum. Plastic caps to be installed in areas exposed to pedestrian traffic. Wood posts may be used if anticipated length of service is less than 90 days and provided they are 4 feet in length minimum and have a nominal cross section of 2 inches by 4 inches for pine or 2 inches by 2 inches for hardwoods. If allowed, wood posts shall be replaced if deterioration renders post ineffective.

202.5.2.3. Wire Support. Silt fence shall be supported by steel wire fence fabric as follows:

- (1) 4" x 4" mesh size, W1.4 /1.4, minimum 14-gauge wire fence fabric;
- (2) Hog wire, 12 gauge wire, small openings installed at bottom of silt fence;
- (3) Standard 2" x 2" chain link fence fabric; or
- (4) Other welded or woven steel fabrics consisting of equal or smaller spacing as that listed herein and appropriate gauge wire to provide support.

202.5.2.4. Stone. When a stone overflow is specified, the stone shall be 1½-inches washed stone containing no fines meeting the requirement for coarse crushed stone in [Section 504.2.2.1](#). (a) Coarse Crushed Stone Embedment.

202.5.3. Construction. Silt Fence shall consist of synthetic fabric supported by wire mesh and steel posts set a minimum of 1-foot depth and spaced not more than 6-feet on center. A 6-inch wide trench is to be cut 6-inches deep at the toe of the fence to allow the fabric and wire mesh to be laid below the surface and backfilled with compacted earth or gravel. This entrenchment prevents any bypass of runoff under the fence. Fabric shall overlap at abutting ends a minimum of 3-feet and shall be joined such that no leakage or bypass

occurs. Sufficient room for the operation of sediment removal equipment shall be provided between the silt fence and other obstructions in order to properly maintain the fence. The last 10 feet (or more) at the ends of a line of silt fence shall be turned upslope to prevent bypass of stormwater. Additional upslope runs of silt fence may be needed every 200 to 400 linear feet, depending on the traverse slope along the line of silt fence. A stone overflow structure constructed in accordance with Standard Drawing 1020A shall be installed at all low points or spaced approximately every 300 feet if there is no apparent low point.

202.6. INTERCEPTOR SWALE

202.6.1. Description. A temporary interceptor swale may have a V-shape, parabolic, or be trapezoidal with a flat bottom. Interceptor swales are used to shorten the length of exposed slope by intercepting runoff and can also serve as perimeter swales preventing off-site runoff from entering the disturbed area or prevent sediment-laden runoff from leaving the construction site or disturbed area. The outlet (discharge point) of the swale shall be designed to have non-erosive velocities or designed with velocity dissipation devices. Diverted runoff from a disturbed area or other construction activity shall be conveyed to a sediment control. The swales shall remain in place until the disturbed area is permanently stabilized.

202.6.2. Applications and Design Criteria. It is the responsibility of the OWNER to provide specific details and specifications of all interceptor swales.

202.7. DIVERSION DIKE

202.7.1. Description. A temporary diversion dike is a barrier created by the placement of an earthen embankment to reroute the flow of runoff to an erosion control device or away from an open, easily erodible area. A diversion dike intercepts runoff from small upland areas and diverts it away from exposed slopes to a stabilized outlet or sediment trapping device. Dikes are generally used for the duration of construction to intercept and reroute runoff from disturbed areas to prevent excessive erosion until permanent drainage features are installed and/or slopes are stabilized. The outlet (discharge point) of the diversion dike shall be designed to have non-erosive velocities or designed with velocity dissipation devices. Diverted runoff from a disturbed area or other construction activity shall be conveyed to a sediment control.

202.7.2. Materials. For grades less than 2 percent and velocities less than 6 feet per second, the minimum required channel stabilization shall be grass, erosion control blankets, or anchored mulch. For grades in excess of 2 percent or velocities exceeding 6 feet per second, stabilization is required in the form of turf reinforcement mats (or rip-rap with appropriate size, gradation, and thickness depending on flow conditions). Velocities greater than 8 feet per second will require approval by the OWNER. Dike material shall consist of in situ soils with a plasticity index greater than 25.

202.7.3. Construction and Maintenance. Diversion dikes shall be installed prior to and maintained for the duration of construction and should intercept no more than 5-acres of runoff. Maximum depth of flow at the dike shall be 1 foot based on a 2-year return period design storm peak flow. Dikes shall have a minimum top width of 2.0-ft. and a minimum height of compacted fill of 18" measured from the top of the existing ground at the upslope toe to top of the dike and having side slopes of 3:1 or flatter. The soil for the dike shall be placed in lifts of 8" or less and be compacted to 95-percent standard proctor density using ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort. The channel formed by the dike must have positive drainage for its entire length to a controlled outlet.

CONTRACTOR shall inspect dikes on a regular basis, at least as frequently as required by the SWPPP. Deficiencies shall be repaired as required by the SWPPP or as directed by the OWNER. Remove temporary diversion dike at direction of OWNER or upon establishment of permanent ground cover; and establish permanent ground cover in the area disturbed by the removal.

202.8. TRIANGULAR SEDIMENT FILTER DIKE

202.8.1. Description. The work shall consist of installing a temporary triangular sediment filter dike as shown on the plans during the construction period to control sedimentation.

The purpose of a triangular sediment filter dike is to intercept and detain water-borne sediment from unprotected areas of limited extent. Triangular filter dikes are used in place of silt fence, treating sediment flow at the perimeter of construction areas and at the perimeter of the site. Also, the dikes can serve as

stream protection devices by preventing sediment from entering the streams. This measure can be effective on paved areas where installation of silt fence is not possible.

202.8.2. Materials.

202.8.2.1. Geotextile. The fabric must meet the following minimum criteria:

- (1) Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 90-lbs.
- (2) Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 60-lbs.
- (3) Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 280-psi.
- (4) Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 30 (max) to 100 (min).
- (5) Ultraviolet Resistance, ASTM D4345 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus, Minimum 70 percent.

202.8.2.2. Wire Mesh Support. The internal support for the dike structure shall be 6-gauge 6" x 6" wire mesh or 4" x 4" welded wire fabric folded into triangular form being 18" on each side.

202.8.2.3. Filter Stone for Rock Bags. Material shall consist of 1-inch Crushed Stone conforming to [Item 504.2.2.1](#). Crushed Stone Embedment.

202.8.2.4. Bag Material for Rock Bags. Bag material shall be polypropylene, polyethylene, polyamide or cotton burlap woven fabric, minimum unit weight 4-ounces-per-square-yard, mullen burst strength exceeding 300-psi as determined by ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, and ultraviolet stability exceeding 70-percent. Bag material shall be free of all defects.

202.8.3. Construction. Triangular sediment filter dikes shall be installed across exposed slopes during construction with ends of the dike tied into existing grades to prevent failure. Filter material shall lap over ends 6-inches to cover dike-to-dike junction; each junction shall be secured by shoat rings. Where the dike is placed on pavement, two rock bags shall be used to anchor the overlap to the pavement. Additional bags shall be used as needed to ensure continuous contact with the placement (no gaps). The ends of the dike shall be turned up grade to prevent bypass of stormwater.

202.9. CHECK DAM (ROCK)

202.9.1. Description. The work shall consist of constructing temporary rock check dams as shown on the plans during the construction period to control erosion and sedimentation.

202.9.2. Materials.

202.9.2.1. Stone. Stone shall be well graded with size range from 1½-inches to 3½-inches in diameter depending on expected flows. Where the channel design flow velocity will be greater than 5 feet per second the upper size limit of the stone will need to be increased by the designer and specified on the construction drawings.

202.9.2.2. Geotextile Fabric. Use geotextile filter fabric under check dams exceeding 18 inches in height. If required, the check dam shall be placed on geotextile fabric meeting the following minimum criteria:

- (1) Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 250-lbs
 - (2) Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 135-lbs.
 - (3) Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 420-psi.
- Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 20 (max).

202.9.3. Construction and Maintenance. Check dams should be placed at a distance and height to allow small pools to form between each one. Typically, dam height should be between 12" and 36". Dams should be spaced such that the top of the downstream dam should be at the same elevation as the toe of the

upstream dam. Rock check dams should be triangular in cross section with slopes of 1:1 or flatter on the upstream side and 2:1 or flatter on the downstream side. The middle overflow section of the check dam shall be half the total depth of the channel.

The check dam shall be inspected regularly in accordance with the SWPPP. The check dams shall be reshaped or replaced as needed during inspection. When the silt reaches 1/3 the height of the berm or 1-foot, whichever is less, the accumulated silt shall be removed and disposed of at an approved site in a manner that will not contribute to additional siltation. The check dam shall be left in place until all upstream areas are stabilized and accumulated silt removed; removal shall be done by hand.

202.10. CHECK DAM (FILTER TUBE)

202.10.1. Description. The work shall consist of constructing temporary filter tube check dams as shown on the plans during the construction period to control channel velocity and erosion.

202.10.2. Materials.

202.10.2.1. Filter Tube. Filter tubes shall meet the material requirements of [Item 202.18](#) Filter Tubes.

202.10.2.2. Stakes (Metal and Wood). Galvanized or painted steel stakes in studded "T" shape or punched "U" shape, minimum filter tube diameter of 18" and a weight of 1.25 pounds per linear foot minimum. Hardwood stakes or pressure treated wood stakes nominal 2"x2"x36" minimum dimensions.

202.10.2.3. Geotextile Fabric. Section held for future use.

202.10.3. Construction and Maintenance. Filter tube check dams should be placed at a distance and diameter (i.e. height) to allow small pools to form between each one. Typically, minimum tube diameter shall be 6". The tubes should be spaced such that the top of the downstream tube should be at the same elevation as the toe of the upstream tube. The filter tube shall be placed in a bedding trench to ensure firm contact between the tube and ground.

The check dam shall be inspected regularly in accordance with the SWPPP. The check dams shall be reshaped or replaced as needed during inspection. When the silt reaches 1/3 the height of the berm or 1-foot, whichever is less, the accumulated silt shall be removed and disposed of at an approved site in a manner that will not contribute to additional siltation. The check dam shall be left in place until all upstream areas are stabilized and accumulated silt removed; removal shall be done by hand.

202.11. STABILIZED CONSTRUCTION EXIT

202.11.1. Description. The work shall consist of constructing a temporary stabilized construction in accordance with contract documents. The exit will consist of a pad of crushed stone placed on a geotextile filter cloth and remain in place for the duration of the construction period to facilitate the removal of sediment and other debris from construction equipment prior to exiting the construction site. This includes all labor and materials associated with installation, maintenance, and ultimate removal of the stabilized construction exit as shown in the construction drawings or similar document.

202.11.2. Materials.

202.11.2.1. Stone. Stone material shall consist of 3-inch to 5-inch minimum coarse aggregate and shall be placed in a layer of at least 6-inches thickness. No crushed concrete shall be allowed.

202.11.2.2. Geotextile. The geotextile fabric must meet the following minimum criteria:

- (1) Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 300-lbs.
- (2) Puncture Strength, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 120-lbs.
- (3) Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 600-psi.
- (4) Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 40 (max).

202.11.3. Construction and Use. A temporary stabilized construction exit shall be installed at any point where traffic will be leaving a construction site to or from a paved surface such as a street, alley, sidewalk or parking area. The purpose of a stabilized construction exit is to reduce or eliminate the tracking or flowing of sediment onto paved surfaces. The exit shall be properly graded, sloping away from offsite paved surfaces

or incorporate a drainage swale to prevent runoff from leaving the construction site. Avoid placing construction access at the lowest point on the construction site or on top of proposed utility lines. The minimum length shall be 50 feet. The minimum width shall be 20 feet for sites less than 5 acres and 30 feet for sites 5 acres and larger.

The stabilized construction exit shall be maintained in a condition that prevents tracking or flow of sediment onto paved surfaces. Periodic re-grading and top dressing with additional stone must be done to keep the efficiency of the exit from diminishing. The rock shall be re-graded when ruts appear. Additional rock shall be added when soil is showing through the rock surface.

Additional controls will be required if inspections reveal a properly installed and maintained exit, but tracking of soil outside the construction area is still evident. All sediment spilled, dropped, washed or tracked onto public rights of way shall be removed immediately by the CONTRACTOR. The use of water to wash sediment from streets is prohibited.

When necessary, vehicles must be cleaned to remove sediment prior to entrance onto paved roads, streets, or parking lots. When vehicular washing is required, it shall be done on a constructed wheel wash facility that drains into an approved sediment trap or sediment basin or other sedimentation/filtration device.

202.12. STONE OUTLET SEDIMENT TRAP

202.12.1. Description. A stone outlet sediment trap is an impoundment created by the placement of a stone embankment and filter stone to prevent soil and sediment loss from a site. The stone embankment may be confined within a gabion basket or chain link fence fabric or unconfined. This item includes all labor and materials associated with installation, maintenance and ultimate removal of the stone outlet sediment trap as shown in the construction drawings or similar document.

202.12.2. Materials.

202.12.2.1. Embankment Stone. The embankment stone shall be comprised of Type A Dry Riprap stone conforming to [Item 803.3](#). Riprap and with a size range of 6 to 12 inches in diameter.

202.12.2.2. Filter Stone. The filter stone covering the upstream face of the 6 to 12 inch Riprap shall be 1 inches washed stone containing no fines meeting the requirement for coarse crushed stone in [Section 504.2.2.1](#), Crushed Stone Embedment.

202.12.2.3. Geotextile. The embankment stone shall be place on geotextile fabric meeting the following minimum criteria:

- (1) Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 250-lbs.
- (2) Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 135-lbs.
- (3) Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 420-psi.
- (4) Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 20 (max).

202.12.2.4. Confinement. When a confined stone outlet sediment trap is used the confinement of the embankment stone shall be by one of the following:

- (1) Gabion Basket – Gabion baskets shall meet the requirements of [Item 803.2.2.1](#), Baskets, Metallic Coated. Tie wire shall be supplied by the gabion manufacturer for use with the product selected.
- (2) Chain Link Fence Fabric – Fabric shall meet the requirements of [Item 801.4.2.1](#), Chain Link Fence Fabric, Zinc or Aluminum coated. Tie wire or metal bands for closure and anchoring shall be as recommended by the fabric supplier for use with the fence material used.

202.12.2.5. Anchor Pipe. Standard weight, 2" nominal diameter galvanized steel pipe.

202.12.3. Construction and Maintenance. The required temporary storage volume behind the stone outlet structure as shown on the construction plans shall be provided with the existing topography or can be provided by additional excavation as needed. Embankment slopes of excavated area should not be steeper than 2H: 1V to prevent slope failures into the storage area.

202.12.3.1. Stone Embankment. The maximum stone embankment height shall be 6 feet as measured from the toe of the slope on the downstream side. The minimum width of the stone

embankment at the top shall be 2 feet. Embankment slope shall be 1.5H: 1V or flatter. The embankment shall have a depressed area to serve as the overflow with a minimum width of 4 feet. The overflow width shall be designed to have a minimum freeboard of 6" at design flow.

For a confined stone outlet sediment trap the embankment stone may be enclosed in a gabion basket or chain link fence fabric and anchored to the channel bottom to prevent washing away. This type of device shall be required where the placement will be in a perennial stream channel.

202.12.3.2. Filter Stone Embankment Face. Filter stone shall be placed on the upstream face of the stone embankment to a minimum depth of 6 inches.

202.12.3.3. Maintenance. The filter stone on the upstream face shall be removed and replaced when it becomes clogged with any material that prevents the storage basin from dewatering. Also, accumulated silt shall be removed from the storage area when the depth of sediment is equal to one-third of the height of the embankment as measured from the original toe of slope to the crest of the outlet, or has reached a depth of one foot, whichever is less.

202.13. PIPE SLOPE DRAIN

202.13.1. Description. A temporary pipe slope drain is an erosion control device that combines an earthen diversion dike and a rigid or flexible pipe to carry runoff over an exposed slope to a stabilized outlet apron. This includes all labor and materials associated with installation and maintenance of the pipe slope drain as shown in the construction drawings or similar document. Maximum drainage areas for individual pipe slope drains shall be 5 acres. For areas larger than 5 acres, additional drains shall be added. Both the entrance and outfall of the pipe slope drain should be properly stabilized. Grass can normally be used at the entrance, but armor type stabilization such as stone or concrete riprap is normally required to address the high velocities of the outfall.

202.13.2. Materials.

202.13.2.1. Pipe. The drain pipe shall be made of any material, rigid or flexible capable of conveying runoff. Regardless of material, the drain pipe shall be completely water-tight so that no water leaks onto the slope to be protected.

202.13.2.2. Stabilized Outlet. The most common stabilized outlet consists of well graded stone or recycled concrete riprap. Alternate materials for stabilized outlets may be approved by the OWNER.

202.13.2.3. Stabilized Entrance. Material shall be in accordance with [Item 202.15](#) Erosion Control Blankets.

202.13.2.4. Diversion Dike. Material shall be in accordance with [Item 202.7](#) Diversion Dike.

202.13.3. Construction and Maintenance.

202.13.3.1. Pipe Slope Drain. A diversion dike shall be constructed at the top of the slope which shall be protected. Attached to the inlet end of the pipe, using water-tight fittings, shall be a standard tee fitting with a stabilized entrance apron extending a minimum of 3 feet long by 3 feet wide from the open ends of the tee staked in place per the manufacturer's recommendations. Attached to the branch end of the tee fitting shall be rigid or flexible pipe to be used for containment of the runoff from the top of the slope to the bottom. The pipe shall be secured with hold down anchors spaced 10 feet on center.

202.13.3.2. Stabilized Outlet. A stabilized outlet shall be excavated to accept the runoff from the pipe and dissipate the energy of the flow.

202.13.3.3. Maintenance. Pipe slope drains should be inspected regularly (at least as often as required by the SWPPP Construction General Permit) to locate and repair any damage to joints or clogging of the pipe. In cases where the diversion dike has deteriorated around the entrance of the pipe, it may be necessary to reinforce the dike with sandbags or to install a concrete collar to prevent failure. Signs of erosion around the pipe drain should be addressed by stabilizing the area with erosion control blanket, turf reinforcement mats, riprap, concrete, or other acceptable methods. All repairs shall be completed in a timely manner or as directed by the OWNER.

202.14. INLET PROTECTION

202.14.1. Description. Inlet protection devices vary depending on the type of inlet and whether the inlet is located at grade (i.e. on a slope) or in a sag (i.e. at a low point). The devices are normally located at the inlet, providing either detention or filtration to reduce sediment and floatable materials in storm water. Clogging can greatly reduce or completely stop the flow into the inlet.

Ensure that inlet protection is properly designed, installed and maintained to avoid flooding of the roadway or adjacent properties and structures. Inlet protection devices shall provide overflow capability to allow stormwater overflow during extreme storm events or when the filter media on the protection device has clogged. Inlet protection **shall not** be installed on inlets located on publicly traveled streets unless approved by the OWNER in writing.

The five types of inlets commonly used in public works construction are listed below with their recommended inlet protection devices. Grate inlets are installed in either paved or unpaved locations and they are therefore listed twice in the list below. These measures include all labor and materials associated with installation, maintenance and ultimate removal of the inlet protection as shown in the details or the approved construction drawings.

202.14.1.1. Curb Inlets.

- A. Filter Tube – The use of a prefabricated or site fabricated filter tube and support system at the inlet to slow the sediment laden stormwater to allow sedimentation to occur. The diameter or height of the filter tube shall be two inches shorter than the curb opening height to allow for overflow capability.
- B. Filter Fabric – The use of a geosynthetic filter fabric material and support system at the inlet to slow the sediment laden stormwater to allow sedimentation to occur. A 2-inch high gap shall be cut in the filter fabric just below the top of the curb opening to allow for overflow capability. The filter fabric and support system are held in place with filter stone anchor bags strategically placed to hold the filter fabric in contact with the pavement surface and the curb face.

202.14.1.2. Grate Inlets in Paved Areas.

- A. Filter Tube – The use of a prefabricated or site fabricated filter tube at the inlet to slow the sediment laden stormwater to allow sedimentation to occur. The diameter or height of the filter tube shall be designated on the approved construction plans and shall be small enough to prevent flood damage to on site facilities or adjacent properties. Traffic control warning devices shall be provided to prevent damage from and to vehicles.
- B. Block & Gravel – The use of filter stone with a concrete block and hardware fabric support system to slow the sediment laden stormwater to allow sedimentation to occur.

202.14.1.3. Grate Inlets or Area Inlets in Unpaved Areas.

- (1) Filter Tube – The use of a prefabricated or site fabricated filter tube surrounding the inlet to slow the sediment laden stormwater to allow sedimentation to occur. The diameter or height of the filter tube shall be designated on the approved construction plans and shall be small enough to prevent flood damage to on site facilities or adjacent properties. The filter tube shall be located in a prepared bedding trench to ensure good contact with the underside of the filter tube and shall be staked in place to prevent movement by flowing stormwater.
- (2) Block & Gravel – The use of filter stone with a concrete block and hardware fabric support system to slow the sediment laden stormwater to allow sedimentation to occur.
- (3) Excavated Impoundment – The use of an excavated impoundment at the inlet to slow the sediment laden stormwater to allow sedimentation to occur. Dewatering weep holes shall be provided in the structure walls at the bottom of the excavation to allow the impoundment to dewater after rain events.
- (4) Filter Fabric – The use of filter fabric with wire backing supported by wooden stakes at each corner of the grate and reinforced with a 2"x4" wood frame around the top perimeter of the wood posts.

202.14.1.4. Combination Inlets.

- (1) Filter Tube – The use of a prefabricated or site fabricated filter tube at the inlet to slow the sediment laden stormwater to allow sedimentation to occur. The diameter or height of the filter tube shall be

designated on the approved construction plans and shall be small enough to prevent flood damage to on site facilities or adjacent properties. Traffic control warning devices shall be provided to prevent damage from and to vehicles.

202.14.1.5. Pipe Inlets.

- (1) **Filter Tube** – The use of a prefabricated or site fabricated filter tube and support system at the inlet end of an open pipe system to slow the sediment laden stormwater to allow sedimentation to occur. The diameter or height of the filter tube shall be one half the diameter of the pipe opening to allow for overflow capability.
- (2) **Filter Stone** – The use of a confined or unconfined stone dam with a six inch thick layer of filter stone on the upstream face of the stone dam to slow the sediment laden stormwater to allow sedimentation to occur. The height of the stone dam shall be one half the diameter of the pipe opening to allow for overflow capability.

202.14.2. Materials.

202.14.2.1. Filter Tubes. Filter tubes shall meet the material requirements of [Item 202.18](#) Filter Tubes.

202.14.2.2. Concrete Blocks. Concrete blocks shall be standard 8" x 8" x 16" hollow core concrete masonry units and may be either load bearing or non-load bearing concrete masonry units.

202.14.2.3. Geotextile Filter Fabric. The fabric shall meet the material requirements of [Item 202.5](#) Silt Fence.

202.14.2.4. Filter Stone. Filter stone shall consist of 1-1/2 inch Coarse Crushed Stone conforming to [Item 504.2.2.1](#). Crushed Stone Embedment. Angular shaped stone is preferable to rounded shapes.

202.14.2.5. Stakes (Metal and Wood). Galvanized or painted steel stakes in studded "T" shape or punched "U" shape, minimum 36" long and a weight of 1.25 pounds per linear foot minimum. Hardwood stakes or pressure treated wood stakes nominal 2"x2"x36" minimum dimensions.

202.14.2.6. Wire Mesh. Wire mesh shall be standard hardware cloth or comparable wire mesh with an opening size not to exceed 1/2-inch.

202.14.2.7. Stone Riprap. The stone riprap shall be comprised of Type A Dry Riprap stone conforming to [Item 803.3](#). Riprap with a size range of 6 inches to 12 inches in diameter.

202.14.3. Construction and Maintenance. Inlet protection filter media shall be placed to intercept the flow of sediment laden water into the inlet with no gaps and shall be adequately anchored to prevent movement. When properly installed the inlet filter media will pond water during a rain event and for up to two days after the end of the rain event. If the filter media becomes clogged and will not drain, remove the standing water through another sediment control BMP before it is allowed into the storm drain or off site. **Do not remove the filter media to allow the water to drain.** Replace the filter media with new material prior to the next rain event.

Check inlet protection devices for proper construction immediately after installation, at the end of each work day, immediately prior to rain events and as required by the SWPPP. Remove trapped sediment, floatable debris and yard waste as needed to keep the filter media clear.

202.14.3.1. Curb Inlets. The filter media shall make firm contact with the pavement surface at all times, shall extend beyond the curb opening at least 24 inches along the curb and be pressed tight against the curb face on both sides of the inlet opening. The overflow gap shall be provided to prevent complete blockage of the inlet opening.

202.14.3.2. Grate Inlets in Paved Areas. The filter media shall completely surround the grate inlet with no gaps and shall make firm contact with the pavement surface at all times. The height of the filter media surrounding the grate inlet shall be shown on the approved plans and must be checked on site to ensure that when water attains the top height of the filter media it will not cause localized flooding or property damage. Grate inlets are commonly located in the middle of paved areas subject to local and construction traffic. Installations shall have adequate traffic control devices to prevent damage to vehicles and to prevent damage to the BMP.

202.14.3.3. Grate Inlets & Area Inlets in Unpaved Areas. The filter media shall completely surround the inlet with no gaps and shall make firm contact with the ground surface at all times. A bedding trench

shall be provided under filter tubes when they are used. The height of the filter media surrounding the inlet shall be shown on the approved plans and must be checked on site to ensure that when water attains the top height of the filter media it will not cause localized flooding or property damage.

202.14.3.4. Combination Inlets. The filter media shall surround the three non-curb sides of the grate, extend beyond the curb opening at least 24 inches along the curb and be pressed tight against the curb face on both sides of the inlet opening.

202.14.3.5. Pipe Inlets. The filter media shall surround the pipe opening inlet as shown on the approved plans for project. A bedding trench shall be provided under filter tubes when they are used.

202.15. EROSION CONTROL BLANKETS

202.15.1. Description. An erosion control blanket (ECB) is a temporary erosion prevention product placed over disturbed areas to limit the effects of erosion due to rainfall impact and runoff across barren soil. Erosion control blankets are manufactured by a wide variety of vendors addressing a wide variety of conditions such as slope and functional longevity. Blankets are typically constructed of natural materials such as coir (coconut husk) fibers, excelsior (wood) or straw between two layers of synthetic netting.

202.15.2. Materials.

202.15.2.1. Blanket. Erosion control blanket shall be of a type and class appropriate to site-specific requirements as determined by the OWNER. Installed materials shall meet the applicable "Minimum Performance Standards for TxDOT" as published by TxDOT in its "Erosion Control Report". Approved products may be found in the official listing on the most current annual "Approved Products List for TxDOT" applicable to TxDOT Item 169 Soil Retention Blanket and its Special Provisions.

202.15.2.2. Staples. Staples shall conform to the recommendations shown within the manufacturer's published literature for the approved soil retention blanket. In the absence of manufacturer's recommendation for staples, a minimum 11-gauge wire staples 6-inches in length and 1-inch in width shall be used.

202.15.3. Construction and Maintenance.

202.15.3.1. Erosion Control Blanket. Prior to the installation of any erosion control blankets, all rocks, dirt clods, stumps, roots, trash and any other obstructions that would prevent the mat from lying in direct contact with the soil shall be removed. Anchor trenching shall be located along the entire perimeter of the installation area, except for small areas with less than 2% slope. These trenches shall be 6-inches deep and 6-inches wide and the blanket shall be laid into the trench then backfilled with compacted soil or gravel. At a minimum, the end of each roll of ECB shall overlap the next roll by 3 feet and the sides of rolls shall overlap 4 inches. Blankets shall be fastened to the ground according to the manufacturer's instruction. Staples shall be placed parallel to the flow, at all critical channel points, and at all overlaps. If requested by the OWNER, the CONTRACTOR shall submit staple pattern to the OWNER for approval. Installations shall be in accordance with manufacturer's recommended guidelines with the exception of the minimum criteria stated herein.

202.15.3.2. Maintenance. Blankets shall be inspected for deficiencies every seven days and after each half-inch or greater rainfall event. Noted deficiencies shall be repaired or replaced prior to the next rainfall event, but no later than seven days.

202.16. SECTION HELD FOR FUTURE USE

202.17. SECTION HELD FOR FUTURE USE

202.18. FILTER TUBES

202.18.1. Description. The work shall consist of constructing temporary filter tubes consisting of a filter media confined within a roll or tube of mesh material. The filter tube is then anchored or secured to the ground or pavement surface to prevent movement during storm events. The filter tube slows the flow of

sediment laden stormwater to allow the sediment to settle out or to be filtered out as the stormwater seeps through the filter media. Installations are either for perimeter protection or slope protection.

202.18.2. Materials.

202.18.2.1. Tubes. Tubes shall be constructed out of geosynthetic material, plastic mesh, jute mesh, coir mesh or metal hardware fabric. Material used shall be of adequate strength and durability to withstand anticipated environmental conditions (Heat, cold, ultraviolet light, etc.) and construction hazards during the full term of the device installation. The mesh openings shall be large enough to allow the flow of water through the filter media, but will be small enough to contain the filter media.

202.18.2.2. Filter Media. Filter media may consist of any of the following or an approved combination of the following materials:

- (1) Compost. Erosion Control Compost (ECC) per TxDOT Specification Item 161, Compost.
- (2) Coir or Straw. Commercially produced product interwoven into the tube mesh. Loose material inserted into the tube will not be allowed.
- (3) Filter Stone. Stone shall consist of 1-1/2 inch Coarse Crushed Stone conforming to [Item 504.2.2.1](#). Crushed Stone Embedment.

202.18.2.3. Stakes. Stakes may be metal or wood. Metal stakes when used will be T-section or L-section and 1.3 pounds per linear foot minimum. Wood stakes when used shall have a nominal cross section of 2-inches by 2-inches. Stakes shall be at least six inches longer than the outside diameter of the tube being anchored.

202.18.3. Construction and Maintenance. Installations shall be of the size and material specified on the approved plans or as approved by the OWNER. Overlaps between ends of bound or sealed tubes shall be a minimum of three feet and shall be securely tied together to prevent gaps from forming between the tubes and movement of the tubes. Filter Tubes are to be placed along a line of constant elevation (along a contour line) where possible. The ends of the tube installation at the edge of the disturbed ground area shall be turned uphill to prevent the bypass of stormwater.

202.18.3.1. Perimeter Protection. For installations on soil, construct a one-inch to two-inch deep shaped bedding trench along the full length of the filter tube to ensure positive contact of the filter tube with the soil. Install the properly sized filter tube at the downstream edge of the disturbed land area and anchor in place with stakes placed on maximum eight-foot centers. For installations on pavement which typically occur along utility trenches or when there is a temporary stockpile of erodible material, the mesh with the filter media in place shall provide at least a 6-inch wide contact with the pavement to ensure that the stormwater flows through the filter media. The filter tube shall be anchored with temporary traffic control devices (i.e. vertical panel, barrels, etc.) or standard concrete masonry units to prevent movement of the filter tube during storm events.

202.18.3.2. Slope Protection. Slope protection installations are generally only installed when slopes are steeper than 5H: 1V, slopes that are longer than 30' from top to bottom, or the slope has a large amount of stormwater runoff that will flow downslope. Filter tubes shall be placed at the spacing shown on the approved plans, but generally every 25' apart along lines of constant elevation.

202.19. MEASUREMENT AND PAYMENT

If included in the Contract as a unit price item, measurement for payment will be made complete, in place and ready for use inclusive of all components necessary for a complete and working installation. This includes all labor and materials associated with installation, maintenance, and ultimate removal as shown in the construction drawings or similar document, and establishing permanent ground cover at removal.

ITEM 203. SITE PREPARATION

203.1. GENERAL SITE PREPARATION

203.1.1. Description. This Item shall consist of preparing the right-of-way and designated easements for construction operations by the removal and disposal of all obstructions from the right-of-way and from designated easements, where removal of such obstructions is not otherwise provided for in the plans and specifications. Such obstructions shall be considered to include remains of houses not completely removed by others, foundations, floor slabs, concrete, brick, lumber, plaster, septic tanks, basements, abandoned utility pipes or conduits, equipment or other foundations, fences, retaining walls, outhouses, shacks and other debris.

This item shall also include the removal and disposal of curb and gutters, driveways, paved parking areas, miscellaneous stone, brick, concrete sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron, all rubbish and debris, whether above or below ground except live utility facilities. This Item shall also include the removal and disposal of designated trees, stumps, bushes, vegetation, roots, shrubs, brush, and logs. It is the intent of this specification to provide for the removal and disposal of all obstructions and objectionable materials not specifically provided for elsewhere in the plans and specifications. This Item does not include the removal and disposal of hazardous material.

203.1.2. Construction Methods.

The entire right-of-way, permanent and temporary easements for this project and such additional areas, including public or corporate areas and public or corporate lands, as made available for construction of this project, shall be cleared of all structures and obstructions, as defined above, except that trees or shrubs shall be protected unless specifically designated by the OWNER for removal. Unless designated for removal without replacement, trees and shrubs shall be treated according to [Item 201.1](#), Removal, Protection, and Replacement of Trees, Shrubbery, Plants, Sod, and Other Vegetation. Unless otherwise indicated on the plans, trees and stumps to be removed shall be cut off or otherwise removed as close to the natural ground as practicable on areas which are to be covered by at least 3-ft. of embankment. On areas required for borrow sites and material sources, stumps, roots, etc., shall be removed to the complete extent necessary to prevent such objectionable matter becoming mixed with the material to be used in construction. At all times during site preparation, the area shall be maintained in a manner as to prevent standing water.

Unless otherwise indicated on plans, all foundations and underground obstructions shall be removed to the following depths:

- (1) In areas to receive embankment, 2-ft. below natural ground or to bottom of structure.
- (2) In areas to be excavated, 2-ft. below the lower elevations of the excavation, or to the bottom of structure.
- (3) In all other areas, 1-ft. below natural ground or to bottom of structure.

All basement walls and floors, septic tanks and storage tanks within the limits of the right-of-way shall be removed and the resulting holes backfilled as directed by the OWNER. Holes remaining after removal of all obstructions, objectionable material, trees, stumps, etc., shall be backfilled. The CONTRACTOR shall complete the operation of preparing right-of-way so that the prepared right-of-way shall be free of holes, ditches and other abrupt changes in elevations and irregularities to contour.

The remaining ends of all abandoned-in-place storm sewers, culverts, sanitary sewers, conduits and water or gas pipes shall be plugged with an adequate quantity of concrete to form a tight closure. All materials and debris removed shall become the property of the CONTRACTOR unless otherwise provided for on the plans or in the specifications and shall be removed from the right-of-way. Unless otherwise provided, all merchantable timber removed as previously specified shall become the property of the CONTRACTOR. Gravel, brick, stone or broken concrete, when permitted by special conditions, may be used in the roadway embankment.

203.1.3. Measurement and Payment. General site preparation shall be measured on a lump sum basis, unless indicated otherwise. Measurement for payment shall be made only on areas indicated and classified on the plans as "General Site Preparation," and disposed of properly as indicated in [Item 107.26](#), Disposal of Materials. All work performed and measured as prescribed by this Item shall be paid for at the lump sum

price bid for “General Site Preparation” unless indicated otherwise, which price shall be full compensation for furnishing all labor, equipment, tools, supplies and incidentals necessary to complete the work.

203.2. UNCLASSIFIED EXCAVATION

203.2.1. Description. Unclassified excavation shall consist of required excavation for general site grading, and street and channel excavation within the limits of the OWNER’S right-of-way or designated easements and areas adjacent thereto (except excavation specifically described and provided for elsewhere in the specifications). This will include the proper removal, utilization, and/or disposal of all uncontaminated excavated materials to the required lines, grades and typical cross sections in accordance with the plans and specifications.

203.2.2. Classification. All authorized excavation shall be “unclassified” and involves removal of all materials necessary to permit carrying on the completion of the work. Any reference to rock or other material on the plans and/or in this specification is solely for the OWNER’S and CONTRACTOR’S information and is not to be taken as an indication or guarantee of classification of excavation.

203.2.3. General. In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and specifications. Where excavation to grades established in the field by the OWNER would terminate in unstable soil, the CONTRACTOR shall remove the unstable soil and backfill to the required grade. Work shall be executed in a neat workmanlike manner. All excavation shall be to the line and grade as provided on the approved plans. The CONTRACTOR shall abide by all applicable federal, state and/or local laws governing excavation work.

The CONTRACTOR shall provide for the uninterrupted flow of storm, water and wastewater lines and surface waters during progress of the construction. The CONTRACTOR shall coordinate interruptions to gas, electric, and other services no less than two (2) days prior to construction of the planned interruptions. Completed work shall conform to the established alignment, grades and cross sections.

203.2.4. Water for Construction. The CONTRACTOR shall provide water as needed for site preparation, compaction, and other incidental activities in accordance with local requirements.

203.2.5. Dewatering. During construction, channels, trenches, pits, and other low point excavations shall be kept drained, insofar as practicable. Dewatering work shall include the installation and operation of all pumping, bailing, well-pointing, sumps, and draining necessary to keep the excavation free from groundwater, seepage water, water from storm drains, wastewater collection systems, ditches, creeks, ponds, and other sources. Construction will not be permitted in standing water. All discharges from dewatering activities shall be in conformance with all federal, state, and local requirements in a manner approved by the OWNER. Outlet velocity of discharges from dewatering activities shall be controlled to prevent erosion. Unless provided for as a separate pay item, all dewatering work shall be considered incidental to unclassified excavation.

203.2.6. Excavated Material. Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to the public and to permit safe and convenient access to private and public property adjacent to the line of the work.

All suitable materials removed from the excavation shall be used, insofar as practicable, in the formation of embankments as required by [Item 203.5](#). Embankment, or shall be otherwise utilized. Desirable topsoil, sod, etc. shall be carefully removed and piled separately adjacent to the work when required. Suitable excavated materials to be utilized for the project may be temporarily stockpiled adjacent to the work provided appropriate BMPs are installed.

Unclassified excavated material in excess of that needed for construction or deemed unsuitable shall be known as “waste” and, unless specified otherwise, shall become the property of the CONTRACTOR to be disposed of outside the limits of the project in accordance with federal, state, and local requirements.

203.2.7. Alternate Methods of Excavation. Prior to commencing any alternate method of excavation, the CONTRACTOR shall submit means and methods approach for approval by the OWNER. All alternate methods of excavation shall be in compliance with applicable federal, state, and local requirements. If approved by the OWNER, alternate methods of excavation shall be at no additional cost to the OWNER.

203.2.8. Measurement and Payment. All unclassified excavation shall be measured in its original position and the volume in cubic-yards determined by the average end area method. Work performed for finishing of parkways and medians shall not be measured directly, but shall be considered subsidiary to unclassified excavation.

All unclassified excavation work performed as prescribed by this Item shall be paid for at the contract bid price per cubic-yard for unclassified excavation, which price shall constitute payment in full for furnishing and operating all equipment, excavation, placement, compaction, loading, hauling, and unloading and for satisfactory disposal of unsuitable and excess materials; finishing slopes, ditches and parkways; for all maintenance blading or scarifying the ground surface; and for furnishing all labor, fuel, tools, materials, equipment, implements, and incidentals necessary to the satisfactory performance of the work.

203.3. SECTION HELD FOR FUTURE USE

203.4. BORROW & SPOIL

203.4.1. Description. Borrow shall consist of required excavation, removal, and proper utilization of materials obtained from designated or approved off-site sources. Spoil shall consist of the required excavation, removal, transportation, deposit, and storage of materials to an off-site location.

203.4.2. Classification. All authorized borrow shall be “unclassified” unless otherwise noted.

203.4.3. Construction Methods. All suitable materials removed from the excavation shall be used, insofar as practicable, in the formation of the embankment as required by the governing item for embankment; or shall otherwise be utilized as indicated on the plans or as directed. The completed work shall conform to the established alignment, grades and cross section. Site of the borrow and spoil operations shall be left so as to provide proper drainage where practicable. Where indicated on the plans, the sides and/or ends of borrow pits shall be sloped to the dimensions indicated on the plans.

203.4.4. Selection of Materials. Where shown on the plans, select material shall be utilized in the formation of embankment, embedment or backfill, or to improve the project, in which case the work shall be performed in such a manner and sequence that suitable material may be selected, removed separately and deposited in the project as shown on the approved plans. When required, acceptable borrow material, tested by standard laboratory methods, and shall meet the requirements indicated on the plans.

203.4.5. Measurement and Payment. Borrow shall be measured in a compacted condition in its final position and the volume computed in cubic-yards by the method of average end areas, or as specified otherwise. Spoil sites shall be considered part of the overall project site, and the spoil area shall contribute to the total project acreage.

All work performed as required herein and in the [Item 203.5](#), Embankment, and measured as provided in this Item shall be paid for at the unit price bid. Payment shall not be allowed for excavation for any material which is used for purposes other than those designated. The unit price shall be full compensation for furnishing all labor, for materials, tools, equipment, compaction, hauling and incidentals necessary to complete the work, as well as for any and all fees associated with disposal.

203.5. EMBANKMENT

203.5.1. Description. Embankment shall consist of the placement and compaction of all suitable materials obtained from excavation, borrow or any other approved excavation.

203.5.2. Construction Methods. Prior to the placing of any embankment, all clearing and grubbing and site preparation shall have been completed. Stump holes or other small excavations within the limits of the embankment shall have been backfilled with material with same properties as to in-situ material or specified fill material before commencing the embankment construction. The surface of the ground, including plowed or loosened ground or small ditches or washes, shall be restored to approximately its original slope.

The surface of hillsides shall be loosened by the scarifying or plowing to a depth of not less than 4-in. or cut into steps before embankment materials are placed. The embankment shall then be placed in layers as hereinafter specified, beginning at the low side in part widths as the embankment is raised. The material

which has been loosened shall be recompacted simultaneously with the embankment material placed at the same elevation.

Where embankment is to be placed over or adjacent to the existing roadbeds, the slopes shall be plowed or scarified to a depth not less than 4-in. and the embankment built up in successive layers, as hereinafter specified, to the level of the old roadbed before its height is increased. Then the old roadbed shall be scarified and recompacted with the next layer of embankment. The total depth of the scarified and added materials shall not exceed the permissible depth of the layer. All embankments for roadbeds shall be constructed in layers approximately parallel to the finished grade of the street and shall be so constructed as nearly as possible to conform to the cross section of the subgrade section.

Embankments shall be constructed to the established grade and to the shape of the typical section shown on the plans, and each section shall conform to the detailed sections of slopes. After completion of the embankment, it shall be continuously maintained to its finished section and grade until the project is accepted.

Earth embankments shall be constructed in successive layers, for the full width of specified depth or cross sections; and in such lengths as are suitable for the sprinkling and compaction methods to be used. Each layer of earth embankment shall be uniform as to material, density, and moisture content before beginning compaction. Prior to compaction, the layers shall not exceed 6-in. in depth for pneumatic tire rolling or 8-in. in depth for rolling with other types of rollers unless otherwise specified on the plans.

Earth embankment for the construction of dams and placed adjacent to and over pipes, culverts, arches and bridges shall be of material as specified on the plans and shall be placed in successive layers approximately horizontal. Layers of embankment shall be brought up uniformly on each side of the structure, and special care shall be taken to prevent any wedging action against the structure. For such distances along embankments adjacent to structures where it is impracticable to obtain compaction by rolling, the embankment material shall be placed in layers not exceeding 6-in. in depth of loose material wetted uniformly to the moisture content directed; and shall then be compacted by methods approved by the OWNER, maintaining the required moisture content by additional sprinkling, if necessary, supplemented by such hand work as is necessary to secure a uniform and thoroughly compacted fill, until each layer has been uniformly compacted to the satisfaction of OWNER.

All earth cuts, full or part width in the side of a hill, which are not required to be excavated below subgrade elevation for base or backfill, shall be scarified to a uniform depth of not less than 6-in. below grade shown on the plans, and the materials shall be mixed and reshaped by blading and then sprinkled and rolled in accordance with the hereinabove outlined requirements for earth embankments.

Rock embankments shall be composed principally of rock and shall be constructed in successive layers for the full width of the specified depths or cross sections, and each layer shall be 18-in. or less in depth. Each layer shall be constructed by starting at one end, dumping the rock on top of the layer being constructed and then pushing the dumped material ahead in such a manner that the larger rock shall be placed on the ground or preceding rock embankment layer; and the interstices between the larger stones shall be filled with smaller stones and spalls both by this operation and from the placing of succeeding loads of rock materials. Each rock layer shall be rolled or compacted as specified in the plans. The upper or final layer of rock embankment shall contain no stones larger than 4-in. in their maximum dimension, and insofar as such is available by selection of the excavation, this layer shall be composed of materials so graded that the maximum density and uniformity of the surface layer may be secured. Each rock embankment layer shall be rolled as directed by the OWNER.

In addition to the foregoing selection of materials and utilization of the materials in the embankment, the embankment shall be constructed in the proper sequence to receive select materials as specified or as shown on the plans, with any modifications as may be directed by the OWNER. The layer of embankment immediately preceding the upper layer of select material shall be constructed to the required cross section and the proper elevation within a tolerance of not more than 0.1-ft. from the established cross section or elevation after proper compaction and shall be finished as necessary to receive the select material.

203.5.3. Density. For each layer of earth embankment and select material, the relative compaction of the embankment shall be as shown on the plans. Earth embankment and select material shall be compacted to between 95 percent and 100 percent of Standard Proctor Density as determined by ASTM D-698 at, or up to

five (5) percentage points above, optimum moisture content, using mechanical compaction methods, unless otherwise specified in the plans or specifications. After each section of earth embankment or select material is completed, such tests as are necessary shall be made as specified by the OWNER, unless otherwise specified in the special provisions or in the plans.

203.5.4. Measurement and Payment. Embankment shall not be measured or paid for as a separate contract pay item, but the cost of construction of the embankment complete in place shall be included in such contract pay items as described in standard specifications [Item 203.2](#). Unclassified Excavation or [Item 203.4](#). Borrow & Spoil. The contract pay items provided shall be full compensation for the furnishing of all labor, material, tools, equipment and incidentals necessary to complete the embankment, including cost of water, sprinkling or wetting, rolling, compaction, etc., in accordance with the plans and specifications.

203.6. DUST CONTROL

203.6.1. Description. Sprinkling for dust control shall consist of the authorized application of water or other material approved by the OWNER on those portions of the projects as shown on the plans or as directed and as herein specified. It shall be the responsibility of the CONTRACTOR to take preventive measures to eliminate, reduce, or alleviate any dust nuisance in the work area. The OWNER will approve the method used. Should the CONTRACTOR fail to control dust as outlined above, the OWNER may suspend the work until corrective measures are taken.

203.6.2. Materials. Water or other material approved by the OWNER shall be furnished by the CONTRACTOR and shall be clean, free from industrial waste and other objectionable matter. Emulsions shall meet the requirements of [Item 302.3.5](#). Emulsions for Priming, Curing and Erosion Control.

203.6.3. Construction Methods. The CONTRACTOR shall use sprinkling or other methods acceptable to the OWNER to control dust in accordance with TCEQ airborne contamination requirements. When sprinkling, the CONTRACTOR shall furnish and operate a sprinkler equipped with positive and rapidly working cutoff valves and approved spray bars, which shall insure the distribution of material in a uniform and controllable rate of application.

The CONTRACTOR shall maintain all excavations, embankment, stockpiles, haul roads, and access roads within or outside the project boundaries free from dust, which would cause a hazard or nuisance to adjacent property owners. The CONTRACTOR shall effectively prevent and control erosion and sedimentation from any runoff resulting from dust control activities. It shall be the CONTRACTOR'S continuous responsibility to be on call at all times including nights, holidays, weekends, etc. and respond in a timely manner, until acceptance of the project by the OWNER, to maintain the project free of dust in a manner which shall cause the least inconvenience to the public.

203.6.4. Measurement and Payment. Sprinkling performed as provided above shall be measured by the 1,000-gallons as delivered on the project. Sprinkling provided in the proposal and the contract as a separate pay item shall be paid for in accordance with the contract unit price. Noncompliant dust control activities shall not be approved for payment by the OWNER. When sprinkling is not classified separately for payment, then such sprinkling shall be considered as incidental work and shall not be paid for as a separate item; the cost thereof shall be included in such contract pay items as are provided. In either case, such pay items shall be the total compensation for all labor, materials, tools, machinery, equipment and incidentals necessary to complete the work in accordance with the plans and this specification.

ITEM 204. LANDSCAPING

204.1. VEGETATION REMOVAL AND REUSE, CLEARING AND GRUBBING

204.1.1. Trees. No trees shall be removed unless so noted on the plans or upon the specific approval of the OWNER. Where trees are adjacent to the line of the work and are not to be removed or are designated on the plans to be removed and replaced, the CONTRACTOR shall protect such trees by substantial wooden boxes and guards and shall not permit machinery or employees to scrape, tear the limbs from, damage or attach guy cables to them. If, in the opinion of the OWNER, such trees, etc., would be damaged by machinery, etc., hand excavation may be required. The CONTRACTOR shall be responsible for all damage to adjacent trees, etc., and any such damage shall be remedied to the satisfaction of the OWNER. All damaged limbs over 1-inch in diameter shall be sawed clean adjacent to the damaged area or at the trunk and dressed with acceptable tree wound treatment material, unless dressing is waived by the OWNER. Trees that are to be removed and subsequently replaced shall be designated on the plans. The cost of protection shall not be paid for as a separate contract pay item; the costs thereof shall be included in such pay items as are provided for in the proposal and contract.

204.1.2. Shrubbery, Plants, Sod and Other Vegetation. Shrubbery, plants, sod and any vegetation noted on the plans to be removed shall be removed and disposed of. Reuse of these items, unless specifically called for by the plans, shall not be permitted. The cost of removal shall be paid for as a separate contract pay item if a separate pay item is provided; otherwise, the costs thereof shall be included in such pay items as are provided in the proposal and contract. Where shrubbery, plants, sod and any vegetation are removed in making the excavation, such areas shall have the same shrubbery, plants, sod, vegetation, etc., of the same kind, and in new condition, replaced in their prior positions or as close as possible. When backfilling is completed, the shrubbery, plants, sod, vegetation, etc. shall be carefully replaced in their original location and the area thoroughly wet down. The cost of such replacement shall be paid for as a separate contract pay item if a separate pay item is provided; otherwise, the costs thereof shall be included in such pay items as are provided in the proposal and contract.

204.2. TOPSOIL

204.2.1. Description. This Item shall consist of furnishing and placing topsoil, free from rock and foreign material, as indicated on the plans, to the lines and grades as established by the construction plans.

204.2.2. Materials and Storage. All excavated material which is suitable for topsoil shall be used before any topsoil is obtained from a borrow source. Topsoil shall be secured from borrow sources as required to supplement suitable material secured from project excavation. Topsoil material secured from excavations shall be stockpiled at locations approved by OWNER.

204.2.3. Construction Methods. Approved topsoil shall be a minimum thickness of 6-inches unless otherwise specified on the plans, and shall be placed on areas formed to the line and grade specified in the plans.

204.2.4. Measurement and Payment. Topsoil secured from borrow sources shall be measured by the square yard in place on the project site. Measurement for payment shall be made only on topsoil secured from borrow sources. All work performed as ordered and measured as provided under this Item shall be paid for at the unit price bid for topsoil. The price shall be full compensation for excavating (except as noted below), loading, hauling, placing and furnishing all labor, equipment, tools, supplies and incidentals necessary to complete the work.

All labor, equipment, tools and incidentals necessary to place salvage topsoil as specified shall be included in the price bid for [Item 203.2](#). Unclassified Excavation. All excavation required by this Item in cut section shall be measured in accordance with provisions for the various excavation items involved with the provision that excavation shall be measured and paid for once only, regardless of the manipulations involved.

204.3. SOIL AMENDMENTS

204.3.1. General. Where indicated on the plans and defined in the specifications, soil amendments shall be added as defined or as noted in these specifications.

204.3.2. Sand. All sand shall be thoroughly washed, coarse grade construction or brick sand, free of clay balls, weeds or grass. So-called cushion sand, blow sand, creek silt or water treatment solid byproducts shall not be acceptable. A quart sample of the sand proposed to be used shall be submitted for the OWNER's approval.

204.3.3. Compost. This Item shall govern for the furnishing and placing of approved compost material to the depths and area shown on the plans or as directed by the OWNER.

204.3.3.1. Materials. Compost material shall be an organic substance produced by the aerobic (biological) decomposition of organic matter. All compost is to be clean and free of visible refuse, live plants, seed, excessive cotton lint and any chemical elements harmful to plant growth. Composted matter may include, but is not limited to, brush, manure and/or other agricultural residuals, forest residues and bark, and unrecyclable paper. Mixed municipal solid waste compost, and Class B Biosolids (as defined in 40 CFR part 503) shall not be allowed. Raw organics in the finished compost shall not be allowed.

Compost materials furnished shall meet all applicable Federal (40 CFR Part 503 Standards for Class A Biosolids) and TCEQ health and safety regulations (TAC Chapter 332). All compost material supplied shall be processed to meet the time and temperature standards in TAC Chapter 332 Subchapter B Part 23 to control noxious weeds, pathogen and vector attraction; and the physical requirements shown in Table 204.3.4.1.(a) Compost Physical Requirements.

Table 204.3.3.1.(a) Compost Physical Requirements

Compost for Manufactured Topsoil	Erosion Control Compost	General Use Compost
Organic Matter Content as determined by loss on ignition (ASTM D5268 Standard Specification for Topsoil Used for Landscaping Purposes @ 824°F)		
30% (dry mass)	40-60% (dry mass)	40-60% (dry mass)
Particle Size as determined by TEX-110-E Particle Size Analysis of Soils		
100% passing 1"	100% passing 3" <70% passing 2"	100% passing 3/4" <70% passing No. 20
Soluble Salts as determined by TEX-129-E Measuring the Resistivity of Soil Materials		
5.0 max. mmhos/cm)	5.0 max. mmhos/cm	5.0 max. mmhos/cm
(1) Maturity		
Finished	Finished	Finished
pH as determined by TEX-128-E Determining Soil pH		
5.5 - 8.5	5.5 - 8.5	5.5 - 8.5

204.3.3.2. Construction Methods. After the designated areas have been completed to the lines, grades, and cross sections shown on the plans and as provided for in other items to the contract, compost of the type specified shall be placed in accordance with the requirements hereinafter described and as directed by the OWNER. Any stockpile areas shall be well drained, and shall be left in a neat and presentable condition upon completion of the removal of the materials. Where rolling is specified, the roller shall be a light corrugated drum roller of the type approved by the OWNER. Compost shall be loose and friable and not dusty at the time of application. Compost may be required to be brought to an acceptable moisture content, as directed by the OWNER. No compost materials shall be placed within 30-yards of any source of surface water or drinking water supply.

204.3.3.2.1. Compost Manufactured Topsoil. Compost manufactured topsoil shall consist of soil constituents amended with 5- to 30-percent compost, measured by volume, as shown on the plans. Any trash, stumps, roots, weeds, or other objectionable materials in the soil shall be removed and disposed of, as approved by the OWNER, prior to beginning the mixing process.

Blended On-Site. Compost shall be spread in a uniform layer over the previously prepared subgrade area and thoroughly incorporated into the soil materials, to the depths shown on the plans, by rototilling, harrowing, or other suitable methods. After the topsoil has been produced and shaped, it shall be sprinkled and rolled as directed by the OWNER.

Pre-Blended. Topsoil manufactured from sources outside the right-of-way shall be produced in accordance with the requirements for Blended On-Site topsoil, and spread over the prepared subgrade so as to form a uniform layer of loose material of the thickness shown on the plans. After the topsoil has been placed, it shall be raked carefully to remove all objectionable materials and to yield a consistent grade, and then sprinkled and rolled as directed by the OWNER.

204.3.3.2.2. Erosion Control Compost. Compost shall be spread evenly over the previously prepared subgrade or slopes so as to form a uniform layer of loose material of the thickness shown on the plans. Erosion Control Compost shall not be placed on any slope having a slope ratio steeper than 2:1. After the compost has been placed, it shall be sprinkled and rolled as directed by the OWNER.

204.3.3.2.3. General Use Compost. General use compost shall be applied as a top dressing by placing the material evenly upon established areas of turf, grass, or other ground cover growth to the depth specified on the plans or as directed by the OWNER. Compost applications shall not bury or kill existing vegetation. All stems, roots, or other debris larger than 2-inches diameter shall be removed from the ground surface.

204.3.4. Measurement and Payment. "Compost Manufactured Topsoil (Blended On-Site)", "Compost Manufactured Topsoil (Pre-Blended)", "Erosion Control Compost" and "General Use Compost" will be measured by the cubic-yard in vehicles at the point of delivery.

The work performed and materials furnished in accordance with this Item and measured as provided for shall be paid for at the unit price bid for "Compost Manufactured Topsoil (Blended On-Site)", "Compost Manufactured Topsoil (Pre-Blended)", "Erosion Control Compost" or "General Use Compost" for the depth specified. This price shall be full compensation for securing any necessary source(s) and any royalty involved; for furnishing all materials, for all excavation, loading, hauling, stockpiling, placing, rototilling, harrowing, raking, rolling and sprinkling; and for furnishing all labor, tools, equipment and incidentals necessary to complete the work.

204.4. FERTILIZER

204.4.1. General. Fertilizer shall be a commercial product, uniform in composition, free flowing, with uniform particle size, minimal dust, and suitable for application with approved equipment. Fertilizer may be a natural organic, synthetic organic or inorganic fertilizer. If requested by the OWNER, a sample label or specification of proposed fertilizer(s) to be used shall be submitted to the OWNER for approval.

All fertilizer used shall be delivered in original bags or containers clearly labeled to show analysis of the contents. Fertilizer shall be in good physical condition. Fertilizer which has been exposed to high humidity and moisture or has become caked or otherwise damaged, making it unsuitable for use, shall be rejected.

The fertilizer is subject to testing by the OWNER in accordance with the Texas Fertilizer Law. A fertilizer shall be used with an analysis as indicated below. The figures in the analysis represent the percent of nitrogen, phosphoric acid and potash nutrients, respectively, as determined by the methods of the Association of Official Agricultural Chemists. In the event it is necessary to substitute a fertilizer of a different analysis with a lower concentration, the total amount of nutrients furnished and applied per unit area shall equal or exceed that specified for each nutrient.

204.4.2. Preplanting Application. Fertilizer analysis shall be based on soil test results and the nitrogen requirements for the turfgrass specified. If the OWNER waives soil testing, fertilizer analysis shall be, by weight, in a 1-1-1 or 1-2-1 (N-P-K) ratio (such as 13-13-13 or 10-20-10,) and 10- to 15-percent sulphate and traces of iron and zinc as required and approved by the OWNER.

Preplanting application rate shall be 10-lbs.-fertilizer-per-1,000-sq.ft.

204.4.3. Post Planting Application. Fertilizer analysis shall be based on soil test results and the nitrogen requirements for the turfgrass specified. If the OWNER waives soil testing, fertilizer analysis shall be as

specified below except that for autumn applications a complete fertilizer with a 4-1-2 to 3-1-2 (N-P-K) ratio shall be applied.

Fertilizer shall contain 30- to 50-percent slow release nitrogen, unless specified otherwise by the OWNER.

204.4.3.1. Seeds or Sprigs. As soon as new growth starts after seeding or sprigging, grass shall be fertilized every 10- to 14-days with 0.75- to 1.0-lb.-nitrogen-per-1,000-sq.ft. Applications shall alternate between nitrogen only fertilizer whose analysis is, by weight, 21-0-0 or 45-0-0 (N-P-K) and a complete fertilizer with a 3-1-2 or 4-1-2 (N-P-K) ratio (such as 21-7-14.)

204.4.3.2. Sod. Fertilizer analysis shall be based on soil test results. Fertilizer shall be applied every 4- to 6-weeks at 1.0-lb.-(actual)nitrogen-per-1,000-sq.ft.

204.4.4. Measurement and Payment. Fertilizing may be paid for as a separate pay item or considered subsidiary to other pay items as specified by the OWNER.

204.5. SODDING

204.5.1. Description. Sodding shall consist of furnishing and planting grass as designated on the plans and in accordance with the requirements of this specification and special conditions.

204.5.2. Materials. Sod shall be “*Stenotaphrum secundatum*” (St. Augustine grass), “*Cynodon dactylon*” (Common Bermudagrass), “*Buchloe dactyloides*” (Buffalograss), an approved hybrid of Common Bermudagrass, or an approved hybrid of Zoysiagrass, or other as approved by the OWNER. Sod shall consist of stolons, leaf blades, rhizomes, and roots with a healthy, virile system of dense, thickly matted roots throughout the soil of the sod for a thickness not less than 0.75-in. Sod shall be alive, healthy, vigorous, free of insects, disease, stones, and undesirable foreign materials, weeds and grasses deleterious to its growth or which might affect its subsistence or hardiness when transplanted. The grass shall have been mowed prior to sod cutting so that the height of the grass shall not exceed 2-inches. St. Augustine grass sod shall have been produced on growing beds of clay or clay loam topsoil. Bermudagrasses and zoysiagrasses shall have been grown on sand or sandy loam soils. Sod shall not be harvested or planted when its moisture condition is so excessively wet or dry that its survival shall be affected. Sod shall be protected from exposure to wind, sun and freezing. If sod is stacked, it shall be kept moist and shall be stacked roots to roots and grass to grass.

Sod to be placed between curb and walk and on terraces shall be the same type grass as adjacent grass or existing lawn.

Sod to be placed during the dormant stage of these grasses shall be inspected by the OWNER to verify that the grass is acceptable.

204.5.2.1. Dimensions. All sod shall have been machine cut to uniform soil thickness of ½-in. ± ⅛-in. All sod shall be of the same thickness. Rectangular sections of sod may vary in length, but all shall be of equal width and of a size that permits the sod to be lifted, handled and rolled without breaking. Broken pads and torn, uneven ends shall be rejected.

204.5.3. Construction Methods. After the designated areas have been completed to the lines, grades and cross sections shown on the plans and as provided for in other items of the contract, sodding of the type specified shall be performed in accordance with the requirements hereinafter described. Sodding shall be either plugging or solid.

Care shall be taken at all times to retain native soil on the roots of the sod during the process of excavating, hauling and planting. Sod material shall be kept moist from the time it is dug until planted. When so directed by the OWNER, the sod existing at the source shall be watered to the extent required prior to excavating. Sod material shall be planted within 3-days after it is excavated unless preserved by techniques such as shrink wrapping and transporting in refrigerated trucks, in which case the OWNER shall approve the time interval between excavation and planting.

When necessary, the sodded areas shall be smoothed after planting has been completed and shaped to conform to the cross section previously provided and existing at the time sodding operations were begun. Any excess dirt from planting operations shall be spread uniformly over the adjacent areas or disposed of as directed by the OWNER, so that the completed surface shall present a sightly appearance.

204.5.3.1. Plugging. Furrows parallel to the curb line or sidewalk lines, 12-in. on centers or to the dimensions shown on the plans, shall be opened on areas to be sodded. In all furrows, sod approximately 3-in.-square shall be placed on 12-in. centers at proper depth so that the top of the sod shall not be more than ½-in. below finished grade. Holes of equivalent depth and spacing may be used instead of furrows. Soil shall be firm around each block; then the entire sodded area shall be carefully rolled with a heavy, hand roller developing 15- to 25-lb.-per-square-inch compression. Hand tamping may be required on terraces.

204.5.3.2. Solid Sodding. At locations on the plans, or where directed, sod blocks shall be carefully placed on the prepared areas. Sod shall be so placed that the entire designated areas shall be covered. Any voids left in the solid sodding shall be filled with additional sod and tamped. The entire sodded area shall be rolled and tamped to form a thoroughly compact solid mass. Surfaces of solid sod which, in the opinion of the OWNER, may slide due to the height or slope of the surface or nature of the soil, shall, upon direction of the OWNER, be pegged with wooden pegs driven through the sod block to the firm earth, sufficiently close to hold the sod firmly in place.

204.5.3.3. Fertilizing Sod. Fertilizing shall consist of providing and distributing fertilizer over such areas as are designated on the plans and in accordance with these specifications. The fertilizer shall be applied uniformly over the area specified to be fertilized and in the manner directed. Fertilizer for sod shall comply with applicable provisions of [Item 204.4](#). Fertilizer.

204.5.3.4. Watering and Finishing Sod. Sodded areas shall be thoroughly watered immediately after they are planted. Large areas shall be planted by irrigation zones, so areas can be watered as soon as they are planted. Sod shall be subsequently watered and mowed at such time and in a manner and quantity directed by the OWNER until completion and final acceptance of the project by the OWNER.

Sod shall not be considered finally accepted until the sod has started to peg down (roots growing into the soil), and is free from dead blocks or rolls of sod.

204.5.4. Measurement and Payment. Plugging and solid sodding shall be measured for payment in square yards of sodded area completed in accordance with the plans and specifications. Plugging or solid sodding, as the case may be, shall be paid for at the contract unit price per square yard, complete in place, as provided in the proposal and contract. The contract unit price shall be the total compensation for furnishing and placing all sod, for all rolling and tamping, for all water, for disposal of all surplus material, and for all material, labor, equipment, tools and incidentals necessary to complete the work, all in accordance with the plans and these specifications.

204.6. SEEDING TURFGRASS

204.6.1. General. Seeding shall consist of preparing the ground, providing and planting seed or a mixture of seed of the kind specified along and across such areas as may be designated on the plans and in accordance with these specifications.

204.6.2. Materials. All material for turfgrass provided shall be in accordance with these specifications and as noted in the plans and contract documents. Prior to planting, CONTRACTOR shall provide the OWNER with the State of Texas Certificate stating analysis of purity and germination of seed.

Seed shall be labeled in accordance with U.S. Department of Agriculture rules and regulations.

204.6.2.1. Bermuda Grass Seed. Turfgrass seed shall be “Cynodon Dactylon” (Common Bermuda Grass). The seed shall be harvested within 1-year prior to planting, free of Johnsongrass, field bind weed, dodder seed, and free of other weed seed to the limits allowable under the Federal Seed Act and applicable seed laws. The seed shall not be a mixture. The seed shall be hulled, extra fancy grade, and have a germination and purity that shall produce, after allowance for Federal Seed Act tolerances, a pure live seed content of not less than 85-percent. Pure Live Seed (PLS) Percent shall be determined using the formula: $\text{Percent Pure Live Seed} = \% \text{Purity} \times [(\% \text{Germination} + \% \text{Firm or Hard Seed}) \div 100]$

204.6.2.2. Ryegrass Seed. Turfgrass seed shall be “Lolium multiflorum” (Italian or Annual Ryegrass). The seed shall be harvested within 1-year prior to planting and shall be free of perennial ryegrass seed, other grass seed and weed seed to the limits allowable under the Federal Seed Act and applicable seed

laws. Seed shall be at least 95-percent pure, treated with fungicide, and shall have a 90-percent minimum germination rate.

204.6.2.3. Sprigs. Turfgrass sprigs and stolons shall be “Cynodon Dactylon” (Common Bermuda Grass) (Hybrid Bermuda Grass of the Tifway 419/ Tifton 10/Tifgreen Strain). Sprigs shall be acquired from a healthy stand of grass, free of weeds and other grasses. The source is to be inspected and approved by the OWNER. Sprigs and stolons are to be delivered and planted within 24-hours of harvest unless special precautions are taken to prevent drying of sprigs to assure optimum rooting.

204.6.3. Planting Season and Application Rates. All planting shall be done between the dates specified for each grass type except when specifically authorized in writing. The seeds planted per acre shall be of a type specified with the mixture, rate and planting dates as shown in Table 204.6.3.(a) Seeding Turfgrass, or as specified by the OWNER.

Table 204.6.3.(a) Seeding Turfgrass

Type	Planting Season	Seed and Rate
Type I	March through September	Bermuda Grass, hulled, 50-lb.-PLS ¹ -per-acre
Type II	October through February	Rye Grass, 100-lb.- PLS ¹ -per-acre combined with Bermuda Grass, unhulled, 20-lb.- PLS ¹ -per-acre
Other	specified on the plans	specified on the plans

1. Pure Live Seed (PLS) is determined by multiplying the gross weight times purity times the germination. (For example, a 100-lb. bag with 85% purity and 80% germination: PLS = pounds in bag x purity x germination = 100-lb. x 0.85 x 0.80 = 60.8-lb. of pure live seed.)

204.6.4. Construction Methods.

204.6.4.1. General. After the designated areas have been completed to the lines, grades and cross sections shown on the plans and as provided for in other items of this contract, seeding of the type specified shall be performed in accordance with the requirements hereinafter described. All seeding operations shall be performed by either “drilling” or “cultipacker” process or approved equivalent. Seed shall be covered by + ¼” topsoil.

The OWNER may reject seeded area on the basis of weed populations.

204.6.4.2. Broadcast Seeding. Area to be treated shall be rough graded and raked. Seed or seed mixture in the quantity specified shall be uniformly distributed over the areas shown on the plans and where directed. If the sowing of seed is by hand, rather than by mechanical methods, the seed shall be sown in two directions at right angles to each other. Seed and fertilizer may be distributed at the same time, provided the specified uniform rate of application for both is obtained.

204.6.4.3. Disc Seed. Soil over the area shown on the plans as directed to be seeded shall be loosened to a minimum depth of 3-in. All particles in the seedbed shall be reduced to less than 1-in. in diameter, or they shall be removed. The area shall then be finished to the line and grade as specified under [Item 204.6.4.6. Watering, Maintaining, and Finishing Seeded Areas.](#)

Seed or seed mixture specified shall then be planted at the rate required, and application shall be made uniformly. If the sowing of seed is by hand rather than by mechanical methods, seed shall be sown in two directions at right angles to each other. Seed and fertilizer may be distributed at the same time, provided the specified uniform rate of application for both is obtained. After planting, the seed shall be raked or harrowed into the soil to a depth of approximately 0.125-in.

204.6.4.4. Hydraulic Mulching. All mulch shall be cellulose fiber mulch and shall be refined specifically for lawn hydraulic mulch applications. Use “Conwed” or an approved equal. Adhesive (Tacking) agents for mulch may include guar gum, polyacrylamide, or other tacking agent, as approved by the OWNER. Tacking agent shall be evenly distributed in the hydraulic mulch before land application in the proportion recommended by the mulch manufacturer.

Seed or seed mixture, in the quantity specified, shall be uniformly distributed over the areas shown on the plans or where directed. Seed and fertilizer are to be distributed as a water slurry, and the mixture shall be applied to that area to be seeded within 30-minutes after all components are placed in the

equipment. Fertilizer shall conform to the applicable requirements of [Item 204.4](#). Fertilizer. After placement is completed, the planted area shall be watered sufficiently to assure uniform moisture from the surface to a minimum 6-in. depth.

204.6.4.5. Fertilizing. Fertilizing shall consist of providing and distributing fertilizer over such areas as are designated on the plans and in accordance with applicable requirements of [Item 204.4](#). Fertilizer. The fertilizer shall be applied uniformly over the area specified to be fertilized and in the manner directed.

204.6.4.6. Watering, Maintaining, and Finishing Seeded Areas. Seeded areas shall be thoroughly watered immediately after they are planted. Seeded areas shall be watered as directed by the OWNER at least twice daily for at least 14-days after seeding in such a manner as to prevent washing of the slopes or dislodgment of the seed. Water shall be applied to the cultivated areas until a minimum depth of 6-inches is thoroughly moistened. CONTRACTOR shall re-seed washed areas. The CONTRACTOR shall be responsible for proper watering until final acceptance.

Seeded areas shall be maintained, including watering and mowing, at such time and in a manner and quantity directed by the OWNER until completion and final acceptance of the project by the OWNER. At minimum, the CONTRACTOR shall maintain the seeded area until each of the following conditions is achieved: vegetation is evenly distributed, without large bare areas, and covers 70% of the seeded area.

Where applicable, the shoulders, slopes and ditches shall be smoothed after seeding has been completed and shaped to conform to the cross section previously provided and existing at the time planting operations were begun.

204.6.5. Measurement and Payment. Acceptable material for broadcast seeding, disced seeding, and hydraulic mulching shall be measured by the square-yard or by the acre complete in place. The work performed and materials furnished and measured as provided in this Item shall be paid for at the unit price for broadcast seeding, disced seeding, or hydraulic mulching of the type specified, as the case may be. The price shall be full compensation for furnishing all materials, including water for seed-fertilizer slurry and hydraulic mulching, fertilizer, and for performing all operations necessary to complete the work.

Water for sprinkling the cultivated area or seedbed when required shall meet the requirement of and shall be measured and paid for in accordance with the provisions governing [Item 203.6](#). Dust Control.

204.7. MULCHING

204.7.1. Description. Mulching provides protection for bare soil by absorbing the energy of each raindrop prior to the point when this energy would dislodge individual soil particles and begin the erosion process. Mulching fosters plant growth by providing insulation from temperature extremes and retaining valuable moisture necessary for proper germination.

204.7.2. Materials.

204.7.2.1. Organic Mulches.

204.7.2.1.1. Straw. The best quality straw mulch comes from wheat, oats or barley and shall be free of weed and grass seed that may not be desired vegetation for the area to be protected. Straw mulch is light and therefore shall be properly anchored to the ground.

204.7.2.1.2. Wood Chips. Wood chips are suitable for areas that will not require mowing frequently and are heavy enough that they do not require anchoring. They do however deplete nitrogen from the soil, which is a necessary nutrient for all plants. To alleviate this condition wood chips must be treated with 12-pounds-ammonium-nitrate-per-ton of mulch used.

204.7.2.1.3. Bark Chips. Bark chips are popular for ornamental applications as they do not require anchoring, do not decompose very rapidly and serve as an excellent insulation material. When using bark chips, it is not necessary to treat for nitrogen deficiency or to fertilize.

204.7.2.1.4. Compost and Wood Mulch Mixture. Compost and wood mulch mixtures should be a blend of 50% untreated wood mulch with 50% compost measured by volume. Wood mulch should be less than or equal to 5 in. in length with 95% passing a 2-in. screen and less than 30% passing a

1-in. screen. The compost shall meet the Physical Requirements specified in Table 1 of TxDOT Special Specification 1058, Compost.

204.7.2.1.5. Other. Other types of organic mulches shall be approved by the OWNER.

204.7.3. Construction and Maintenance.

204.7.3.1. Organic Mulch. Prior to the placement of any mulch, the area to be protected shall be graded completely in accordance with plans. Fertilization and soil treatment shall then be done prior to placement of mulch with the exceptions of when seed is to be applied by means of hydraulic seeding or when seed is distributed following straw mulch spreading during winter months. Organic mulches may be distributed by hand or by mechanical means, so long as a complete covering is achieved. The application of straw mulch should be approximately 2 tons dry straw per acre spread uniformly across the area. Other forms of mulch, such as wood chips or chopped site vegetation, should be placed in thicknesses of two-inches or greater over the area. Straw mulch should be anchored by application of a fiber mulch binder, by the application of a synthetic liquid mulch binder, by using a tractor-drawn crimper to punch into the soil, or by placing a netting above the mulch stapled to the ground, as required.

204.7.3.2. Maintenance. All mulching materials shall be inspected on a weekly basis, and after each significant local rainfall event of ½ inch or more to locate areas of erosion. Where erosion has occurred, either additional mulch shall be applied or an alternative method shall be implemented, as required by the OWNER.

204.7.4. Measurement. If included in the Contract as a unit price item, measurement of organic mulches shall be made by the square yard of treated area, in place and ready for use as an erosion control surface treatment. Alternatively, it may be measured per pound of organic mulch.

204.8. REJECTION

Landscape materials may be rejected for failure to meet any of the requirements shown in the plans and specifications.

ITEM 301. SUBGRADE, SUBBASE, AND BASE PREPARATION

301.1. GENERAL

Subgrade is that portion of the roadbed upon which the subbase, base or the pavement is to be placed. It includes minimum 12-in. beyond the back of the curb for streets, which are to be paved with concrete. Subbase is that layer of specified material of plan thickness between a base and a subgrade. Base is that layer of specified material of plan thickness placed immediately below the pavement course surfacing.

301.1.1. Subgrade Preparation.

301.1.1.1. Description. These specifications shall govern for the preparation of the subgrade except as otherwise provided or specified.

301.1.1.2. Equipment. All equipment necessary for the construction of this item shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used. Any equipment that achieves the desired results in the time frame allowed is acceptable.

301.1.1.3. Construction Methods. After the excavation of embankment has been substantially completed, the subgrade shall be shaped so that after rolling as specified in [Item 301.1.2](#). Rolling of Embankment, Subgrade or Flexible Base and subsequent finishing operations, it shall conform to the correct alignment, cross section and elevation. Subgrade shall be proof rolled prior to subgrade stabilization and after final compaction after subgrade stabilization as specified in [Item 301.1.1.3.1](#). Proof Rolling. Rolling and sprinkling, as needed, shall be performed when and to the extent directed and the roadbed shall be completed to or above the plane of the typical section shown on the plans and the lines and grades established by the OWNER.

After completion of the compaction and immediately before the application of subbase, base or pavement, the subgrade preparation equipment shall be operated using approved methods in a manner to finish the subgrade to the required section. The subgrade shall then be tested with the approved template, operated and maintained by the CONTRACTOR. All irregularities which develop in excess of 1/2-in. in a length of 16-ft. measured longitudinally shall be corrected by loosening, adding or removing material; reshaping; and recompacting by sprinkling and rolling. The completed subgrade shall have a uniform density of not less than 95-percent of the maximum density determined by ASTM D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³). Moisture content shall be within minus-2- to plus-4-of-optimum.

The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade, until the subbase, base or pavement is placed, and shall be kept wetted down sufficiently in advance of placing any subbase, base or pavement to insure its being in a firm and moist condition for at least 2-in. below surface of the prepared subgrade. Only such subgrade as is necessary for the satisfactory execution of the work shall be completed ahead of the placement of base or pavement. Hauling or operating of unnecessary equipment on the completed subgrade shall be kept to a minimum. If equipment is operated on recent work, the OWNER may inspect and require subgrade replacement for such defects as fractures, rutting, or any other failure. Complete drainage of the subgrade shall be provided at all times.

Finishing of the subgrade by other methods shall be permitted on pavement widening projects, on sections where the pavement width is not uniform, at intersections and elsewhere where the operation of certain equipment would not be practical. Subgrade finished by hand or other methods shall conform to the requirements above specified. Subgrade finished by hand or other methods shall conform to the requirements above specified.

301.1.1.3.1. Proof Rolling. This Item shall govern for furnishing and operating heavy pneumatic tire compaction equipment for locating unstable areas of earthwork or base.

301.1.1.3.1.1. Proof Rolling Equipment. The proof rolling equipment shall consist of not less than four pneumatic tire wheels, running on axles carrying not more than four wheels, and mounted in a rigid frame and provided with loading platform or body suitable for ballast loading.

All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces.

The proof roller under working conditions shall have a rolling width of from 8-ft. to 10-ft., and shall be so designed that, by ballast loading, the gross load may be varied uniformly from 15 tons to 25 tons. The tires shall be capable of operating under the various loads with up to 150 pounds per square inch air pressure. Tires shall be practically full of liquid. (Tires shall be considered as being practically full when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position.)

The operating load and tire pressure shall be within the range of the manufacturer's chart as directed by the OWNER. The CONTRACTOR shall furnish the OWNER charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished.

The proof roller shall be towed by a suitable crawler type tractor or rubber tire tractor of adequate tractive capacity, or may be of the self-propelled type. A proof roller unit shall consist of either a self-propelled roller or combination of roller and towing tractor.

There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of 25 tons.

Rubber tire tractive equipment shall be used on base courses and asphalt pavements. Other type tractive equipment may be used on embankment subgrade. The heavy pneumatic tire roller unit shall be capable of turning 180 degrees in the crown width or operating in forward and reverse modes.

In lieu of the rolling equipment specified, the CONTRACTOR may, upon written permission from the OWNER, operate other compacting equipment that will produce equivalent results in the same period of time as the specified equipment. The CONTRACTOR shall submit together with any proposed alternate compacting equipment, the weight (empty and with proposed loading), the wheel configuration and load distribution along with his proposed procedure to provide full width and length coverage of the subgrade area within the required period of time. If the substituted compaction equipment fails to produce the desired results within the same period of time as would be expected of the specified equipment, as determined by the OWNER, its use shall be discontinued.

301.1.1.3.1.2. Proof Rolling Construction Methods. This work shall be done when specified in the plans and specifications. The subgrade and base layer shall be proof rolled to locate unstable areas.

Within the ranges set forth in [Item 301.1.1.3.1.1](#), Proof Rolling, the load and tire inflation pressures shall be adjusted as directed by the OWNER. It is proposed to use a contact pressure corresponding as nearly as practical to the maximum supporting value of the earthwork or base. A minimum of two coverages of the proof roller will be required. Each succeeding trip of the proof roller shall be offset by not greater than one tire width. Rollers shall be operated at speeds directed by the OWNER which shall be between 2 and 6 miles per hour.

Where the operation of the proof roller unit shows an area to be unstable or non-uniform, it shall be corrected in accordance with the applicable Item of Work.

301.1.1.4. Measurement and Payment. Preparation of subgrade shall not be measured for payment as a separate contract pay item. Preparation of the subgrade or fine grading shall not be paid for as a separate contract pay item; and cost thereof shall be included in such contract items as are provided, which pay items shall be the total compensation for the furnishing of all labor, tools, materials, equipment and incidentals necessary to complete the work, including disposal or surplus material, all in accordance with the plans and these specifications.

301.1.2. Rolling of Embankment, Subgrade or Flexible Base

301.1.2.1. Description. Rolling shall consist of the compaction of embankment, subgrade or flexible base by the operation of approved power rollers, as herein specified and as directed by the OWNER.

301.1.2.2. Roller Requirements. All equipment necessary for the construction of this item shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used. Any equipment that achieves the desired results in the time frame allowed is acceptable. If equipment fails to produce the desired result within the required time frame, its use shall be discontinued and the CONTRACTOR will be required to furnish equipment, as determined by the Engineer, at no additional cost to the OWNER.

Sufficient rollers shall be provided to compact the material in a manner satisfactory to the OWNER. When operations are so isolated from one another that one roller unit cannot perform the required compaction satisfactorily, the CONTRACTOR shall provide additional roller units.

301.1.2.3. Rolling Methods. The embankment, subgrade or base course shall be sprinkled as directed by the OWNER. Rolling patterns and speeds shall be established per project and indicated on the plans.

301.1.2.4. Measurement and Payment. Rolling provided in the proposal and contract, as a separate contract pay item, shall be measured for payment by the actual hours the roller is in operation, as ordered by the OWNER. Rolling provided in the proposal and the contract, as a separate pay item, shall be paid for in accordance with the contract unit price. When rolling is not classified separate for payment, then such rolling shall be considered as incidental work and shall not be paid for as a separate item. The cost thereof shall be included in such contract pay items as are provided. In either case, such pay items shall be the total compensation for all labor, materials, tools, machinery, equipment and incidentals necessary to complete the work in accordance with the plans and this specification.

301.2. LIME TREATMENT

This item shall consist of treating subgrade, subbase, and base courses by the pulverization, addition of lime, mixing and compacting the mixed material to the required density. This item applies to natural ground, embankment, or pulverized recycled asphalt pavement base or subbase courses placed under this contract, which shall be constructed as specified herein and in conformity with the typical section, lines and grades as shown on the plans.

301.2.1. Materials.

301.2.1.1. Hydrated Lime (Slurry).

301.2.1.1.1. General. Hydrated lime slurry shall be a pumpable suspension of solids in water. The solids portion of the mixture, when considered on the basis of "solids content," shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following requirements as to chemical composition and residue.

301.2.1.1.2. Chemical Composition. The "solids content" of the lime slurry shall have a hydrate alkalinity $\text{Ca}(\text{OH})_2$ of not less than 90-percent by weight.

301.2.1.1.3. Residue. The percent by weight of residue retained in the "solid content" of lime slurry shall conform to the requirements in Table 301.2.1.1.3.(a) Hydrated Lime.

Table 301.2.1.1.3.(a) Hydrated Lime

Sieve Size	Residue Retained, Percent by Weight
No. 6 (3360 micron)	None
No. 10 (2000 micron)	Max. 1.0%
No. 30 (590 micron)	Max. 2.5%

301.2.1.1.4. Slurry Grades. Type B, commercial lime slurry, shall conform to one of the following three grades:

- (1) Grade 1: The "dry solids contents" shall be at least 31-percent by weight of the slurry.
- (2) Grade 2: The "dry solids contents" shall be at least 35-percent by weight of the slurry.
- (3) Grade 3: The "dry solids contents" shall be at least 46-percent by weight of the slurry.

When Type B, commercial lime slurry, is specified, the CONTRACTOR shall select, prior to construction, the grade to be used and shall notify the OWNER in writing before changing from one grade to another.

301.2.1.2. Quicklime.

CAUTION: Handling and use of quicklime can be dangerous. Quicklime should be prescribed by a registered professional engineer familiar with its use.

301.2.1.2.1. General. Quicklime is a dry material consisting essentially of calcium oxide. It shall be furnished either in “pebble” gradation suitable for dry placing and slurry placing, or as a dry powder suitable only for slurry placing. Powdered quicklime is restricted to slurry placing, as the possibility of appreciable amounts of finely divided powdered quicklime makes it unsuitable for dry placing.

301.2.1.2.2. Chemical Composition. Quicklime shall conform to the chemical requirements of ASTM C977 Quicklime and Hydrated Lime for Soil Stabilization.

301.2.1.3. Tests. If the minimum design strength or percent lime to be used for the treated subgrade, existing base, new subbase or new base is specified, it shall be determined by preliminary laboratory tests at the OWNER’S expense. Optimum lime addition percentage shall be determined by Tex-112-E Admixing Lime to Reduce Plasticity Index of Soils (Atterberg Limits Soil-Lime Series) and/or by ASTM D6276 Test Method for Using pH to Estimate the Soil-Lime Proportion Requirement for Soil Stabilization (pH Soil-Lime Series.) The actual minimum lime dosage to be applied shall be 1% above the minimum test results.

301.2.1.4. Lime Delivery and Storage. If hydrated lime is furnished in bags, each bag shall bear the manufacturer’s certified weight. Bags varying more than 5-percent by weight may be rejected, and the average weight of the bags in any shipment, as shown by weighing 50 bags taken at random, shall not be less than the manufacturer’s certified weight. If lime is furnished in trucks, each truck shall bear the weight of lime measured on certified scales, or the CONTRACTOR shall place a set of standard platform truck scales or hopper scales at a location approved by the OWNER.

Hydrated lime and quicklime shall be stored and handled in closed, weatherproof containers until immediately before distribution on the road. If storage bins are used, they shall be completely enclosed. Hydrated lime bags shall be stored in weatherproof buildings with adequate protection from ground dampness. Quicklime, when permitted, shall be shipped only in bulk; bagged material shall not be acceptable.

301.2.1.5. Water. Water shall conform to the requirements of [Item 303.2.7. Water](#).

301.2.1.6. Soil. The soil shall consist of the in-situ soil or approved soil, free from vegetation, roots, or other objectionable matter. It may be either the material encountered in the existing section, material secured from approved sources shown on the plans or as designated by the OWNER, or a combination of existing and additional soil from approved sources, as shown on the plans, or as directed by the OWNER.

301.2.1.7. Recycled/Reclaimed Asphalt Pavement. Recycled/Reclaimed asphalt pavement is defined as a salvaged, milled, pulverized, broken or crushed asphaltic pavement uncontaminated by dirt or other objectionable materials.

301.2.1.8. Rejection. Any materials that do not conform to the requirements of this specification shall be rejected.

301.2.2. Equipment. Machinery, tools and equipment necessary for proper performance of the work shall be on the project and approved by the OWNER prior to the beginning of construction operations.

301.2.3. Lime Treatment Construction Methods.

301.2.3.1. General. It is a primary requirement of this specification to secure a completed course of treated material containing a uniform lime mixture, free from loose or segregated areas, or uniform density and moisture content, well bound for its full depth, and with a smooth surface and suitable for placing subsequent courses. It shall be the responsibility of the CONTRACTOR to regulate the sequence of work, to use the specified amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

Prior to beginning any lime treatment, the roadbed shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the OWNER.

In cases where groundwater is present, application of lime for stabilization shall be evaluated by the OWNER.

301.2.3.2. Section Held for Future Use.

301.2.3.3. General Construction.

301.2.3.3.1. Treatment for Materials in Place. Materials to be treated shall be excavated to the secondary grade (proposed bottom of lime treatment) and removed or windrowed to expose the secondary grade. Any wet or unstable material below the secondary grade shall be corrected by scarifying, adding lime and compacting until it is of uniform stability. The excavated material shall then be spread to the desired cross section.

If the CONTRACTOR elects to use a cutting or pulverizing machine that shall remove the subgrade material accurately to the secondary grade and to pulverize the material at the same time, CONTRACTOR shall not be required to expose the secondary grade or windrow the material. However, the CONTRACTOR shall be required to roll the subgrade before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method shall be permitted only where a machine is provided which shall insure that the material is cut uniformly to the proper depth and which has cutters that shall place the secondary grade to a smooth surface over the entire width of the cut. The machine shall be of such design that a visible indication is given at all times that the machine is cutting to the proper depth.

301.2.3.3.2. Treatment for New Materials. The base and subbase materials, as provided in the governing specifications, shall be delivered, placed and spread in the required amount per station.

The material shall be manipulated as specified and thoroughly mixed prior to the addition of the lime.

301.2.3.4. Lime Application. Lime shall be spread only on that area where the first mixing operation can be completed in the same working day, except that quicklime shall be mixed at the time of application. The application and mixing of lime with the materials shall be accomplished by the methods hereinafter described unless otherwise approved by the OWNER.

301.2.3.4.1. Dry Placing Quicklime. Quicklime may be placed dry if it is in pebble form. A spreader or motor grader shall be used to spread pebble Quicklime.

301.2.3.4.2. Slurry Placing.

Hydrated Lime or Commercial Lime Slurry. Lime shall be mixed with water and applied as a thin water suspension or slurry. Type B, commercial lime slurry, shall be applied with a lime percentage not less than that applicable for the grade used. The distribution of lime at the rate shown on the plans shall be attained by successive passes over a measured surface of roadway until the proper moisture and lime content have been achieved.

Quicklime. When Quicklime is applied as a slurry, the amount of dry quicklime shall be 80-percent of the amount shown on the plans. The residue from the Quicklime slurring procedure shall be spread uniformly over the length of the roadway currently being processed unless otherwise approved by the OWNER. This residue is primarily inert material with little stabilizing value, but may contain a small amount of Quicklime particles that slake slowly. A concentration of these particles could cause the compacted stabilized material to swell during slaking.

301.2.3.5. Mixing. Mixing procedure shall be the same for “dry placing” or “slurry placing” as hereinafter described.

301.2.3.5.1. Treatment for Materials-In-Place. Material and lime shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing continued until a homogeneous, friable mixture of material and lime is obtained, free from all clods or lumps. Materials containing plastic clay or other materials which shall not readily mix with lime shall be mixed as thoroughly as possible at the time of the lime application, brought to the proper moisture content, sealed with a pneumatic roller, and left to cure 1- to 4-days as directed by the OWNER. During the curing period,

the material shall be kept moist. After the required curing time, the material shall be uniformly mixed by approved methods. If the soil binder lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that when all nonslaking aggregates obtained on the No. 4 sieve are removed, the remainder of the material shall meet the requirements of Table 301.2.3.5.1.(a) Lime Treated Materials-In-Place when tested dry by laboratory sieves.

Table 301.2.3.5.1.(a) Lime Treated Materials-In-Place

Sieve Size	Minimum Passing
1¾-in. (45mm)	100%
No. 4 (4.75mm)	60%

1. Recycled asphalt pavement shall be pulverized so that 100-percent shall pass a 2-in. (50mm) sieve.

During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6-hours or more, or to excessive loss due to washing or blowing, shall not be accepted for payment.

In addition to the above, when pebble quicklime is used, the material and lime shall be mixed as thoroughly as possible at the time of application. Sufficient moisture shall be added during the mixing to hydrate the quicklime. After mixing, and prior to compaction, the mixture of material, quicklime and water shall be moist cured for 2- to 7-days, as approved by the OWNER. After curing, mixing shall continue until the pulverization requirements are met.

301.2.3.5.2. Treatment of New Material. The base or subbase material, lime and required water shall be thoroughly mixed and blended by approved road mixers or other approved equipment and the mixing continued until a homogeneous, friable mixture is obtained. When lime is placed as a slurry and mixed by the use of blades, the material shall be bladed as the lime water mixture is applied; after the total amount has been placed, the mixture shall be thoroughly blended to the satisfaction of the OWNER.

During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6-hours or more, or to excessive loss due to washing or blowing, shall not be accepted for payment.

301.2.3.6. Compaction. Compaction of the mixture shall begin immediately after final mixing and in no case later than 3-days after final mixing. The material shall be aerated or sprinkled as necessary to provide optimum moisture. Compaction shall begin at the bottom and shall continue until the entire depth of the mixture is uniformly compacted as shown on the plans or specified by the OWNER. The compacted mixture shall have a uniform density of not less than 95-percent of the maximum density as determined by ASTM D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³). Moisture content shall be within minus 2-percent to plus 4-percent of optimum. After each section is completed, such tests as are necessary shall be made by the OWNER. If any portion fails to meet the density specified, it shall be reworked as necessary to obtain the specified density. After the mixture has been compacted, the surface shall be shaped to the required line, grades and cross sections and then rolled sufficiently to prevent hairline cracking.

301.2.3.7. Maintenance. The CONTRACTOR shall be required to maintain the completed soil lime base within the limits of its contract in good condition, satisfactory to the OWNER as to grade, crown and cross section until such time as the surface course is constructed. The surface of the compacted layer shall be kept moist until covered by other base or paving material or application of a curing seal of emulsified asphalt conforming to requirements of [Item 302.3.5](#). Emulsions for Priming, Curing and Erosion Control (PCE). If a curing seal is used, it should be applied as soon as possible after completion of final rolling, at a rate of between 0.10- and 0.20-gallons-per-square-yard, the exact rate to be determined by the OWNER. No equipment or traffic shall be permitted on lime treated material for 72-hours after curing seal is applied, unless otherwise permitted by the OWNER. In cases where subgrade treatment or subbase sets up sufficiently to prevent objectionable damage from traffic, such layers may be opened to traffic 2-

days after compaction. The CONTRACTOR shall immediately repair all irregularities or other defects that may occur at the CONTRACTOR'S expense. Repairs are to be made as directed by the OWNER and in a manner to insure restoration of a uniform surface and durability of the portion repaired.

301.2.4. Measurement and Payment. Lime treatment shall be measured for payment in square-yards for the thickness shown in the plans for the surface area of completed and accepted work. The measurement for lime shall be by the ton of 2000-pounds dry weight. The measured tonnage of (dry) quicklime shall be multiplied by the conversion factor 1.25 to give the equivalent quantity of hydrated lime (dry) which shall be the basis of payment.

Lime treatment shall be paid for at the contract unit price per square-yard, as provided in the proposal and contract. The contract unit price shall be the total compensation for preparing the roadbed; for loosening, pulverizing, application of lime, water content in the slurry mixture and the mixing water; mixing, shaping, sprinkling, compacting, finishing, curing and maintaining; for manipulations required; and for all labor, equipment, fuels, tools and incidentals necessary to complete the work, all in accordance with the plans and specifications.

Lime material measured as provided in the this item shall be paid for at the unit price bid for "lime material" which price shall be full compensation for furnishing the material; for all freight involved; for all unloading, storing and handling; and for all labor, equipment, fuels, tools and incidentals necessary to complete the work.

301.3. PORTLAND CEMENT TREATMENT

This item shall consist of the treatment of the subgrade, subbase or base course which is to be composed of a compacted mixture of soil, and/or pulverized recycled asphalt pavement, Portland cement and water and shall be constructed as herein specified and in conformity to the cross sections, lines and grades as established by the OWNER. In the event new materials are placed, rather than using in-situ soils, the subbase or base shall be constructed as herein specified and in conformity with the items governing the base or subbase courses.

301.3.1. Materials.

301.3.1.1. Portland Cement. Cement shall be ASTM C150 Type I, II or IP and conform to the requirements of [Item 303.2.2](#). Portland Cement.

301.3.1.2. Water. Water shall conform to the requirements of [Item 303.2.7](#). Water.

301.3.1.3. Soil. The soil shall consist of the in-situ soil or approved soil, free from vegetation, roots, or other objectionable matter. It may be either the material encountered in the existing section, material secured from approved sources shown on the plans or as designated by the OWNER, or a combination of existing and additional soil from approved sources, as shown on the plans, or as directed by the OWNER.

301.3.1.4. Recycled/Reclaimed Asphalt Pavement. Recycled/Reclaimed asphalt pavement is defined as a salvaged, milled, pulverized, broken or crushed asphaltic pavement uncontaminated by dirt or other objectionable materials.

301.3.2. Equipment. All equipment necessary to properly prosecute, perform and complete the work within the contract time shall be on the project and shall be approved by the OWNER as to type and condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used.

The cement-modified soil layer may be constructed with any machine or combination of machines and auxiliary equipment that shall produce the results meeting the requirements for soil pulverization, cement application, water application, mixing, incorporation of materials, compaction, finishing and curing as specified herein. The CONTRACTOR shall at all times provide sufficient equipment to enable continuous performance of the work and its completion in the required number of working days.

301.3.3. Portland Cement Treatment Construction Methods.

301.3.3.1. General. The primary requirement of this specification is to secure a complete course of treated material containing a uniform Portland cement mixture, free from loose or segregated areas, of uniform density and moisture content, well bound and compacted for its full depth with a smooth surface suitable for placing additional subbase, base or surface courses. It shall be the responsibility of the CONTRACTOR to regulate the sequence of work, to process a sufficient quantity of material so as to

provide full depth as shown on plans, to use the proper amount of Portland cement, maintain the work and to rework the courses as necessary to meet the foregoing requirements.

Cement stabilized base shall not be mixed or placed when the air temperature is below 40°F and falling, but may be mixed or placed with the air temperature is above 35°F and rising, the temperature being taken in the shade and away from artificial heat, and with the further provisions that cement stabilized base shall be mixed or placed only when weather conditions, in the opinion of the OWNER, are suitable.

301.3.3.2. Treatment for Materials-In-Place. Before other construction operations are begun, the roadbed shall be graded and shaped as required to construct the Portland cement treatment for material in place in conformance with the lines, grades, thickness and typical cross sections shown on the plans. Unsuitable soil or material shall be removed and replaced with acceptable soil. The subgrade shall be firm and able to support without displacement the construction equipment and achieve the compaction herein specified. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

The soil and/or recycled asphalt pavement shall be so pulverized that at the completion of moist-mixing, it meets the gradation in Table 301.3.3.2.(a) Cement Treated Materials-In-Place.

Table 301.3.3.2.(a) Cement Treated Materials-In-Place

Sieve Size	Minimum Passing by Dry Weight^{1,2}
1-in. (25mm)	100%
No. 4 (4.75mm)	80%

1. Exclusive of gravel or stone retained on these sieves.

2. Recycled asphalt pavement shall be pulverized so that 100-percent shall pass a 2-in. (50mm) sieve.

301.3.3.2.1. Application of Cement to Materials-In-Place. Portland cement shall be spread by an approved dry or slurry method uniformly on the soil at the rate specified on the plans or as determined by preliminary laboratory tests. If a bulk cement spreader is used, it shall be positioned by string lines or other approved method during spreading to insure a uniform distribution of cement. Cement shall be applied only to such an area that all the operations can be continuous and completed in daylight within 6-hours of such application.

The percentage of moisture in the soil at the time of cement application shall not exceed the quantity that shall permit uniform and intimate mixture of soil and cement during dry-mixing operations, and it shall not exceed the specified optimum moisture content for the soil and cement mixture. In the event of high soil-moisture contents, cement may be applied at one-half the specified rate when approved by the Engineer. The remainder of the application rate of cement shall be applied the following day(s), not to exceed 48-hours. The usual construction sequence shall then be resumed.

No equipment, except that used in the spreading and mixing, shall be allowed to pass over the freshly spread cement until it is mixed with the soil.

301.3.3.2.2. Mixing and Processing of Stabilized Materials-In-Place. Any method used to achieve the specified results is acceptable. Mixing shall continue until a homogeneous, friable mixture of the material and cement is obtained, free from all clods or lumps. The mixture shall be kept within moisture tolerances throughout the operation.

301.3.3.2.3. Compaction and Finishing of Stabilized Materials-In-Place. Compaction shall begin after mixing and after gradation and moisture requirements have been met. The material shall be compacted to at least 95-percent of the maximum density as determined by ASTM D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³). At the start of compaction, the percentage of moisture in the mixture and in unpulverized soil lumps, based on oven-dry weights, shall be within 2-percentage-points of the specified optimum moisture content and shall be less than the quantity which shall cause the soil-cement mixture to become unstable during compaction and finishing. When the uncompacted soil-cement mixture is wetted by rain so that the

average moisture content exceeds the tolerance given at the time of final compaction, the entire section shall be reconstructed in accordance with this specification at the sole expense of the CONTRACTOR. The specified optimum moisture content and density shall be determined in the field on the representative samples of soil-cement mixture obtained from the area being processed. Final moisture content shall be within minus-2- to plus-4-of-optimum.

Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth. Compaction shall begin at the bottom and shall continue until the entire depth of the mixture is uniformly compacted. The loose mixture shall then be uniformly compacted to the specified density within 2-hours. After the soil and cement mixture, except the top mulch, is compacted, water shall be uniformly applied as needed and thoroughly mixed in. The surface shall then be reshaped to the required lines, grades and cross section and then lightly scarified to loosen any imprint left by the compacting or shaping equipment.

The resulting surface shall be thoroughly rolled with a pneumatic tire roller and "clipped," "skinned," and "tight-bladed" by a power grader to a depth of approximately 1/4-in., moving all loosened soil and cement from the section. The surface shall then be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. When directed by the OWNER, surface finishing methods may be varied from this procedure, provided a dense, uniform surface, free of surface material, is maintained at its specified optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 2-hours, a smooth, closely knit surface, free of cracks, ridges or loose material, conforming to the drawn grade and line shown on the plans.

OWNER shall conduct in-place density tests shall as outlined in ASTM D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth). In-place density tests shall be performed at the rate of one-per-300-linear-ft. of paving for two (2) lanes. The suitability of the modification shall be confirmed by Atterberg Limit testing at the rate of one-test-per-2,500-cubic-yards of processed material.

In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be made by the OWNER. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the stability, density and finish before the next course is placed or the work is accepted, it shall be recompacted and refinished at the sole expense of the CONTRACTOR.

301.3.3.3. Plant-Mixed Cement Treated Base.

301.3.3.3.1. Subgrade Preparation. Before other construction operations are begun, the area to be paved shall be graded and shaped as required to receive the cement treated base in conformance with the grades, lines, thicknesses and typical cross-section shown on the plans. Unsuitable subgrade soil or material shall be removed and replaced with acceptable soil. The subgrade shall be firm and able to support without displacement of the construction equipment and compaction. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

301.3.3.3.2. Mixing and Processing for Plant-Mixed Cement Treated Base. The aggregate, cement and water shall be mixed in a pug mill as approved by the Engineer. The plant shall be equipped with feeding and metering devices that add the aggregate, cement and water into the mixer in the specified quantities to produce a mixture that meets or exceeds the mix design criteria. Aggregate and cement shall be mixed sufficiently to prevent cement balls from forming when the mix water is added. Mixing time shall be sufficient to assure an intimate, uniform mixture of aggregate, cement and water. The percentage of moisture in the aggregate, at the time of cement application shall be the amount that assures a uniform and intimate mixture of aggregate and cement during

mixing operations. It shall not exceed the specified moisture content required for adequate compaction.

Free access to the plant shall be provided to the OWNER for construction quality control. The mixture shall be hauled to the paving area in trucks having beds cleaned of deleterious material.

The CONTRACTOR shall submit a mix design for the proposed Cement Treated Base (CTB) to the OWNER for approval in advance of the proposed work. Unconfined compression strength test results shall be submitted with the mix design by the supplier of the CTB material. Work shall not begin until the mix design is approved by the OWNER.

301.3.3.3.3. Placement of Plant-Mixed Cement Treated Base. The mixture shall be placed on a moistened subgrade in a uniform layer by any approved method of spreading that will deposit the required quantity per lineal foot, without segregation, to produce a uniformly compacted base conforming to the grade and cross-section. Not more than 30-minutes shall elapse between placement of cement treated base in adjacent lanes at any location except at longitudinal and transverse construction joints. Compaction shall start as soon as possible after spreading. Elapsed time between the addition of water to the cement treated base mixture and the start of compaction shall not exceed 60-minutes under normal conditions. The Engineer may alter this time if environmental conditions, such as temperature, humidity or wind conditions would justify such a change. Laboratory tests may be required to verify changes in compaction time limits.

301.3.3.3.4. Compaction and Finishing of Plant-Mixed Cement Treated Base. At the start of compaction, the percentage of moisture in the mixture shall not be more than one-percentage-point-below or two-percentage-points-above the specified optimum moisture content, and shall be less than that quantity which will cause the cement treated base mixture to become unstable during compaction and finishing. The specified optimum moisture content and density shall be determined in the field by a Moisture-Density Test AASHTO T134 or ASTM D558 Test Methods for Moisture-Density Relations of Soil-Cement Mixtures, on representative samples of cement treated base mixture obtained from the area prior to compaction. Prior to compaction, the mixture shall be in a loose condition for its full depth. The loose mixture shall then be compacted uniformly to the specified density. During compaction operations, initial shaping may be required to obtain uniform compaction and required grade and cross-section.

When initial compaction is completed, the surface of the cement treated base shall be shaped to the required lines, grades and cross-section. The moisture content of the surface material shall be maintained at not less than its specified optimum moisture content during finishing operations. If any reshaping of the surface is necessary, it shall be lightly scarified to remove any compaction planes, scales or smooth surfaces left by equipment. Final compaction shall then be continued until uniform and adequate density is obtained. Cement treated base shall be uniformly compacted to a minimum of 95-percent of maximum density. Compaction and finishing shall be done in such a manner as to produce, in not longer than two-hours, a smooth, dense surface free of compaction planes, cracks, ridges, or loose material.

301.3.3.4. Finishing and Preparation for Surfacing. After the final layer or course of the cement-modified soil has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling as directed with a pneumatic tire or other suitable roller sufficiently light to prevent hair cracking. Preparation for final surfacing may begin immediately.

301.3.3.5. Protection and Cover. After the roadway has been finished as specified herein, it shall be immediately protected against rapid drying by applying a curing seal of emulsified asphalt at the rate of 0.2-gallon-per-square-yard. The curing seal shall consist of emulsified asphalt conforming to requirements of [Item 302.3.5](#). Emulsions for Priming, Curing and Erosion Control (PCE). Immediately prior to application of the curing seal, the section shall be wetted by the use of pressure water distributors so that all voids in the soil-cement surface are filled with water, but without free water standing on the surface. The curing seal shall be applied while this moisture condition exists so that

undue asphalt penetration of the soil-cement surface shall be prevented; and at the same time aided in complete coverage by the curing seal.

Should it be necessary for construction equipment or other traffic vehicles to pass over the section before the curing seal has dried sufficiently to prevent pickup, it shall be the responsibility of the CONTRACTOR to dust or sand the surface before such use. The CONTRACTOR shall also maintain the curing cover for 7-days so that all of the soil-cement base course shall be covered effectively with curing seal during this period. The curing seal shall remain in place for the additional asphalt-wearing surface.

301.3.3.6. Opening to Traffic. The CONTRACTOR shall not be permitted to drive heavy equipment over completed portions. Pneumatic-tired equipment required for hauling cement and water may be permitted to drive over after the surface has hardened sufficiently to prevent the equipment from marring the surface, provided that protection and cover are not impaired. The soil-cement course may be opened to local traffic as soon as the curing seal has been applied and dusted or sanded as necessary to prevent it from being picked up by traffic. Completed portions may be opened to all traffic after 7-days or as directed by OWNER.

301.3.3.7. Maintenance. The CONTRACTOR shall be required within the limits of its contract to maintain the soil-cement treatment in good condition from the time it first starts work until all work shall have been completed. Maintenance shall include immediate repairs of any defect that may occur after the cement is applied. Such maintenance work shall be done by the CONTRACTOR at the CONTRACTOR'S expense and repeated as often as necessary to keep the area continuously intact. Repairs are to be made in such a manner as to insure restoration of a uniform surface for the full depth of treatment. Any low area of treated subgrade shall be remedied by scarifying the surface to a depth of at least 2-in., filling the area with treated material and compacting. Any low area of subbase or base shall be remedied by replacing the material for the full depth of subbase or base treatment rather than adding a thin layer of stabilized material to the completed work.

301.3.4. Measurement and Payment. Portland cement treatment shall be measured by the square-yard of completed and accepted cement treated course. Measurement for cement shall be by the ton of 2000-pounds of dry weight, as determined by certified weight tickets. No allowance shall be made for any materials used or work done outside the limits as established by the OWNER.

The work performed and material furnished as prescribed by this item and measured as provided in this item shall be paid for at the unit price bid for soil-cement treated subgrade, subbase, or base course, which price shall be full compensation for pulverizing or providing the soil material; handling, hauling and spreading dry or slurry cement, mixing the cement with the soil either in-place or in a mixing plant; furnishing, hauling and mixing water with the soil-cement mixture; spreading and shaping the mixture; compacting the mixture, including all rolling required for this compaction; surface finishing; curing; and for all manipulation, labor, equipment, appliances, tools and incidentals necessary to complete the work and carry out the maintenance provisions in this specification. Cement material measured as provided in this item shall be paid for at the unit price bid for cement material, which price shall be compensation for furnishing the material, for all freight involved, for all unloading and storing, and for all labor, equipment, fuels, tools and incidentals necessary to complete the work, all in accordance with the plans and these specifications.

301.4. ASPHALT EMULSION TREATMENT

This item shall consist of treating subgrade, subbase, and base courses by the pulverization, addition of asphalt base stabilization agent, mixing and compacting the mixed material to the required density. This item applies to natural ground, embankment, base or subbase courses placed under this contract, which shall be constructed as specified herein and in conformity with the typical section, lines and grades as shown on the plans.

Asphalt stabilization of recycled material such as crushed concrete or other non-hazardous recycled materials, processed recycled asphalt pavements, bottom ash, foundry slag, glass, recycled crumb rubber to create subgrade, subbase or base courses shall conform to TxDOT Special Specification 3157 Cold Processed - Recycled Paving Material (RPM) for Use as Aggregate Base Course. Asphalt emulsion for such recycling shall conform to [Item 302.3.6](#). Specialty Emulsions or [Item 302.3.7](#). Emulsion for In-Place Asphalt Recycling, as specified by the OWNER.

301.4.1. Materials.

301.4.1.1. Asphalt Soil (Base) Stabilization Agent. The product shall be composed of petroleum of resin oil base with selective hardening and drying agents to form a stable subgrade, subbase, or base. Independent laboratory tests shall certify compliance with requirements of Table 301.4.1.1.(a) Asphalt Soil Stabilization Agent Requirements, as specified on the plans.

If the minimum design strength or percent asphalt base stabilization agent to be used for the treated subgrade, existing base, new subbase or new base is specified, it shall be determined by preliminary laboratory tests at the OWNER'S expense.

Table 301.4.1.1.(a) Asphalt Soil Stabilization Agent Requirements

Property	Test Method, Test Parameters	Required Value	
		Minimum	Maximum
Appearance	Visual Inspection	Brown Liquid	
Viscosity S.F. at 77°F Sec	ASTM D244 Emulsified Asphalts	5	175
Residue, % min	ASTM D244, modified ¹	55	65
Penetration 77°F, Sec		5	40
Miscibility Test	ASTM D244, modified ²	No coagulation	
Moisture, wt %		-	45
Volatile %		25	-
% Non-Volatile Soluble in Trichloroethylene	AASHTO T 45-56	-	8
Accelerated Weathering (2-year exposure)	Federal Spec TT C-555 B, 40 ml	No material deterioration after exposure	
Resistance To wind and Driven Rain (@ 98 mph)	Federal Spec TT C-555 B, As 4ml sealer after cure	Passes/no wt. gain	
Ash, % wt.		-	8
Polymer, % wt.		-	4
Particle Charge	ASTM D244	Positive	
Flash Point	TCC	275°F	
Shaker Test 2- to 4-hrs.	Mix Burrell Wrist Action Shaker Model 75 set on Level 7, diluted 1 part water to 4 parts soil stabilizer, Sieve #40	-	1%

1. ASTM D244 Modified Evaporation Test for percent of residue is made by heating 50-gram sample to 300°F until foaming ceases, then cool immediately and calculate results.

2. Test procedure identical with ASTM D244, except that 0.02 Normal Calcium Chloride solution shall be used in place of distilled water.

301.4.1.2. Base and Subbase Materials. Base and subbase materials shall meet the requirements shown on the plans or in the pertinent specifications.

301.4.1.3. Delivery and Storage. If asphalt base stabilization agent is furnished in trucks, each truck shall bear the weight of asphalt base stabilization agent measured on certified scales, or the CONTRACTOR shall place a set of standard platform truck scales or hopper scales at a location approved by the OWNER.

Asphalt base stabilization agent shall be stored and handled in tank, tanker or distributor truck until immediately before distribution on the road. Asphalt base stabilization agent shall be stored in freeze-proof containers.

301.4.2. Equipment. Machinery, tools and equipment necessary for proper performance of the work shall be on the project and approved by the OWNER prior to the beginning of construction operations. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

301.4.3. Asphalt Emulsion Treatment Construction Methods.

301.4.3.1. General. It is a primary requirement of this specification to secure a completed course of treated material containing a uniform asphalt base stabilization agent mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface and suitable for placing subsequent courses. It shall be the responsibility of the CONTRACTOR to regulate the sequence of work, to use the proper amount of asphalt base stabilization agent, maintain the work and rework the courses as necessary to meet the above requirements.

Prior to beginning any asphalt base stabilization agent treatments, the roadbed shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the OWNER.

301.4.3.2. General Construction.

301.4.3.2.1. Treatment for Materials-In-Place. Materials to be treated shall be excavated to the secondary grade (proposed bottom of asphalt base stabilization agent) and removed or windrowed to expose the secondary grade. Any wet or unstable material below the secondary grade shall be corrected by scarifying, adding asphalt base stabilization agent and compacting until it is of uniform stability. The excavated material shall then be spread to the desired cross section.

If the CONTRACTOR elects to use a cutting or pulverizing machine that shall remove the subgrade material accurately to the secondary grade and to pulverize the material at the same time, CONTRACTOR shall not be required to expose the secondary grade or windrow the material. However, the CONTRACTOR shall be required to roll the subgrade before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method shall be permitted only where a machine is provided which shall insure that the material is cut uniformly to the proper depth and which has cutters that shall place the secondary grade to a smooth surface over the entire width of the cut. The machine shall be of such design that a visible indication is given at all times that the machine is cutting to the proper depth.

301.4.3.2.2. Treatment for New Materials. The base and subbase material, as provided in the governing specifications, shall be delivered, placed and spread in the required amount per station. The material shall be manipulated as specified and thoroughly mixed prior to the addition of the asphalt base stabilization agent.

301.4.3.3. Asphalt Base Stabilization Agent Application. Asphalt base stabilization agent shall be spread only on that area where the mixing can be completed in the same working day. Asphalt base stabilization agent shall be mixed with water and applied as a thin water suspension. The distribution of asphalt stabilization agent at the rate shown on the plans shall be attained by successive passes over a measured surface of roadway until the proper moisture content and asphalt base stabilization agent content has been achieved.

The asphalt base stabilization agent shall be distributed at a uniform rate and in such a manner as to reduce heavy or light areas to a minimum. A motor grade can be used to cover the exposed asphalt base stabilization agent. If necessary, the material shall be sprinkled until a proper moisture content has been achieved.

301.4.3.4. Mixing. The application and mixing of asphalt base stabilization agent with the material shall be thorough. During the interval of time between application and mixing, asphalt base stabilization agent that has been exposed to the open air for a maximum time of 2-hours, or a shorter period when the breaking of the emulsion has occurred, shall not be accepted for payment. *(Breaking of the emulsion is when the emulsion is over exposed on the surface without mixing, thus turning it from a brown color to black. The color change is due to the evaporation of the water from the emulsion, thus rendering it ineffective in mixing in the soil, base or subbase material).* The CONTRACTOR is responsible for monitoring the application and the mix time of the asphalt stabilization agent with the soil, base or subbase material. The overexposed area shall be retreated with another application of asphalt base stabilization agent and mixed.

301.4.3.4.1. Treatment for Materials-In-Place. Material and asphalt base stabilization agent shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing

continued until a homogeneous, friable mixture of material and asphalt base stabilization agent is obtained, free from all clods or lumps. Materials containing plastic clay or other materials which shall not readily mix with asphalt base stabilization agent shall be mixed as thoroughly as possible, and meet the requirements of Table 301.4.3.4.1.(a) Asphalt Emulsion Treated Materials-In-Place when tested dry by laboratory sieve at the time of the asphalt base stabilization agent application, brought to the proper moisture content, sealed with a pneumatic roller, and left to cure 1 to 2 days as directed by the OWNER. During the curing period, the material shall be kept moist.

Table 301.4.3.4.1.(a) Asphalt Emulsion Treated Materials-In-Place

Sieve Size	Minimum Passing by Dry Weight^{1,2}
1¾-in. (45mm)	100%
No. 4 (4.75mm)	60%

301.4.3.4.2. Treatment of New Material. The base or subbase material, asphalt base stabilization agent and required water shall be thoroughly mixed and blended by approved road mixers or other approved equipment and the mixing continued until a homogeneous, friable mixture is obtained. When the asphalt base stabilization agent is placed and mixed by the use of blades, the material shall be bladed as the asphalt base stabilization agent water mixture is applied; after the total amount has been placed, the mixture shall be thoroughly blended to the satisfaction of the OWNER.

301.4.3.4.3. Central Mixing Plant. The soil, asphalt base stabilization agent and water shall be mixed in a pugmill either of the batch or continuous-flow type. The plant shall be equipped with feeding and metering devices which shall add the soil, asphalt base stabilization agent and water into the mixer in the specified quantities. Soil and asphalt base stabilization agent shall be mixed sufficiently to prevent asphalt base stabilization agent balls from forming when water is added. Mixing shall continue until a uniform and intimate mixture of soil, asphalt base stabilization agent and water is obtained. The mixture shall be placed on the moistened subgrade in a uniform layer by an approved spreader or spreaders.

After mixing asphalt stabilization agent with the base or subbase material the following conditions shall be met:

- (1) Not more than 3-hours shall elapse between the placement of soil-asphalt emulsion mixture in adjacent lanes and placement at any location except at longitudinal construction joints.
- (2) Not more than 3-hours shall elapse between the start of spreading the soil-asphalt emulsion mixture and start of compaction.
- (3) Not more than 4-hours shall elapse between the start of mixing and the start of compaction.

The layer of soil-asphalt base stabilization agent shall be uniform in thickness and surface contour, and in such quantity that the completed base shall conform to the required grade and cross section. Dumping of the mixture in piles or windrows upon the subgrade shall be permitted.

301.4.3.5. Compaction. Compaction of the mixture shall begin immediately after final mixing and in no case later than 2-days after final mixing. The material shall be aerated or sprinkled as necessary to provide optimum moisture content. At the start of compaction, the moisture in the mixture and in unpulverized soil lumps, based on oven-dry weights, shall be within minus-2- to plus-2-percent-of-optimum. The specified optimum moisture content and density shall be determined in the field on the representative samples of soil-asphalt base stabilization agent mixture obtained from the area being processed. Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth. The loose mixture shall be uniformly compacted to the specified density within 4-hours. Compaction shall begin at the bottom and shall continue until the entire depth of the mixture is uniformly compacted as shown on the plans or specified by the OWNER.

The compacted mixture shall have a uniform density of not less than 95-percent of the maximum density as determined by ASTM D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³). Final moisture content shall be within minus-2- to plus-4-percent-of-optimum. If the soil-asphalt base stabilization agent mixture is wetted by rain so that the average moisture content

exceeds the tolerance given at the time of final compaction, the entire section shall be reconstructed in accordance with this specification at the sole expense of the CONTRACTOR. After the soil and asphalt base stabilization agent mixture, except the top layer, is compacted, water shall be uniformly applied as needed and thoroughly mixed in with a spike tooth harrow or equal. The surface shall then be reshaped to the required lines, grades and cross sections and then lightly scarified to loosen any imprint left by the compacting or shaping equipment. After each section is completed, such tests as are necessary shall be made by the OWNER. If any portion fails to meet the density specified, it shall be reworked as necessary to obtain the specified density at the sole expense of the CONTRACTOR.

301.4.3.6. Finishing, Curing and Preparation for Surfacing. The resulting surface shall be thoroughly rolled with a pneumatic tire roller and “clipped”, “skinned”, and “tight-bladed” by a power grader to a depth of approximately 1/4-in., moving all loosened soil and asphalt base stabilization agent from the section. The surface shall then be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. When directed by the OWNER, surface finishing methods may be varied from this procedure, provided a dense, uniform surface, free of surface material, is maintained at its specified optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 4-hours, a smooth, closely knit surface, free of cracks, ridges or loose material, conforming to the drawn grade and line shown on the plans.

The completed section shall then be moist-cured for a minimum of 2-days before further courses are added, unless otherwise directed by the OWNER. In cases where, in the opinion of the OWNER, subgrade treatment or subbase sets up sufficiently to prevent objectionable damage from traffic, such layers may be opened to traffic after compaction. The surface of the compacted layer shall be kept moist until covered by other base or paving material or application of a curing seal of emulsified asphalt. If a curing seal is used, it shall be applied as soon as possible after completion of final rolling, at a rate of between 0.10- and 0.20-gallons-per-square-yard, the exact rate to be determined by the OWNER. No equipment or traffic shall be permitted on asphalt base stabilization agent treated material for 12-hours after curing seal is applied, unless otherwise permitted by the OWNER.

301.4.3.7. Maintenance. The CONTRACTOR shall be required to maintain the completed asphalt stabilized base within the limits of its contract in good condition, satisfactory to the OWNER as to grade, crown and cross section until such time as the surface course is constructed. The CONTRACTOR shall immediately repair all irregularities or other defects that may occur at the CONTRACTOR’S expense. Repairs are to be made as directed by the OWNER and in a manner to insure restoration of a uniform surface and durability of the portion repaired.

301.4.4. Measurement and Payment. Asphalt base stabilization agent treatment shall be measured for payment in square-yards for the thickness shown in the plans for the surface area of completed and accepted work. The measurement for asphalt base stabilization agent shall be by the gallon.

Asphalt base stabilization agent treatment shall be paid for at the contract unit price per square yard, as provided in the proposal and contract. The contract unit price shall be the total compensation for preparing the roadbed; for loosening, pulverizing, application of asphalt base stabilization agent, water content in the asphalt base stabilization agent mixture and the mixing water; mixing, shaping, sprinkling, compacting, finishing, curing and maintaining; for manipulations required; and for all labor, equipment, fuels, tools and incidentals necessary to complete the work, all in accordance with the plans and specifications. Asphalt base stabilization agent material measured as provided in this item shall be paid for at the unit price bid for “asphalt emulsion base stabilizer” which price shall be full compensation for furnishing the material; for all freight involved; for all unloading, storing and handling; and for all labor, equipment, fuels, tools and incidentals necessary to complete the work.

301.5. FLEXIBLE SUBBASE OR BASE (CRUSHED STONE/CONCRETE)

This item shall consist of a foundation course for a surface course or for other subbase or base courses; shall be constructed as herein specified in one or more courses in conformity with the typical section shown on the plans and to the lines and grades as established by the OWNER.

301.5.1. Material.

301.5.1.1. General. Should the CONTRACTOR elect to produce the material from local pits, the material shall be secured from sources approved by the OWNER. The pits as utilized shall be opened up in such a manner as to immediately expose the vertical faces of all the strata of acceptable material in the depth mined. Unless otherwise directed, the material shall be secured in successive vertical cuts extending through all of the exposed strata, in order that a uniform mixed material shall be secured. Should OWNER allow crushed concrete, materials shall meet the requirements in Table 301.5.1.2.(a) Flexible Base or Subbase Material Requirements, according to specified grade. Additionally, this material shall be free of thin, laminated, or elongated pieces, reinforcing steel, or an excess of shale, dirt, organic matter or other objectionable materials as determined by the OWNER that could be harmful to the production of a homogenous base coarse.

301.5.1.2. Tests and Physical Requirements. Tests shall be performed in accordance with ASTM D4318 Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. The preparation of samples for testing according to ASTM D4318 shall be in accordance with the requirements of ASTM D2217 Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants. The material shall also be tested under TxDOT Test Method Tex-116-E The Wet Ball for Determining the Disintegration of Flexible Base Materials. When a magnesium soundness value is shown on the plans the material shall be tested in accordance with Test Method Tex-411-A Soundness of Aggregate Using Sodium Sulfate or Magnesium Sulfate. Physical properties shall meet the requirements in Table 301.5.1.2.(a) Flexible Base or Subbase Material Requirements, according to specified grade.

Table 301.5.1.2.(a) Flexible Base or Subbase Material Requirements

Property	Grade 1		Grade 2	
Triaxial Class	1		1 to 2.3	
Minimum Compressive Strength at lateral pressure 0-psi at lateral pressure 15-psi	45-psi 175-psi		35-psi 175-psi	
Master Grading	Sieve	Percent Retained	Sieve	Percent Retained
	1 ³ / ₄ "	0	2 ¹ / ₂ "	0
	7 ⁸ / ₈ "	10-35	1 ³ / ₄ "	0-10
	3 ⁸ / ₈ "	30-50	No. 4	45-75
	No. 4	45-65	No. 40	60-85
	No. 40	70-85		
Maximum Liquid Limit	35		40	
Maximum Plasticity Index	10		12	
Maximum Wet Ball Mill ¹	40		45	
Maximum increase in passing No. 40	20%		20%	
Maximum foreign material allowed	1%		1%	

1. When lightweight aggregates are used, the wet ball mill requirements shall not apply; lightweight aggregate shall meet the Los Angeles Abrasion, Pressure Slaking and Freeze Thaw requirements of TxDOT Item 303 Aggregate for Surface Treatment (Lightweight).

301.5.1.3. Rejection. Aggregate that fails to meet the requirements of these specifications may be rejected by the OWNER. Such rejection shall incur no cost to the OWNER. Aggregate sources from which materials are delivered with properties not meeting these specifications may be rejected as further supply sources to the project by the OWNER.

301.5.2. Construction Methods.

301.5.2.1. Preparation of Subgrade. Preparation of the subgrade shall be in conformity with the requirements of [Item 301.3.3.3.1. Subgrade Preparation](#).

301.5.2.2. Placing. Immediately before placing the subbase or base course material, the subgrade shall be checked as to conformity with grade and section.

The material shall be delivered in approved vehicles of a uniform capacity. It shall be the charge of the CONTRACTOR that the required amount of specified material shall be delivered to secure the proper thickness of the completed subbase or base course. Material deposited on the subgrade shall be spread and shaped the same day. All material shall be moved at least once from the original position in which it is deposited. In the event of inclement weather or other unforeseen circumstances which render impracticable the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed by the OWNER. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped to conform to the typical section as shown on the plans.

All areas and “nests” of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material as directed by the OWNER. If additional binder is considered desirable or necessary after the material is spread and shaped, it shall be furnished and fully incorporated with the material in place by scarifying, harrowing, brooming or by other approved methods. The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as specified in [Item 301.5.2.3. Density](#). In addition to the requirements specified for density, the full depth of flexible subbase or base shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each course is completed, tests as necessary shall be made by the OWNER unless otherwise specified in the special provisions or in the plans. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements.

Throughout the entire operation, the shape of the course shall be maintained by blading. The surface, upon completion, shall be smooth and in conformity with the typical sections shown on the plans to the established lines and grades. On the surface on which pavement is to be placed, any deviation in excess of ½-in. in cross section in a length of 16-ft. measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. All fractures, settlement, or segregation that develops shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.

Should the subbase or base course, due to any reason or cause, lose the required stability, density and finish before the surfacing is complete, it shall be recompacted and refinished at the sole expense of the CONTRACTOR.

301.5.2.3. Density. The density required under this item shall not be less than 92-percent compaction as determined by ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³). Moisture content shall be within minus-2- to plus-4-of-optimum.

301.5.2.4. Courses. Non full depth asphalt pavements, paving types with flexible base under the curb and gutter, shall be placed and compacted at the same time and in the same operation as the flexible base under the pavement. Where the subbase or base course exceeds 6-in. in thickness, it shall be constructed in two or more courses of equal thickness as indicated on the typical section. A minimum course depth of 3-in. is recommended. The first course shall be placed and compacted under the curb and gutter and under the pavement. The curb and gutter shall then be built upon the first course. The final course of the flexible base shall be placed following the curing time as specified in [Item 305.1. Concrete Curb and Gutter](#).

301.5.3. Measurement and Payment. Work and accepted materials as specified for this item shall be measured by the square-yard of the required depth from plans and specifications completed flexible base as follows:

- (1) Where no curb and gutter is in place or is to be constructed in connection with the flexible base, measurement shall be made to the lines shown on the plans or established as the edge of the base to be constructed.
- (2) Where curb and gutter is in place or is proposed to be constructed in connection with the placing of the flexible base, measurement shall be made to the lip of the gutter. Material placed under the curb and gutter or behind the curb shall not be measured as flexible base but shall be considered as foundation courses for the curb and gutter.

The work performed and material placed (including additional binder if required) as prescribed for this item, measured as provided in this item, shall be paid for at the unit price bid per square-yard for flexible base, which price shall be full compensation for preparation of subgrade, furnishing of material, hauling, blading, sprinkling, compacting and furnishing all of labor and equipment necessary to complete the work.

301.6. GEOTEXTILES USED IN PAVING APPLICATIONS

301.6.1. Materials.

301.6.1.1. Physical Properties. The fabric properties shall conform to those shown in Table

301.6.1.(a) Geotextiles for Paving, as determined by the Federal Highway Administration Task Force 25 Guidelines using ASTM Test Methods, except where noted.

301.6.1.2. Certification. The manufacturer, if required by the OWNER, shall provide documents stating the name and manufacturer, the chemical composition of the filaments or yarns and test values of the properties of the geotextile. The manufacturer must certify that the material meets or exceeds these specifications.

301.6.1.3. Rejection. Geotextile may be rejected for failure to meet any of the requirements of this specification.

Table 301.6.1.(a) Geotextiles for Paving

Designation (Test Method)	Characteristic	Average Roll Minimum Value
ASTM D4632 Grab Breaking Load and Elongation of Geotextiles	Grab Strength	80-lbs. @ 12-in.-per-minute
ASTM D4632	Elongation @ Break	50% @ 12-in.-per-minute
Tex-616-J, Construction Fabrics	Asphalt Retention	0.5-oz.-per-sq.-ft.
ASTM D276 Identification of Fibers in Textiles	Melting Point	300°F

301.6.2. Construction Methods. Construction methods for each type unit shall be provided by the manufacturer and approved by the OWNER based on the site-specific use.

301.6.3. Measurement and Payment. If provided as a separate contract item, geotextile shall be measured by the square-yard, complete in place.

Geotextile, when provided as a separate pay item, shall be paid for by the square-yard, complete in place, which price shall include materials, hauling, placing, anchoring, and all other work necessary to achieve a functional geotextile layer(s) in the subbase or base layer. If not provided as a separate contract item, geotextile shall be considered subsidiary to those items provided for subbase or base preparation.

ITEM 302. ASPHALT PAVEMENT

302.1. DESCRIPTION

This Item establishes the requirements for asphalt construction. This Item includes material requirements and construction methods for emulsified asphalts, hot-mix asphalt pavement, performance graded (PG) asphalts and other miscellaneous asphaltic materials and polymer additives. Alternately, the use of warm-mix asphalt may be permitted with the OWNER'S approval in accordance with the Texas Department of Transportation Pavement Design Guide - Section 5: Hot-Mix Asphalt Concrete Pavement Mixtures.

302.2. AGGREGATES FOR HOT-MIX ASPHALT PAVEMENT

302.2.1. General Requirements. Aggregates shall conform to the requirements contained in this [Item 302.2](#). Aggregates for Hot-Mix Asphalt Pavement and shall be approved by the OWNER prior to use. The integrity of the aggregate shall be such as to produce a workable material within the limits contained in this specification.

302.2.1.1. Deleterious Substances. Aggregates shall be free from loam, clay balls or other injurious foreign matter occurring either free or as a coating on the aggregates.

302.2.1.2. Storage. Prior to stockpiling of aggregates, the area shall be cleaned of trash, weeds and grass and be relatively smooth. Aggregates shall be stockpiled in such a manner as to prevent mixing of one aggregate with another. Coarse aggregates shall be separated into stockpiles of different gradation, such as a large coarse aggregate and a small coarse aggregate stockpile and such that the grading requirements of the specified type shall be met when the piles are combined in the asphaltic mixture. No coarse aggregate stockpile shall contain more than 15-percent by weight of material that shall pass a No. 10 (2.0mm) sieve except as noted on the plans. Fine aggregate stockpiles may contain coarse aggregate in the amount of up to 20-percent by weight; however, the coarse aggregate shall meet the quality tests specified in [Item 302.2.2](#). Coarse Aggregates. Suitable equipment of acceptable size shall be furnished by the CONTRACTOR to work the stockpiles and prevent segregation of the aggregates.

302.2.1.3. Quality and Testing Requirements. Test of aggregates, when required, shall be made in accordance with applicable Texas Department of Transportation tests or ASTM Test Methods, as shown in the tables below or as required by OWNER.

Requirements for hot-mix asphalt pavement aggregates are shown in Table 302.2.2.(a) Coarse Aggregate Quality Requirements.

302.2.1.4. Aggregate Rejection. Aggregates that fail to meet the requirements of these specifications may be rejected by the OWNER. Such rejection shall incur no cost to the OWNER. The OWNER may reject sources from which materials are delivered with properties not meeting these specifications. Such rejection shall incur no cost to the OWNER.

302.2.2. Coarse Aggregates. Coarse aggregates shall be that portion of the total aggregates retained on the No. 10 sieve (2.0mm). Coarse aggregates shall consist of clean, tough, durable fragments of crushed stone, crushed gravel, or steel slag as specified herein, of uniform quality throughout.

All coarse aggregates shall meet the requirements listed in Table 302.2.2.(a) Coarse Aggregate Quality Requirements.

Table 302.2.2.(a) Coarse Aggregate Quality Requirements¹

Characteristic	Test Method	Value
Deleterious Material	Tex-217-F, Part I, Determining Deleterious Material in Coarse Aggregates (Bituminous Mixtures)	1.5% Max.
Decantation	Tex-217-F, Part II, Decantation Test for Coarse Aggregate (Bituminous Mixtures)	1.5% Max.
Los Angeles Abrasion	Tex-410-A, Abrasion of Coarse Aggregate Using the Los Angeles Machine (ASTM C131)	35% Max.
Magnesium Sulfate Soundness Loss, 5 Cycle	Tex-411-A, Soundness of Aggregate Using Sodium Sulfate or Magnesium Sulfate	30% Max. (lower value may be shown on plans)
Coarse Aggregate Angularity Two Crushed Faces	Tex-460-A, Part I, Determining Crushed Face Count	90% Min.
Flat Elongated Particles	ASTM D4791 Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate	20% Max. @ 3:1

1. Sampled during delivery to the plant or from the stockpile, unless otherwise shown on the plans.

302.2.3. Fine Aggregate. Fine aggregate may consist of crushed stone, crushed gravel, sand, and/or limestone or steel slag screenings.

Fine aggregate shall meet the requirements listed in Table 302.2.3.(a) Fine Aggregate Quality Requirements.

Table 302.2.3.(a) Fine Aggregate Quality Requirements¹

Characteristic	Test Method	Value
Linear Shrinkage	Tex-107-E, Determining the Bar Linear Shrinkage of Soils	3% Max.
Sand Equivalent Value	Tex-203-F, Sand Equivalent Test	45% Min.

1. Sampled during delivery to the plant or from the stockpile, unless otherwise shown on the plans.

302.2.3.1. Sand. Sand material may constitute a part of the fine aggregates for hot-mix asphalt pavement. The fine aggregate portion of the sand passing the No. 40 (425- μ m) sieve shall meet the Linear Shrinkage requirement listed in Table 302.2.3.(a) Fine Aggregate Quality Requirements.

302.2.3.1.1. Gradation. Fine aggregate sand shall be that portion of the sand in the total aggregate passing the No. 10 (2.0mm) sieve. It shall be well graded and composed of sound, durable sand particles.

302.2.3.2. Limestone or Steel Slag Screenings. Limestone or steel slag screenings may constitute part or all of the fine aggregates for hot-mix asphalt pavement. Screenings shall be of the same or similar material for coarse aggregates. Where limestone rock screenings are specified for use, they shall be screenings resulting from crushing operation.

The fine aggregate portion passing the No. 40 (425- μ m) sieve shall meet the Linear Shrinkage requirement listed in Table 302.2.3.(a) Fine Aggregate Quality Requirements. Fine aggregates from each source shall meet Linear Shrinkage requirements.

302.2.3.2.1. Gradation. The limestone or steel slag screening shall meet the grading requirements in Table 302.2.3.2.1.(a) Limestone or Steel Slag Screenings Gradation unless otherwise shown on the plans.

When authorized by the OWNER, stone or steel slag screenings containing particles larger than $\frac{3}{8}$ -in. (9.5-mm) may be used but only that portion of the material passing the $\frac{3}{8}$ -in. (9.5-mm) sieve shall be considered as fulfilling the requirements for screenings when a minimum percent of screenings is specified for a particular mixture.

Table 302.2.3.2.1.(a) Limestone or Steel Slag Screenings Gradation

Sieve Size	Percent Passing by Weight
$\frac{3}{8}$ -in. (9.5-mm)	100
Passing No. 200 (75- μ m)	0 to 30

302.2.4. Mineral Filler. Mineral filler shall consist of a thoroughly dry stone dust Portland cement or other mineral dust approved by the OWNER. All mineral filler shall meet the requirements listed in Table 302.2.4.(a) Mineral Filler Quality Requirements.

Table 302.2.4.(a) Mineral Filler Quality Requirements¹

Characteristic	Test Method	Value
Linear Shrinkage	Tex-107-E, Determining the Bar Linear Shrinkage of Soils	3% Max.

1. Sampled during delivery to the plant or from the stockpile, unless otherwise shown on the plans.

302.2.4.1. Gradation. When tested by the method outlined in TxDOT Test Method Tex-200-F Sieve Analysis of Fine and Coarse Aggregates (Part 1 Dry Sieve Analysis (Based on Weight) or Part 3 Volumetric Sieve Analysis, as applicable), it shall meet the requirements of Table 302.2.4.1.(a) Mineral Filler Gradation.

Table 302.2.4.1.(a) Mineral Filler Gradation

Sieve Size	Percent Passing by Weight
No. 30 sieve (600- μ m)	95 to 100
No. 80 sieve (180- μ m)	Not Less Than 75
No. 200 sieve (75 μ m)	Not Less Than 55

302.3. BITUMINOUS MATERIALS

302.3.1. General. This Item consists of bituminous material, including performance graded asphalts, modified performance graded asphalts, asphalt cement, emulsified asphalt, and other miscellaneous asphaltic materials. Asphalt for use in paving shall be a refined asphalt produced from crude petroleum. The base asphalt shall be homogeneous and free from water and residue from distillation of coal, coal tar or paraffin oil and shall not foam when heated to 347°F.

302.3.1.1. Tests and Certification of Bituminous Materials. When tested according to ASTM or AASHTO test methods, the various materials shall meet the applicable requirements of this specification. At the time of delivery of each shipment of asphalt, the vendor supplying the material shall deliver to the CONTRACTOR certified copies of the test report. Two copies of the test reports shall be furnished to the OWNER. Test reports shall indicate the name of the vendor, type and grade of bituminous material delivered, date and point of delivery, quantity delivered, delivery ticket number, purchase order number, and results of the specified tests. The test report, signed by an authorized representative of the vendor, shall certify that the product delivered conforms to the specifications for the type and grade indicated. The certified test reports and the testing required in connection with the reports shall be at no cost to the OWNER.

Until the certified test reports and samples of the material have been checked by the OWNER to determine their conformity with the prescribed requirements, the material to which such report relates and any work in which it may have been incorporated as an integral component, shall be only tentatively accepted by the OWNER. Final acceptance shall be dependent upon the determination by the OWNER that the material involved fulfills the prescribed requirements.

302.3.1.2. Rejection. Any material specified in this section may be rejected for failure to meet any of the provisions for this specification, or for any defect causing it to be unsuitable for its intended use.

302.3.2. Performance Graded (PG) Asphalt Binders. Performance graded asphalt binders shall be smooth and homogeneous, shall be free from water, shall not foam when heated to 347°F and shall meet the

requirements for performance graded asphalt binders shown in Table 302.3.2.(a) Performance Graded Asphalt Binders.

PG binders shall show no separation when tested according to Tex-540-C Measurement of Polymer Separation on Heating in Modified Asphalt Systems. Separation testing is not required if one of the following conditions is met:

- (1) The modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer; or
- (2) The binder is blended on site in continuously agitated tanks; or
- (3) Binder acceptance is based on field samples taken from an in-line sampling port at the hot-mix plant after the addition of modifiers.

302.3.2.1. Modified Performance Graded Asphalt Binders. In addition to meeting the requirements in Table 302.3.2.(a) Performance Graded Asphalt Binders, modified performance graded asphalt binders shall also meet the requirements listed herein according to grade.

302.3.2.1.1. SBR Latex Rubber Modified Performance Graded Binders. Available grades include PG 64-28L, PG 70-28L, PG 70-22L, PG 76-22L, and PG 82-22L. The manufacturer shall provide certification that SBR latex rubber was used in production of the binder. Ductility tested according to AASHTO T51: 39.2°F, 1-cm/min, cm, 70-cm minimum.

302.3.2.1.2. SBS Rubber Modified Performance Graded Binders. Available grades include PG 64-28S, PG 70-28S, PG 70-22S, PG 76-22S, and PG 82-22S. The manufacturer shall provide certification that SBS rubber was used in production of the binder. Elastic recovery tested according to Tex-539-C Measurement of Elastic Recovery of Tensile Deformation Using a Ductilometer: 50°F, 55% minimum.

302.3.2.1.3. Tire Rubber Modified Performance Graded Binders. Available grades include PG 64-28TR, PG 70-28TR, PG 70-22TR, PG 76-22TR, and PG 82-22TR. The manufacturer shall provide certification that tire rubber was used in production of the binder. Elastic recovery tested according to Tex-539-C Measurement of Elastic Recovery of Tensile Deformation Using a Ductilometer: 50°F, 40% minimum.

302.3.2.2. Acceptance of Performance Graded (PG) Asphalt Binders.

302.3.2.2.1. Location of Manufacture. Performance graded binder acceptance procedures are dependent on where the binder is manufactured. The requirements are as follows.

Manufactured at the Source. PG binders manufactured at the source are normally approved at the source according to the applicable requirements of the OWNER. The OWNER may acquire field samples at any time, particularly if material quality is suspect.

Manufactured at the Job Site. If PG binders are manufactured at the job site, for example where SBR latex is injected at the hot mix plant, the following quality measures are required. Antistrip agents are not considered asphalt modifiers.

- (1) Preconstruction. The CONTRACTOR shall provide the OWNER with a 1-quart sample of the proposed binder and a test report showing compliance with the required performance grade. The sample and test report will be forwarded to OWNER for verification testing. If the OWNER chooses to verify that the sample meets specifications, the OWNER will complete verification testing within ten (10) working days after receipt of the sample. If the OWNER chooses to verify the sample, then the sample shall be verified before mixture production is allowed to begin.
- (2) Construction. A sampling port is required which meets the requirements of AASHTO T40 Practice for Sampling Bituminous Materials, Section 9, "Sampling From Pipelines During Loading or Unloading". This sampling port shall be located on the asphalt line before introduction of the asphalt into the mix plant and shall be downstream from the addition of any modifiers and any dispersing or mixing equipment associated with their introduction.

Sample containers shall be provided by the CONTRACTOR and shall be clean, double friction top round 1-quart cans. All samples shall be taken by the CONTRACTOR, and witnessed by the Engineer.

All samples shall be taken from the sampling port after a sufficient amount of asphalt is run out and wasted, in order to clear any residual asphalt that builds up in the sampling port. All samples shall be taken in a clean, 1-gallon can, immediately stirred and used to fill three (3) 1-quart sample cans. The cans shall be delivered to the OWNER. The OWNER will choose one sample can for testing and the other cans are retained until testing is complete, in case the original sample is lost or damaged.

302.3.2.2.2. Sampling Frequency. A sample of the PG binder may be taken from each mixture production day, at a time determined by the OWNER. The sample from the first day's production may be subjected to verification testing. Additionally, throughout the duration of the project, the OWNER may randomly select binder samples for verification testing.

302.3.2.2.3. Verification Testing. OWNER may perform verification testing on all construction samples. The OWNER will complete verification testing within 10 working days after receipt of the sample.

For verification testing which fails to confirm the required performance grade, the CONTRACTOR shall review the manufacturing process to locate the source of the problem. The OWNER may stop production until the CONTRACTOR can show that the next binder produced will meet the specifications. The OWNER may require materials not meeting the specification requirements to be removed and replaced at the CONTRACTOR's expense.

302.3.3. Asphalt Cement. Asphalt cement is bituminous liquid binder. The material for asphalt cement shall be homogeneous, shall be free from water, shall not foam when heated to 347°F and shall meet the requirements of Table 302.3.3.(a) Requirements for Asphalt Cement.

Table 302.3.3.(a) Requirements for Asphalt Cement

Property, Test Parameters	Value According to Grade							
	AC-3		AC-5		AC-10		AC-20	
	Min	Max	Min	Max	Min	Max	Min.	Max
Viscosity, 140°F, Stokes	250	350	400	600	800	1200	1600	2400
Viscosity, 275°F, Stokes	1.1	—	1.4	—	1.9	—	2.5	—
Penetration, 77°F, 100-g, 5-sec.	210	—	135	—	85	—	55	—
Flash point C.O.C., °F	425	—	425	—	450	—	450	—
Solubility in trichloroethylene (%)	99.0	—	99.0	—	99.0	—	99.0	—
Tests on residues from thin film oven test: Viscosity, 140°F, Stokes	—	900	—	1500	—	3000	—	6000
Ductility, 77°F 5-cms-per-min, cms.	100	—	100	—	70	—	50	—
Spot Test	Negative for all grades							

302.3.3.1. Polymer Modified Asphalt Cement. For surface treatment applications, a polymer additive consisting of an anionic emulsion of styrene-butadiene low-temperature copolymer shall be added to the AC-5 or AC-10 asphalt when specified on the plans or in the specifications in the contract. The polymer additive shall consist of two-percent (by weight) polymer additive (solids basis) which has good storage stability. Polymer additive shall possess the properties specified in [Item 302.3.3.1.1](#). Polymer Additive Properties. The manufacturer shall furnish the actual styrene-butadiene rubber (SBR) content for each batch of polymer emulsion. This information shall accompany all shipments to facilitate proper addition rates.

The finished polymer modified asphalt cement blend shall be smooth, homogeneous, and comply with the requirements in Table 302.3.3.1.(a) Polymer Modified Asphalt Requirements.

Table 302.3.3.1.(a) Polymer Modified Asphalt Requirements

Property	Test Method, Test Parameters	Value According to Grade	
		AC-5 + 2% Polymer Solids	AC-10 + 2% Polymer Solids
Minimum SBR Content	Tex-533-C Determining Polymer Additive Percentages in Polymer Modified Asphalt Cements, IR Determination ¹	2.0% Solids By Wt.	2.0% Solids By Wt.
Penetration	AASHTO T49, 100-G, 5-Sec, 77°F	120 Min	80 Min
Minimum Viscosity	AASHTO T202, 140°F	700-Poise	1300-Poise
Maximum Viscosity	AASHTO T202, 275°F	7.0-Poise	8.0-Poise
Ductility	AASHTO T51, 39.2°F, 5-cm/Min	70-cm, Min	60-cm, Min
Separation of Polymer	Tex-540-C Measurement of Polymer Separation on Heating in Modified Asphalt Systems, After 48-Hrs. at 325°F	None	None

1. The asphalt supplier shall furnish the OWNER samples of the asphalt cement and polymer emulsion used in making the finished product.

302.3.3.1.1. Polymer Additive Properties.

The polymer additive shall be an emulsion of styrenebutadiene low-temperature copolymer in water. The emulsion shall have good storage stability and possess the properties in Table 302.3.3.1.1.(a) Polymer Additive Requirements.

Table 302.3.3.1.1.(a) Polymer Additive Requirements

Property	Value
Monomer Ratio of Polymer (butadiene to styrene)	73 ± 5 27 ± 5
Minimum Solids Content (percent by weight)	45
Viscosity of Emulsion at $77 \pm 1^\circ\text{F}$, cps, max (No.3 spindle, 20-rpm, Brookfield RVT Viscometer)	2000

302.3.4. Emulsified Asphalt. Emulsified asphalt shall be composed of a paving asphalt base uniformly emulsified with water. It shall be homogeneous throughout and, when stored, shall show no separation within 30-days after delivery. Emulsified asphalt shall meet the requirements for the specified type and grade shown in Tables 302.3.4.(a) through (d).

302.3.4.1. Testing Requirements. Test reports and certification shall be made for emulsified asphalt in accordance with [Item 302.3.1.1](#). Tests and Certification of Bituminous Materials.

302.3.4.2. Temperature. Emulsified asphalt may be reheated, but at no time after loading for transportation from refinery to the purchaser shall the temperature of the emulsion be raised above 160°F . During reheating, the emulsified asphalt shall be agitated to prevent localized overheating. Emulsified asphalt shall not be permitted to cool to a temperature of less than 40°F . Unless otherwise specified, emulsified asphalt shall be applied at a temperature within the limits specified in Table 302.5.(a) Requirements for Storage, Heating and Application Temperature. CONTRACTOR shall furnish and keep on the site an accurate thermometer suitable for determining the temperature of the emulsified asphalt.

Table 302.3.4.(a) Tests and Properties of Anionic Emulsions

Property	Rapid Setting				Medium Setting		Slow Setting			
	Type - Grade									
	RS-2		RS-2h		MS-2		SS-1		SS-1h	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol at 77°F, sec	-	-	-	-	-	-	20	100	20	100
at 122°F, sec	150	400	150	400	100	300	-	-	-	-
Sieve Test, %	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10
Miscibility (Standard Test)	-	-	-	-	-	-	Passing		Passing	
Cement Mixing, %	-	-	-	-	-	-	-	2.0	-	2.0
Demulsibility, 35-ml of 0.02 N CaCl ₂ , %	60	-	60	-	-	30	-	-	-	-
Storage Stability, 1-day, %	-	1	-	1	-	1	-	1	-	1
Freezing Test, 3 cycles ¹	-	-	-	-	Passing		Passing		Passing	
Distillation Test:										
Residue by Distillation, % by weight	65	-	65	-	65	-	60	-	60	-
Oil Distillate, % by volume of emulsion	-	½	-	½	-	½	-	½	-	½
Tests on Residue from Distillation:										
Penetration at 77°F, 100 g, 5 sec	120	160	80	110	120	160	120	160	70	100
Solubility in Trichloroethylene, %	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-
Ductility at 77°F, 5 cm/min, cm	100	-	80	-	100	--	100	-	80	-

1. Applies only when the Engineer designates material for winter use.

Table 302.3.4.(b) Tests and Properties of High Float Anionic Emulsions

Property	Rapid Setting		Medium Setting	
	Type - Grade			
	HFRS-2		AES-300	
	Min	Max	Min	Max
Viscosity, Saybolt Furol at 77°F, sec	-	-	75	400
at 122°F, sec	150	400	-	-
Sieve Test, %	-	0.10	-	0.10
Coating Ability and Water Resistance:				
Coating, dry aggregate	-	-		good
Coating, after spraying	-	-		fair
Coating, wet aggregate	-	-		fair
Coating, after spraying	-	-		fair
Demulsibility 35-ml of 0.02 N CaCl ₂ , %	50	-	-	-
Storage Stability Test, 1-day, %	-	1	-	1
Distillation Test:				
Residue by Distillation, % by weight	65	-	65	-
Oil Distillate, by volume of emulsion, %	-	1/2	-	5
Tests on Residue from Distillation:				
Penetration at 77°F, 100 g, 5 sec	100	140	300	-
Solubility in Trichloroethylene, %	97.5	-	97.5	-
Ductility at 77°F, 5 cm/min, cm	100	-	-	-
Float Test at 140°F, sec	1200	-	1200	-

Table 302.3.4.(c) Tests and Properties of Cationic Emulsions

Property	Rapid Setting				Medium Setting				Slow Setting			
	Type - Grade											
	CRS-2		CRS-2h		CMS-2		CMS-2s		CSS-1		CSS-1h	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol at 77°F, sec	-	-	-	-	-	-	-	-	20	100	20	100
at 122°F, sec	150	400	150	400	100	300	100	300	-	-	-	-
Sieve Test, %	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10
Cement Mixing, %	-	-	-	-	-	-	-	-	-	2.0	-	2.0
Demulsibility, 35 ml 0.8 percent sodium dioctyl sulfosuccinate, %	40	-	40	-	-	-	-	-	-	-	-	-
Storage Stability, 1 day, %	-	1	-	1	-	1	-	1	-	1	-	1
Coating Ability and Water Resistance:												
Coating, dry aggregate	-	-	-	-	good		good		-	-	-	-
Coating, after spraying	-	-	-	-	fair		fair		-	-	-	-
Coating, wet aggregate	-	-	-	-	fair		fair		-	-	-	-
Coating, after spraying	-	-	-	-	fair		fair		-	-	-	-
Particle Charge Test	positive		positive		positive		positive		positive		positive	
Distillation Test:												
Residue by Distillation, % by wt	65	-	65	-	65	-	65	-	60	-	60	-
Oil Distillate, % by volume of Emulsion	-	½	-	½	-	7	-	5	-	½	-	½
Tests on Residue from Distillation:												
Penetration at 77°F, 100-g, 5-sec	120	160	80	110	120	200	300	-	120	160	80	110
Solubility in Trichloroethylene, %	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-
Ductility at 77° F, 5 cm/min, cm	100	-	80	-	100	-	-	-	100	-	80	-

Table 302.3.4.(d) Tests and Properties of Polymer Modified Emulsions

Property	High Float Anionic Rapid Setting		Cationic Rapid Setting	
	Type - Grade			
	HFRS-2P		CRS-2P	
	Min	Max	Min	Max
Polymer Content, percent by weight of the distillation residue ¹	3.0	-	3.0	-
Viscosity, Saybolt Furol at 122°F, sec	150	400	150	400
Storage Stability Test, 1-day, %	-	1	-	1
Demulsibility, 35-ml of 0.02 N CaCl ₂ , %	40	-	-	-
Demulsibility, 35-ml 0.8-percent sodium dioctyl sulfosuccinate, %	-	-	40	-
Sieve Test, %	-	0.10	-	0.10
Particle Charge Test	-		Positive	
Distillation Test: ²				
Oil distillate, by volume of emulsion, %	-	½	-	½
Residue, % by wt	65	-	65	-
Tests on Residue from Distillation:				
Float Value at 140°F, sec	1200	-	-	-
Penetration, 77°F, 100-g, 5-sec	100	140	110	150
Ductility, 39.2°F, 5-cm/min, cm	50	-	50	-
Viscosity at 140°F, poises	1500	-	1300	-
Solubility in Trichloroethylene, %	97	-	97	-

1. The CONTRACTOR shall provide the OWNER samples of the asphalt cement and polymer used in making the finished emulsion with a certified statement from the Emulsion Supplier stating that the provided asphalt cement and polymer used in the finished product are the same as provided.

2. The temperature on the lower thermometer shall be brought slowly to 350°F plus or minus 10°F and maintained at this temperature for 20-minutes. The total distillation shall be completed in 60-minutes plus or minus 5-minutes from the first application of heat.

302.3.5. Emulsions for Priming, Curing and Erosion Control (PCE).

302.3.5.1. General Use Emulsions. The emulsion shall be a slow curing anionic or cationic emulsion of a petroleum based material in water. The supplier must state whether the material supplied is cationic or anionic. Such emulsions may be used for priming of base materials, curing seal for stabilized base materials, and erosion control applications such as dust control, soil surface stabilization, or mulch binder.

Emulsion properties shall fall within the ranges as shown in Table 302.3.5.1.(a) Tests and Properties of PCE (General Use) Emulsions. The base emulsion material may be diluted with water to achieve the desired concentration of residual with maximum dilution rates as indicated in Table 302.3.5.1.(b) Maximum Dilution Rate.

Table 302.3.5.1.(a) Tests and Properties of PCE (General Use) Emulsions

Property	Test Methods, Test Parameters	Minimum	Maximum
Viscosity	Saybolt Furol, 25°C	10-seconds	100-seconds
Sieve Test	Sieve Test	-	0.1%
Miscibility	ASTM D244 Emulsified Asphalts, modified ¹	Passing	-
Residue by Evaporation	ASTM D244, modified ²	60% by weight	-
Tests on Residue from Evaporation	Flash Point, C.O.C. Kinematic Viscosity, 60°C	200°C 100-cSt	- 350-cSt

1. Except the dilution shall use 350-ml of distilled or deionized water and a 100-ml beaker.

2. Except the sample shall remain in the oven until foaming ceases, then cooled and weighed.

Table 302.3.5.1.(b) Maximum Dilution Rate

Use	Maximum Dilution Rate
Priming of Base Materials	(1) part PCE to (3) parts water
Curing Seal	(1) part PCE to (3) parts water
Erosion Control	(1) part PCE to (7) parts water

302.3.5.2. Emulsions Specifically for Priming and Curing. Product shall be a water-based emulsion composed of petroleum of resin oil base with selective hardening and drying agents to form a road prime and sealer. Emulsions may be provided either concentrated or pre-diluted. Concentrated prime and/or road sealing emulsions specified in this [Item 302.3.5.2](#). Emulsions Specifically for Priming and Curing shall meet the requirements of Table 302.3.5.2.(a) Requirements for MCS-600-C – Concentrated. Diluted prime and/or road sealing emulsions specified in this [Item 302.3.5.2](#). Emulsions Specifically for Priming and Curing shall meet the requirements of Table 302.3.5.2.(b) Requirements for MCS-600-D – Dilute.

Table 302.3.5.2.(a) Requirements for MCS-600-C – Concentrated

Property	Test Methods, Test Parameters	Required Value	
		Minimum	Maximum
Appearance	Visual Inspection	Brown Liquid	
Viscosity S.F. at 77°F Sec	ASTM D244 Emulsified Asphalts	15	200
Residue, % min	ASTM D244, modified ¹	56	65
Miscibility Test	ASTM D244, modified ²	No coagulation	
Moisture, wt %		-	48
Volatile %		35	-
% Non-Volatile Soluble in Trichloroethylene	AASHTO T 45-56	-	6
Accelerated Weathering (2-year exposure)	Federal Spec TT C-555 B, 40 ml	No material deterioration after exposure	
Resistance To wind and Driven Rain (@ 98 mph)	Federal Spec TT C-555 B, As 4ml sealer after cure	Passes/no wt. gain	
Ash, % wt.		-	8
Polymer, % wt.		-	4
Freeze Test (Concentrated Form)	3-cycle	Pass	
Particle Charge	ASTM D244	Positive	
Shaker Test 2- to 4-hrs.	Mix Burrell Wrist Action Shaker Model 75 set on Level 7, diluted 1 part water to 4 parts road prime, Sieve #40	-	1%

1. ASTM D244 Modified Evaporation Test for percent of residue is made by heating 50-gram sample to 300°F until foaming ceases, then cool immediately and calculate results.

2. Test procedure identical with ASTM D244, except that 0.02 Normal Calcium Chloride solution shall be used in place of distilled water.

Table 302.3.5.2.(b) Requirements for MCS-600-D – Dilute

Property	Test Methods, Test Parameters	Required Value	
		Minimum	Maximum
Appearance	Visual Inspection	Brown Liquid	
Viscosity S.F. at 77°F Sec	ASTM D244 Emulsified Asphalts	5	70
Residue, % min	ASTM D244, modified ¹	10	20
Miscibility Test	ASTM D244, modified ²	No coagulation	
Moisture, wt %		-	90
Volatile %		90	-
% Non-Volatile Soluble in Trichloroethylene	AASHTO T 45-56	0	2
Accelerated Weathering (2-year exposure)	Federal Spec TT C-555 B, 40 ml	No material deterioration after exposure	
Resistance To wind and Driven Rain (@ 98 mph)	Federal Spec TT C-555 B, As 4ml sealer after cure	Passes/no wt. gain	
Ash, % wt.		-	2
Polymer, % wt.		-	1
Freeze Test (Concentrated Form)	3-cycle	Pass	
Particle Charge	ASTM D244	Positive	
Shaker Test 2- to 4-hrs. (non-diluted)	Mix Burrell Wrist Action Shaker Model 75 set on Level 7, Sieve #40	-	1%

1. ASTM D244 Modified Evaporation Test for percent of residue is made by heating 100-gram sample to 300°F until foaming ceases, then cool immediately and calculate results.

2. Test procedure identical with ASTM D244, except that 0.02 Normal Calcium Chloride solution shall be used in place of distilled water.

302.3.6. Specialty Emulsions. Specialty emulsions shall be slow setting emulsions of a petroleum-based material in water. Specialty emulsions may be used for purposes such as tack coat, fog seals, priming base materials, curing seal for stabilized base materials, recycled/reclaimed asphalt pavement (RAP) rejuvenator, repairing surface deficiencies, and erosion control applications. Specialty emulsions are classified as either Restorative Seal or Maltene Rejuvenator and shall meet the requirements for the specified type shown in Table 302.3.6.(a) Requirements for Restorative Seal or Table 302.3.6.(b) Requirement for Maltene Rejuvenator, respectively. Specialty emulsions shall be freeze stabilized and if freezing has occurred a homogeneous mixture shall be obtained when the material has thawed and been thoroughly mixed.

Table 302.3.6.(a) Requirements for Restorative Seal

Properties	Test Methods	Requirements
Test on Emulsion		
Viscosity @77°F, SES	ASTM D244 Emulsified Asphalts	25 - 150
Sieve Test, % by Wt.	ASTM D244, modified ¹	0.1 Max.
Particle Charge Test	ASTM D244	Positive
Cement Mixing Test, % by Wt.	ASTM D244	2.0 Max.
Pumping Stability	See Note 2.	Pass
5-day Settlement Test, % by Wt.	ASTM D244	5.0 Max.
Residue, % Wt.	ASTM D244, modified ³	64 Min.
Test on Residue from Distillation		
Viscosity @ 140°F, cSt	ASTM D2170 Kinematic Viscosity of Asphalts (Bitumens)	1,000 – 4,000
Maltene Distribution Ratio ⁴	ASTM D2006-70 Method of Test for Characteristic Groups in Rubber Extender and Processing Oils by the Precipitation Method (Discontinued 1975)	0.7 – 1.1
PC/S Ratio ⁴	ASTM D2006-70	0.5 Min.
Asphaltenes, % Wt.	ASTM D2006-70	11.00 Max.

1. Test procedure identical with ASTM D244 except that distilled water shall be used in place of two-percent sodium oleate solution.

2. Pumping stability is determined by charging 15-ounces (450-ml) of emulsion into 30-ounce (one-liter) beaker and circulating the emulsion through a gear pump (Roper 29.B22621) having ¼" inlet and outlet. The emulsion passes if there is not significant oil separation after circulating ten-minutes.

3. ASTM D244 Evaporation Test for percent of residue is modified by heating 2-ounces (50-gram) sample to 300°F until foaming ceases, then cooling immediately and calculating results.

4. In the Maltene Distribution Ratio Test by ASTM Method D2006-70:

$$(PC + A_1) \div (S + A_2)$$

PC=Polar Compounds

A₁=First Acidaffins

A₂= Second Acidaffins

S= Saturated Hydrocarbons

Table 302.3.6.(b) Requirement for Maltene Rejuvenator

Properties	Test Methods		Requirements	
	ASTM	AASHTO	Min.	Max.
Test on Emulsion				
Viscosity @77°F, SES	D244 Emulsified Asphalts	T-59	15	40
Residue, % Wt.	D244 (Mod) ¹	T-59 (Mod)	60	65
Miscibility Test	D244 (Mod) ²	T-59 (Mod)	No Coagulation	
Sieve Test, % by Wt.	D244 (Mod) ³	T-59 (Mod)	-	0.1
Particle Charge Test	D244	T-59	Positive	
Percent Light Transmittance	See Note 4.		-	30
Test on Residue from Distillation				
Flash Point, COC, °F	D92 Flash and Fire Points by Cleveland Open Cup	T-48	385	-
Viscosity @ 140°F, cSt	D445 Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)	-	100	200
Asphaltenes, % Wt.	D2006-70 Method of Test for Characteristic Groups in Rubber Extender and Processing Oils by the Precipitation Method (Discontinued 1975)	-	-	1.0
Maltene Distribution Ratio ⁵	D2006-70		0.3	0.6
PC/S Ratio ⁵	D2006-70	-	0.5	-
Saturated Hydrocarbons, S ⁵	D2006-70	-	21	28

1. ASTM D244 Modified Evaporation Test for percent of residue is made by heating 2-ounces sample to 300°F until foaming ceases, then cool immediately and calculate results.

2. Test procedure identical with ASTM D244 except that 0.02 Normal Calcium Chloride solution shall be used in place of distilled water.

3. Test procedure identical with ASTM D244 except that distilled water shall be used in place of two-percent sodium oleate solution.

4. Test according to Attachment "Standard Procedure for Determining Percent Light Transmittance of Maltene Rejuvenator, Restorative Seal, and PCE Material" in TxDOT Special Provision to Item 300 for Maltene Rejuvenator (Waco District).

5. Chemical composition by ASTM Method D2006-70:

$$(PC + A_1) \div (S + A_2)$$

PC=Polar Compounds A₁=First Acidaffins

A₂= Second Acidaffins S= Saturated Hydrocarbons

302.3.7. Emulsion for In-Place Asphalt Recycling. Emulsion shall be designed to be a recycling agent to be mixed at ambient temperature with existing in-place asphalt, native or selective material and or Recycled Asphalt Pavement (RAP) material. Product shall be a water miscible emulsion. Asphaltene, Resins, Cyclics, Saturates content must be specifically formulated based on laboratory data of existing material in relation to rejuvenation demand and any added RAP material. Product shall meet minimums and fall within the ranges specified in Table 302.3.7.(a) Emulsion Requirements for In-Place Asphalt Recycling.

Table 302.3.7.(a) Emulsion Requirements for In-Place Asphalt Recycling

Properties	Test Methods, Test Parameters	Requirements	
		Min.	Max.
Test on Emulsion			
Viscosity	Saybolt Furol, 122°F	-	185
Sieve %		-	1.0
Particle Charge		Positive	
Specific Gravity @ 77°F	ASTM D244	0.910	1.16
Cement Mixing Test		Passing	
Distillation			
Residue; % from Distillation @ 325°F		60	68
Test on Residue from Distillation			
Penetration, 77°F Extrapolation function		1400	-
Asphaltene, %		3.1	10.1
Resins, % wt.		1.2	8.9
Cyclics		65.0	95.0
Saturates		2.8	18.3
Flash Point C.O.C.		400°F	-

302.4. SECTION HELD FOR FUTURE USE**302.5. STORAGE, HEATING AND APPLICATION TEMPERATURE OF BITUMINOUS MATERIALS**

Asphalt materials should be applied at the temperature that provides proper and uniform distribution. Within practical limits, higher temperatures than necessary should be avoided. Satisfactory application should be obtained within the recommended ranges shown in Table 302.5.(a) Requirements for Storage, Heating and Application Temperature. No material shall be heated above the maximum temperature shown. Performance graded asphalt binders containing particulate or polymer modifiers may be susceptible to separation of the modifier. Appropriate circulation or agitation in storage shall be provided if separation of the modifier is expected or suspected, and in every case when the modified binder will be stored at elevated temperatures for more than one day before use.

WARNING TO CONTRACTOR: Attention is called to the fact that asphaltic materials are highly flammable. Heating of asphaltic materials constitutes a fire hazard to various degrees. The utmost care shall be taken to prevent open flames of any kind from coming in contact with the asphaltic material or the gases of same. Proper precautions should be used in all cases. The CONTRACTOR shall be responsible for any fires or accidents which may result from heating the asphaltic materials.

Binder or modifier supplier instructions regarding recommended application and storage temperatures shall supersede the guidelines below.

Table 302.5.(a) Requirements for Storage, Heating and Application Temperature

Material Type-Grade	Application and Mixing		Heating and Storage
	Recommended Range °F	Maximum Allowable °F	Maximum °F
All PG Binders	275-375	375	400
AC-3, 5, 10, 20	275-325	350	400
Emulsions			
SS-1, SS-1h, SS-1P, CSS-1h	50-130	140	140
RS-2, RS-2h, MS-2, CRS2h, CRS-2P, CMS-2, CMS-2s, HFRS-2, HFRS-2P, AES-300	110-160	170	170
PCE, Restorative Seal or Maltene Rejuvenator	Ambient = 72-130	140	140

302.6. EMULSIFIED ASPHALT TREATMENT

302.6.1. Description. Emulsified asphalt treatment shall consist of one or more applications of a mixture of emulsified asphalt of the proportion and type specified on the plans and water. The mixture shall be applied at the rate specified on the plans. It is to be used as a base treatment, earthwork seal, prime coat or dust preventative. This mixture may be applied to the base course, subgrade, shoulders or detours at the locations and to the extent shown on plans or as directed by the OWNER.

302.6.2. Materials. The amount of emulsified asphalt in the mixture, expressed as a percent by volume of the total mixture, shall be within the limits specified on the plans. When tested by approved laboratory methods, the emulsified asphalt used shall meet the requirements of [Item 302.3.4](#), Emulsified Asphalt or [Item 302.3.5](#), Emulsions for Priming, Curing, and Erosion Control (PCE) or [Item 302.3.6](#), Specialty Emulsions.

The water used shall be clear, free from industrial wastes and other objectionable matter.

302.6.3. Construction Methods. Asphalt materials shall be handled in accordance with [Item 302.5](#), Storage, Heating and Application Temperature of Bituminous Materials.

The emulsified asphalt and water mixture shall be applied by a self-propelled sprinkler meeting the requirements of [Item 203.6](#), Dust Control so operated as to uniformly distribute the mixture in the quantity determined by the OWNER.

The emulsion and water may be mixed in the sprinkler tank. The CONTRACTOR shall make suitable provisions for agitating the two materials sufficiently to produce a uniform blend. The sprinkler tank shall have been recently calibrated, and the OWNER shall be furnished an accurate and satisfactory record of such calibration. After beginning the work, should the yield on the emulsion applied appear to be in error, the distributor shall be recalibrated in a manner satisfactory to the OWNER, before proceeding with the work.

302.6.4. Measurement and Payment. Emulsified asphalt shall be measured by the gallon prior to mixing with water. The work performed and the emulsified asphalt furnished as prescribed by this Item and measured as provided in this Item shall be paid for at the unit price bid of the type specified, which price shall be full compensation for furnishing all required materials including mixing water for application; all freight involved; all hauling, mixing, and distributing the mixture as specified; and all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

302.7. PRIME COAT

302.7.1. Description. This Item shall consist of application of asphaltic materials on the completed base course and/or other approved area, which shall be applied in accordance with these specifications and as shown of the plans.

302.7.2. Materials. The asphaltic material used for the prime coat shall be of the type and grade as stated in the contract and when tested by approved laboratory methods shall meet the requirements of [Item 302.3.4](#), Emulsified Asphalt or [Item 302.3.5](#), Emulsions for Priming, Curing, and Erosion Control (PCE) or [Item 302.3.6](#), Specialty Emulsions.

302.7.3. Equipment. All storage tanks, piping, retorts, booster tanks and distributors used in storing and handling asphaltic material shall be kept clean and in good condition at all times. Equipment shall be operated in such a manner that there shall be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the CONTRACTOR to provide and maintain in good working order a recording thermometer at the storage heating unit at all times. The distributor shall have been recently calibrated and the OWNER shall be furnished an accurate and satisfactory record of such calibration. After beginning the work, should the yield on the asphaltic material applied appear to be in error, the distributor shall be recalibrated in a manner satisfactory to the OWNER before proceeding with the work.

302.7.4. Construction Methods. Asphalt materials shall be handled in accordance with [Item 302.5](#). Storage, Heating and Application Temperature of Bituminous Materials.

Prime coat shall not be applied when the air temperature is below 50°F and falling, but it may be applied when the air temperature is above 40°F and rising, the air temperature being taken in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the OWNER, are not suitable.

When, in the opinion of the OWNER, the base is thoroughly dry and is satisfactory to receive the prime coat, the surface shall be cleaned by sweeping or other methods approved by the OWNER. The asphaltic material shall be applied to the cleaned base at the approximate rate of 0.15- to 0.25-gallons-per-square-yard of surface area. The application shall be made with an approved type of self-propelled pressure distributor so constructed and operated as to distribute the material evenly and smoothly in the quantity specified or directed. The CONTRACTOR shall provide all necessary facilities for determining the temperature of the asphaltic material in all of the heating equipment and in the distribution, for determining the rate at which it is applied, and for securing uniformity at the junction of two distributor loads.

The OWNER shall select the temperature of application within the limits recommended in [Item 302.5](#). Storage, Heating and Application Temperature of Bituminous Materials based on the temperature-viscosity relationship that shall permit application of the asphalt. The CONTRACTOR shall apply the asphalt at a temperature within 15°F of the temperature selected.

No traffic, hauling or placing of subsequent courses shall be permitted over the freshly applied prime coat until authorized by the OWNER.

The CONTRACTOR shall be responsible for the maintenance of the surface until the work is accepted by the OWNER.

302.7.5. Measurement and Payment. The asphaltic material for prime coat will be measured at the point of delivery on the road in gallons at the applied temperature. The quantity to be measured for payment shall be the number of gallons used, as directed, of the specified prime coat.

The work performed and materials furnished in accordance with this Item and measured as provided will be paid for at the unit prices bid for "Asphaltic Material," of the type and grade specified. Price shall be full compensation for cleaning the area to be primed; for furnishing, preparing, hauling and placing all required materials; for all freight and heating involved; for spreading, dragging, brooming, finishing and maintaining under traffic until accepted; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

302.8. ASPHALT BASE COURSE

302.8.1. Description. Asphalt base course shall consist of a compact mixture of mineral aggregates and asphaltic material mixed hot in a mixing plant. It may be a base course, subbase course, or foundation course. It is made of larger aggregate than Hot-Mix Coarse Base (A) as shown in Table 302.9.3.(a) Dense Graded Hot Mix Master Grading.

302.8.2. Materials.

302.8.2.1. Asphaltic Cement. Asphalt for the mixture shall be of the types of asphalt cement as determined by the OWNER and shall meet the requirements of [Item 302.3.2](#). Performance-Graded (PG) Asphalt Binders or [Item 302.3.3](#). Asphalt Cement. The grade of asphalt to be used shall be determined by the OWNER after design tests have been made using the mineral aggregate approved for use in the construction. If more than one type of asphaltic cement mixture is specified for the project, only one grade of asphalt shall be required for all types of mixture unless otherwise shown on the plans. The

CONTRACTOR shall notify the OWNER of the source of asphaltic material prior to production of the asphaltic mixture, and this source shall not be changed during the course of the project, except by written permission of the OWNER.

302.8.2.2. Tack Coat. The liquid asphalt material used for tack coat should be MS-2 or SS-1 in [Item 302.3.4](#). Emulsified Asphalt, Restorative Seal in [Item 302.3.6](#). Specialty Emulsions or one of the other various grades of materials (selected by the OWNER) listed under [Item 302.3.4](#). Emulsified Asphalt.

302.8.2.3. Mineral Aggregate. The material shall be crushed and screened as necessary to meet the requirements hereinafter specified and shall consist of durable coarse aggregate particles mixed with approved binding materials.

Unless otherwise specified, the grading of the mineral aggregate shall conform to the limitations as shown in Table 302.8.2.3.(a) Asphalt Base Course Aggregate Grades.

Table 302.8.2.3.(a) Asphalt Base Course Aggregate Grades

Sieve Size	Grade			
	1	2	3	4
1 ³ / ₄ -inch		100.0	100.0	As Shown on Plans
1 ¹ / ₂ -inch	100.0	90.0-100.0		
1-inch	90.0-100.0			
³ / ₈ -in.	45.0-70.0			
No. 4	30.0-55.0	25.0-55.0		
No. 40	15.0-30.0	15.0-40.0	15.0-40.0	

Testing of the mineral aggregate shall be in accordance with the test methods in Table 302.8.2.3.(b) Aggregate Tests.

Table 302.8.2.3.(b) Aggregate Tests

Property	Test
Preparation of Soil Constants	Tex-101-E Preparing Soil and Flexible Base Materials for Testing
Liquid Limit	ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
Plastic Limit	ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
Plasticity Index	ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
Sieve Analysis	ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
Wet Ball Mill	Tex-116-E Ball Mill Method for Determining the Disintegration of Flexible Base Material
Sand Equivalent	ASTM D2419 Sand Equivalent Value of Soils and Fine Aggregate

Unless otherwise specified on the plans, the mineral aggregate for Grades 1, 2 and 3 shall meet the limits of Table 302.8.2.3.(c) Aggregate Physical Requirements. Mineral aggregate for Grade 4 shall meet the physical requirements shown on the plans.

Table 302.8.2.3.(c) Aggregate Physical Requirements

Property	Limit
Wet Ball Mill	50 Max.
Plasticity Index	15 Max.
Liquid Limit	40 Max.
Sand equivalent	≥ 40

302.8.3. Construction Methods. Asphalt materials shall be handled in accordance with [Item 302.5](#). Storage, Heating and Application Temperature of Bituminous Materials.

Mixing plants may be either the weight-batching type plant, the continuous mixing type plant, or the drum mixing type plant as described in [Item 302.9.5](#). Mixing Plants except that requirements for Type “B” and “D” mixtures of fine graded surface course are deleted.

Equipment for storage, weighing and heating of materials shall be as described in [Item 302.9.4](#). Equipment.

The OWNER shall designate the asphalt content to be used in the mixture after design tests have been made with the aggregates to be used in the project. When tests as determined by the OWNER are made, samples of the mixture shall not vary from the asphalt content designated by the OWNER by more than 0.5-percent dry weight (based on total mixture). The asphaltic material will form typically 4- to 9-percent of the mixture by weight.

The mixture shall consist of a uniform mixture of mineral aggregates and asphaltic material.

The asphaltic mixtures for the weight-batching type plant and from the continuous mixing type plant, when tested in accordance with the current methods outlined in TxDOT Test Method Tex-208-F Test for Stabilometer Value of Bituminous Mixtures (Part I or Part III as applicable), shall have laboratory density and stability as indicated in Table 302.8.3.(a) Stability of Asphalt Base Course. If the mixture produced does not have the specified qualities, the mixture shall be changed until it conforms to the specified qualities.

Table 302.8.3.(a) Stability of Asphalt Base Course

Property	Value
Density (%)	96 ±2
Stability (%) Hveem Stabilometer	Not less than 40 except when otherwise shown on the plans

302.8.4. Measurement and Payment. Asphalt base course shall be measured and paid for in accordance with [Item 302.10](#). Measurement and Payment.

302.9. HOT-MIX ASPHALT PAVEMENT

302.9.1. Description. This Item shall govern pavement consisting of a binder course, a leveling up course, a surface course or any combination of these courses as shown on the plans. Each course shall be composed of a compacted mixture of mineral aggregate and asphaltic material mixed hot in a mixing plant; and shall be constructed on the previously completed and approved subgrade, subbase course, base course, existing pavement, or in the case of a bridge, on the prepared floor slab, all in accordance with these specifications and in conformity with the lines, grades, quantities and typical sections as stated in the contract, plans and/or established in the field by the OWNER.

302.9.2. Materials. The materials proposed to be used may be inspected and tested at any time during the preparation of the work.

302.9.2.1. Aggregates. Mineral aggregates shall consist of a fine aggregate, coarse aggregate and, when required, a mineral filler all in accordance with [Item 302.2](#). Aggregates for Hot-Mix Asphalt Pavement and approved by the OWNER. Representative samples of the materials proposed to be used in the mixture shall be submitted for tests in the quantities required by the OWNER. No material that has in any way become unfit for use after approval shall be used in the work. Approval of both the materials and sources of supply must be obtained from the OWNER prior to delivery of the material.

302.9.2.2. Asphaltic Materials. Material shall conform to the applicable paragraphs of [Item 302.3](#). Bituminous Materials. Only one grade of asphalt shall be required for all the types of mixtures unless otherwise shown on the plans or required by the OWNER.

302.9.2.2.1. Paving Mixture. Asphaltic materials for the paving mixture shall be the type and grade specified, shown on the plans, or as designated by the OWNER after design tests have been made, using the mineral aggregates proposed to be used in the mixture, and shall meet the requirements of [Item 302.3.2](#). Performance Graded (PG) Asphalt Binders or [Item 302.3.3](#). Asphalt Cement. If more than one type of asphaltic pavement mixture is specified for the project, only one grade of asphalt

shall be required for all types of mixtures, unless otherwise shown on the plans. The CONTRACTOR shall notify the OWNER of the source of asphaltic material prior to production of the asphaltic mixture and prior to the paving of this course of the project except on written permission of the OWNER.

302.9.2.2.2. Prime Coat. Prime coat shall conform to the provisions of [Item 302.7](#). Prime Coat.

302.9.2.2.3. Track Coat. The liquid asphalt material used for tack coat should be MS-2 or SS-1 in [Item 302.3.4](#). Emulsified Asphalt, restorative seal in [Item 302.3.6](#). Specialty Emulsions or one of the other various grades of materials (selected by the OWNER) listed under [Item 302.3.4](#). Emulsified Asphalt.

302.9.3. Paving Mixture. The paving mixture shall consist of a uniform mixture of coarse aggregate, fine aggregate, mineral filler, when required, and asphaltic material, accurately proportioned by weight. The grading of each constituent shall be such as to produce, when properly proportioned, a mixture conforming to the following limitations for grading the type specified. The exact proportions of each constituent producing the total aggregate within these limits shall be as directed by the OWNER, and when tested by standard laboratory methods, the mixture shall meet the requirements listed in Tables 302.9.3.(a) through (f). The OWNER shall specify or approve a mixture within the specified limits for all types of mixtures, which shall be suitable for the work in which the asphaltic pavement shall be used. The percentages of asphalt shall not vary more than 0.4-percent from the proportions established by the OWNER.

Table 302.9.3.(a) Dense Graded Hot Mix¹ Master Grading

Sieve Size	Type of Mixture						
	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture	CMHB – C Coarse Surface	CMHB – F Fine Surface
	Percent Passing by Weight						
1½"	100						
1¼"	95-100						
1"		100					
¾"	70-90	95-100	100			98 – 100	
⅝"		75-95	95-100			95 – 100	
½"	50-70			100			98 – 100
⅜"		60-80	70-85	85-100	100	50-70	85 - 100
¼"					95-100		
No. 4	30-50	40-60	43-63	50-70		30 - 45	40 - 60
No. 10	20-34	27-40	30-40	32-42	32-42	15 - 25	15 - 25
No. 40	5-20	10-25	10-25	11-26	9-24	6 – 20	6 – 20
No. 80	2-12	3-13	3-13	4-14	3-13	6 – 18	6 – 18
No. 200	2 - 8	2 - 8	2 - 8	2 - 8	2 - 8	5 - 8	5 - 8
VMA % minimum	11	12	13	14	15	14	15

1. These mixtures shall be designed using a Texas Gyratory Compactor (TGC) and in accordance with Test Method Tex-204-F Design of Bituminous Mixtures. Design must be researched and based on intended use.

Table 302.9.3.(b) Superpave Hot Mix¹ Master Grading

Sieve Size, inches (centimeters)	Nominal Maximum Aggregate Size, inches (centimeters)				
	1½ (3.81)	1 (2.54)	¾ (1.90)	½ (1.27)	⅜ (0.95)
	Coarse Base	Fine Base	Coarse Surface	Fine Surface	Fine Mixture
Percent Passing By Weight					
2 (5.08)	100.0				
1½ (3.81)	90.0 – 100.0	100.0			
1 (2.54)		90.0 – 100.0	100.0		
¾ (1.90)			90.0 – 100.0	100.0	
½ (1.27)				90.0 – 100.0	100.0
⅜ (0.95)					90.0 – 100.0
No. 4					
No. 8	15.0 - 41.0	19.0 – 45.0	23.0 - 49.0	28.0 – 58.0	32.0 – 67.0
No. 16					
No. 30					
No. 50					
No. 100					
No. 200	0.0–6.0	1.0 – 7.0	2.8 - 8.0	2.0 - 10.0	2.0 – 10.0
VMA % minimum	11	12	13	14	15

1. These mixtures shall be designed using a Superpave Gyratory Compactor (SGC) and in accordance with the AASHTO Standard Practice for Designing Superpave Hot Mix Asphalt (PP28-99). Design must be researched and based on intended use.

Table 302.9.3.(c) Superpave – Plant Produced Mixture Requirements

VMA (MIN)	VFA	Dust/Asphalt Ratio
11.0%	64 – 77 %	0.6 – 1.8 %
12.0%	67 – 77 %	0.6 – 1.6 %
13.0%	69 – 80 %	0.6 – 1.6 %
14.0%	71 – 80 %	0.6 – 1.6 %
15.0%	73 – 80 %	0.6 – 1.6 %

Table 302.9.3.(d) Cellulose Modified Mixtures¹ Master Grading

Sieve Size	Stone Mastic Asphalt (SMA)		Permeable Friction Course (PFC)	
	¾"	½"	½"	½" Modified
	Coarse Surface	Fine Surface	Coarse Surface	Fine Surface
	Percent Passing By Weight			
¾"	100.0			
½"	99.0-100.0	100.0	90.0-100.0	85.0-100.0
⅜"	70.0-85.0	70.0-90.0	35.0-60.0	55.0-75.0
No. 4	30.0-42.0	30.0-50.0	10.0-25.0	15.0-25.0
No. 8	20.0-33.0	20.0-30.0	5.0-10.0	5.0-10.0
No. 16		21.0 max		
No. 30		18.0 max		
No. 50		15.0 max		
No. 100				
No. 200	8.0-11.0	8.0-12.0	1.0 - 4.0	2.0 - 4.0

1. These mixtures shall be designed using a Superpave Gyratory Compactor (SGC) and in accordance with the AASHTO Standard Practice for Designing Superpave Hot Mix Asphalt (PP28-99). Design must be researched and based on intended use.

Table 302.9.3.(e) Cellulose Modified Mixture Properties

Property	Requirements	
	Stone Mastic Asphalt (SMA)	Permeable Friction Course (PFC)
Air Voids, %	4.0 (Lab Molded)	20.0 Min. (Lab Molded)
Cellulose Fibers, %	0.4	0.4
VMA, Percent (Min.)	17.0 (Plant); 17.5 (Design)	
VCA ¹ (Mix), Percent	Less Than VCA (DRC)	
TSR, Percent	80.0 Min. (Tex-531-C)	
Draindown @ Production Temp., %	0.30 Max. (T305)	0.30 Max. (T305)
Asphalt Content, Percent	6.0 Min.	6.0 Min.
N(Des)	100	20

1. See NCHRP Report 425 for definition and calculation of VCA (Voids in Coarse Aggregate).

302.9.3.1. Extraction Test. When required by the OWNER, samples of the asphaltic mixture may be taken from the plant, trucks or finished pavement for check tests. The minimum weight of the test specimen in grams shall be 3000 times the maximum size of aggregate in inches, and when tested in accordance with Recovery of Asphalt from Solution by Abson Method and Quantitative Extraction of Bitumen from Bituminous Paving Mixtures, ASTM Designations D1856 and D2172, respectively, it shall not vary from the grading proportions specified for the mixture being used by more than 5-percent.

302.9.3.2. Stability. The asphaltic mixture from the weight-batching plant and from the continuous mixing type plant, when tested in accordance with the current methods outlined in the TxDOT Test Method Tex-208-F Test for Stabilometer Value of Bituminous Mixtures, shall have the laboratory density and stability indicated in Table 302.9.3.(f) Asphalt Pavement Mixture Stability. If the mixture produced does not have the specified qualities, the mixture shall be changed until it conforms to the specified qualities.

Table 302.9.3.(f) Asphalt Pavement Mixture Stability

Property	Value
Density (%)	96 ±1
Stability (%) Hveem Stabilometer	Unless otherwise shown on the plans, Not less than 40 applied on arterials with truck traffic, and Not less than 35 for residential applications

302.9.4. Equipment. All equipment necessary for the construction of the hot-mix asphalt pavement shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used. All equipment shall be maintained in good repair and operating condition.

302.9.4.1. Bins. Bin storage shall be provided with tight cut-off gates to prevent leakage of aggregates or mineral filler into the weight box. The weight box for aggregates shall be of sufficient capacity to hold a complete batch of aggregates and mineral filler without wasting or leveling and shall be so designed that it shall quickly discharge the entire batch into the mixer. The weight box shall be provided with a close fitting and quick operating cut-off gate so that there shall be no leakage of the aggregates into the mixer and shall be satisfactorily attached to the batching scales.

302.9.4.2. Scales. Scales used for weighing different grades of mineral aggregates may be either the springless dial type or the multi-beam type. All scales must be a tare beam for balancing. The beam scales must also be equipped with a telltale indicator of the springless dial type indicating over-and-under loads of at least 50-pounds. Scales shall be accurate within 4-pounds-per-1000-pounds. If plant vibration interferes with accurate weighing, the scales shall be insulated against shock or vibration.

302.9.4.3. Material Bucket. The asphaltic material bucket shall be of sufficient size to hold the necessary asphaltic material for one batch. If the material is measured by weight, the bucket shall be properly attached to the scales herein specified. If the proportioning is by volume based on weight, the measuring bucket used shall be of the overflow type and shall meet the requirements of the OWNER.

302.9.4.4. Asphalt Storage. Asphalt storage shall be sufficient to meet the requirements of the plant. Asphalt in storage shall be heated by steam coils, absolutely tight to prevent leakage of moisture into the asphalt; the steam for heating shall not be at a temperature in excess of 400°F; direct fire heating of the asphalt shall not be permitted. Agitating asphalt with steam or air shall not be permitted.

302.9.4.5. Steam Heating Systems. The steam heating system shall insure the maintaining of the asphalt at a uniform draw-off temperature at the asphalt bucket of between 275°F and 375°F. The temperature shall be maintained with an efficient positive control of heat at all times as directed or approved by the OWNER. Asphalt heated beyond 375°F either before or during mixing with the mineral aggregate shall be rejected. The draw-off at the asphalt bucket shall be of a quick cut-off type which shall not leak. The asphalt supply line shall be of circulating type, and equipped with a recording thermometer indicating the temperature of the asphalt at the draw-off valve. This thermometer may be combined with the one used in recording the temperature of the aggregate.

302.9.4.6. Weight Bucket. The asphalt weight bucket shall be of an approved type. The scales of weighing the asphalt shall be either the springless dial type or the multi-beam type. The dial type shall be arranged for rapid adjustment at zero and shall be provided with a pointer to indicate the weight of the asphalt required in one batch. The beam type shall have a tare beam for balancing and shall be equipped with a telltale indicator of the springless dial type. If plant vibration interferes with accurate weighing, the scales shall be insulated against shock or vibration. The asphalt shall be sprayed into the mixer through an approved spray bar that shall distribute the asphalt uniformly throughout the length of the mixer.

302.9.4.7. Mixer. The mixer shall be of the pugmill type and shall have a capacity of not less than 1,000-pounds in a single batch. The number of blades and their positions shall give a uniform and complete circulation of the batch. A mixer that segregates mineral aggregate or fails to secure a thorough and uniform mixing with the asphalt and mineral filler shall not be permitted to be used. The

adequacy of the mixer to produce a successful mix shall be determined by mixing the standard batch for the required time, then dumping the batch, and taking samples from different parts of the batch; the samples shall be tested by the extraction test and shall show that the batch is uniform throughout.

All mixers shall be provided with an automatic time lock on the discharge gates of the mixer and the weigh box; and shall be locked for a period of 45-seconds after all the mineral aggregates have been introduced into the mixer. When discharged, the mixture shall have a temperature of 225°F to 350°F. The dump doors of the mixer shall be tight to the dry mineral aggregate or dust so that there shall be no spilling from the pugmill or drum. In introducing the batch into the mixer, all mineral aggregates shall first be introduced. Aggregates shall be thoroughly mixed for a period of 5- to 10-seconds before the asphalt is added; then the total mixture shall be mixed for the time required to produce a homogeneous mixture, in which all particles of the aggregates are uniformly coated.

302.9.4.8. Spreading and Finishing Machine. The spreading and finishing machine shall be of a type approved by the OWNER and capable of producing a surface that shall meet the requirements of the typical cross section and surface test.

302.9.4.9. Rollers. Rollers shall meet the governing specifications for [Item 301.1.2](#). Rolling of Embankment, Subgrade or Flexible Base. The use of vibratory roller on overlay thickness less than 1.5 inches will not be permitted.

302.9.4.10. Straightedges. The CONTRACTOR shall provide acceptable 16-ft. straightedges for the surface testing. Satisfactory templates shall be provided as required by the OWNER.

302.9.4.11. Vehicles for Transporting Mixture. Asphaltic concrete shall be transported from the plant to the site of the work in tight vehicles with metal bottoms previously cleaned of all foregoing substances. The OWNER may require that the vehicles be suitably insulated, and each load shall be covered with canvas or other suitable material of sufficient size to protect the asphaltic concrete from the weather and to prevent loss of material.

302.9.5. Mixing Plants. Mixing plants may be either the weight-batching plant, the continuous mixing type plant or the drum mixing type plant as hereinafter described. All types of plants shall be equipped with satisfactory conveyors, power units, aggregates handling equipment, hot-aggregates screens and bins and dust collectors.

Temporary storing or holding of the asphaltic mixture by a surge-storage system is permitted during the normal day's operation. Overnight storage shall not be permitted.

302.9.5.1. Weight Batching Plant. The proportioning of the various materials entering into the asphaltic mixture shall be as approved or directed by the OWNER. The OWNER shall have access at all times to all parts of the paving plant. The plant shall be of the batch type provided with separate storage bins and chambers for heating and mixing the materials.

The various sizes of mineral aggregates as received shall be stored or stockpiled separately, and the feeding of all sizes of mineral aggregates to the dryer shall be done by mechanical means that shall give a uniform and continuous feed to each of the sizes incorporated in order to give a control of the temperature and grading of the mineral aggregates.

The drying of the mineral aggregates shall be done in such a manner that the finer particles shall not escape with the furnace gases. If forced draft is used, a dust collector system shall be installed. If natural draft is used, the OWNER may require a dust collector system to prevent loss of the finer particles. The aggregate shall be heated in a suitable apparatus that continuously agitates the aggregate during the heating and in which the temperature can be efficiently and positively controlled so that the aggregates shall not be damaged and the mixture produced shall have a temperature between 225°F and 350°F.

A recording thermometer shall be provided which shall record the temperature of the aggregates as they leave the dryer. The recording thermometer shall be provided with a 24-hour chart and may be so equipped that it shall record both the temperature of the aggregates and the temperature of the asphalt incorporated into the batch. The drying apparatus shall be of sufficient size to dry and heat the amount of aggregates required to maintain the plant in continuous operation.

The screening capacity and size of the bins shall be sufficient to screen and store the amount of aggregates required to properly operate the plant and keep the plant in continuous operation at full capacity. Provisions shall be made to enable inspection forces to have easy and safe access to the proper location on the mixing plant where representative samples may be taken from the hot bins for testing. The aggregates shall be separated into at least four bins when producing Type “B” mixtures and at least three bins when producing Type “D” mixtures. If mineral filler is needed, an additional bin shall be provided. These bins shall contain the sizes of aggregates as shown in Table 302.9.3.(a) Dense Graded Hot Mix Master Grading.

302.9.5.2. Continuous Mixing Plant. Cold-aggregates bin and proportioning devices, dryer, and screening and proportioning shall conform to the requirements hereinabove for the weight-batching type of plant. The hot-aggregates proportioning device shall be so designed that when properly operated, a uniform and continuous flow of aggregates into the mixer shall be maintained.

An accurate asphaltic material meter shall be installed in the asphalt line leading to the spray bar, so that the amount of asphalt being used can be accurately determined. The asphaltic material spray bar shall be so designed that the asphalt shall be uniformly and continuously sprayed into the mixture.

The mixer shall be of the pugmill continuous type and shall have a capacity of not less than 40-tons-per-hour of mixture. Any mixer that segregates the aggregates or fails to secure a thorough and uniform mixing of the aggregates or fails to secure a thorough and uniform mixing of the aggregates with the asphaltic material shall not be used. This shall be determined by taking samples from different parts of a truckload and testing by the extraction test. These tests must show that the load is uniform throughout.

The amount of aggregates and asphaltic material entering the mixer and the rate of travel through the mixer shall be so coordinated that a uniform mixture of the specified grading and asphalt content shall be produced. The mixture shall not vary from the specified mixture by more than the specified tolerances.

The asphaltic mixture shall be at a temperature of between 225°F and 350°F when dumped from the mixer. The OWNER shall determine the lowest temperature, within the above limitations, at which the material can be satisfactorily dried, mixed, transported, spread and compacted, and the mixture furnished by the CONTRACTOR shall be between this determined temperature and 30°F higher.

302.9.5.3. Drum Mixing Plant. The plant shall be adequately designed and constructed for the process of mixing aggregates and asphalt in the drum mixer. The plant shall be equipped with satisfactory conveyors, power units, aggregates-handling equipment, and feed controls and shall consist of the following essential pieces of equipment.

The number of compartments in the cold-aggregates bin shall be equal to or greater than the number of stockpiles of individual materials to be used. The bin shall be of sufficient size to store the amount of aggregates required to keep the plant in continuous operation and of proper design to prevent overflow of material from one compartment to another. The feed system shall provide a uniform and continuous flow of aggregates in the desired proportion to the drum mixer.

A surge-storage system shall be required. It shall be adequate to minimize the production interruptions during the normal day's operations and shall be constructed to minimize segregation. A device such as gob hopper or other similar device approved by the OWNER to prevent segregation in the surge-storage bin shall be required.

The system shall provide positive weight measurement of the combined cold-aggregates feed by use of belt scales or other approved devices. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device as required by [Item 302.9.4. Equipment](#). When a belt scale is used, mixture production shall be maintained so that the scale normally operates between 50-percent and 100-percent of its rated capacity. Belt scale operation below 50-percent of the rated capacity may be allowed by the OWNER if accuracy checks show the scale to meet the requirements of [Item 302.9.4. Equipment](#) at the selected rate, and it can be satisfactorily demonstrated to the OWNER that the mixture uniformity and quality have not been adversely affected.

An asphaltic material measuring device meeting the requirements of [Item 302.9.4](#). Equipment shall be placed in the asphalt line leading to the drum mixer so that the cumulative amount of asphalt used can be accurately determined. Provisions of a permanent nature shall be made for checking the accuracy of measuring device output. The asphalt measuring device and line to the measuring device shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line and measuring device near the temperature specified for the asphaltic material. Unless otherwise shown on the plans, the temperature of the asphaltic material entering the measuring device shall be maintained at $\pm 10^{\circ}\text{F}$ of the temperature at which the asphalt measuring device was calibrated and set.

The asphaltic material feed-control shall be coupled with the total aggregate weight measuring device in such manner as to automatically vary the asphalt-feed rate as required to maintain the required proportion. A scalping screen shall be required, unless otherwise shown on the plans, and shall be located ahead of any weighing device.

The asphaltic mixture shall be at a temperature of between 225°F and 350°F when dumped from the mixer. The OWNER shall determine the lowest temperature, within the above limitations, at which the material can be satisfactorily dried, mixed, transported, spread and compacted, and the mixture furnished by the CONTRACTOR shall be between this lowest determined temperature and 30°F higher. The drum mix system shall be of the type that continually agitates the aggregates and asphalt mixture during heating and in which the temperature can be so controlled that aggregates and asphalt shall not be damaged in the necessary drying and heating operations required to obtain a mixture of the specified temperature. A continuously recording thermometer shall be provided which shall indicate the temperature of the mixture as it leaves the drum mixer.

Scales may be standard platform truck scales, belt scales or other equipment such as weigh hopper (suspended) scales approved by the OWNER. All scales shall conform to [Item 302.9.4](#). Equipment. If truck scales are used, they shall be placed at a location approved by the OWNER. If other weighing equipment is used, the OWNER may require weight checks by truck scales for the basis of approval of the equipment.

302.9.5.4. Special Instructions for Cellulose Fiber. A separate dry storage area or silo shall be required for cellulose fiber. All equipment used in the storage and handling of cellulose fibers shall be kept a clean condition at all times and shall be operated in such a manner that there will be no contamination with foreign matter.

Cellulose fibers shall be added at $0.3\% \pm 0.1\%$ by mass of the mixture. Drainage shall be tested according to Tex-235-F Determination of Draindown Characteristics in Bituminous Materials. Draindown shall not exceed 0.3%-per-hour.

The cellulose fiber feed system shall supply the proper amount of cellulose fiber to the weigh box. Feeding of the cellulose fiber shall be performed in a manner such that the fibers are not damaged during the feeding and mixing processes and in a manner such that a uniform and constant flow of materials in the required proportions is maintained. The cellulose fiber storage capacity shall be ample to meet the requirements of the plant. Cellulose fiber shall not be allowed in the hot bins.

Mixing system shall control temperature so that the cellulose fiber will not be damaged in drying, heating and mixing operations.

302.9.5.4.1. Weight Batching Plant. Cellulose fiber shall be introduced into the pugmill during the dry mixing of the aggregates, prior to injection of the asphalt.

In introducing the batch into the mixer, all aggregates and then all cellulose fiber shall be introduced first and shall be mixed thoroughly for a minimum period of 5-seconds to uniformly distribute the various sizes of the aggregate and cellulose fiber throughout the batch before asphaltic material is added. The asphaltic material shall then be added and the mixing continued for a wet mixing period of not less than 15-seconds. The mixing period shall be increased if, in the opinion of the Engineer, the mixture is not uniform or the aggregates are not properly coated.

302.9.5.4.2. Continuous Mixing Plant. The mixing requirements shall be the same as is required for a standard Weigh-Batch Plant.

302.9.5.4.3. Drum-Mix Plant. Cellulose fiber shall be added to the mixture during the dry mixing process, unless otherwise approved by the Engineer. Cellulose fiber shall be uniformly dispersed in the mixture. Engineer may require that fiber be introduced into the drum dryer at the recycle port by use of a vane feeder.

The amount of aggregate, cellulose fiber and asphaltic material entering the mixer and the rate of travel through the mixing unit shall be so coordinated that a uniform mixture of the specified grading, cellulose fiber content and asphalt content is produced.

302.9.6. Construction Methods. Asphalt materials shall be handled in accordance with [Item 302.5](#). Storage, Heating and Application Temperature of Bituminous Materials.

The prime coat, tack coat or the asphaltic mixture shall not be placed when the air temperature is below 50°F and is falling but may be placed when the air temperature is above 40°F and is rising, the temperature being taken in the shade and away from artificial heat; with the provision that the asphaltic mixture shall be placed only when the humidity, general weather conditions and temperature and moisture condition of the base, in the opinion of the OWNER, are suitable. Mat thickness of 2 inches and less shall not be placed when the temperature of the surface on which the mat is to be placed is below 50°F.

302.9.6.1. Prime Coat. If required, a prime coat shall be applied to the completed subgrade, subbase or base, in accordance with [Item 302.7](#). Prime Coat. The type and grade of asphaltic material and the application rate shall be as shown on the plans or as directed by the OWNER.

302.9.6.2. Tack Coat. A tack coat shall be applied when the surface to be paved is Portland cement concrete, brick or asphaltic pavement. When a tack coat is required, it shall consist of an application of the asphaltic material indicated and shall be at the rate specified on the plans or as directed by the OWNER, but not to exceed 0.10 gallons-per-square-yard of surface area. The surfaces of curbs, gutters, vertical faces of existing pavements and all structures in actual contact with asphaltic mixes shall be painted with a thin, complete coating of asphaltic material to provide a closely bonded, watertight joint.

302.9.6.3. Compacted Thickness of Hot-Mix Asphalt Pavement Surface Courses and Base Courses.

302.9.6.3.1. Base Courses. The compacted thickness or depth of each base course shall be as shown on the plans. Where the plans require a depth or thickness of the course greater than 4-in., same shall be accomplished by constructing multiple lifts of approximately equal depth, each of which shall not exceed 4-in. compacted depth. If, in the opinion of the OWNER, an additional tack coat is considered necessary between any of the multiple lifts, it shall be applied as in [Item 302.9.6.2](#). Tack Coat and at the rate as directed.

302.9.6.3.2. Surface Courses. The compacted thickness or depth of the asphalt pavement surface course shall be as shown on the plans. Where the plans require a depth or thickness of the surface course greater than 2-in. compacted depth, same shall be placed in multiple courses of equal depth, each of which shall not exceed 2-in. compacted depth. If, in the opinion of the OWNER, an additional tack coat is considered necessary between any of the multiple courses, it shall be applied as in [Item 302.9.6.2](#). Tack Coat and at the rate as directed.

302.9.6.4. Transporting Hot-Mix Asphalt Pavement Material. The mixture shall be hauled to the job site in tight vehicles previously cleaned of all foreign material. The dispatching of vehicles shall be arranged so that all material delivered shall be placed and all rolling shall be completed during daylight hours. In cool weather, or for long hauls, canvas covers may be required. The inside of the truck body may be given a light coating of an approved release agent, if necessary, to prevent the mixture from adhering to the body.

302.9.6.5. Temperature. The hot-mix asphalt mixture shall be at a temperature between 275° and 350°F when dumped from the mixer. The OWNER shall determine the temperature, within the above limitations. The mixture when dumped from the mixer shall not vary from this selected temperature more than 30°F. Restrictions on maximum mixture temperatures placed by environmental regulatory agencies supersede the maximum temperature listed above.

302.9.6.6. Placing. The hot-mix asphalt mixture shall be placed on the approved base course with the specified spreading and finishing machine in such manner that, when properly compacted, the finished course shall comply with the maximum thickness requirements, be smooth and of uniform density, and meet the requirements of the typical cross sections and the surface test. During the placing and spreading of the hot-mix asphalt material, care shall be taken to prevent the spilling of the material onto adjacent pavement, gutters or structures.

302.9.6.7. Compaction. Rolling with a tandem or vibratory roller shall start longitudinally at the sides and proceed toward the center of the surface course, overlapping on successive trips by at least half the width of the rear wheels. Alternate trips of the roller shall be slightly different in length. Rolling with the pneumatic tire roller shall be done as directed by the OWNER. Rolling shall continue until no further compression can be obtained and all roller marks are eliminated. The motion of the rollers shall be slow enough at all times to avoid displacement of the asphaltic surface material. If displacement should occur, it shall be corrected at once by the use of rakes and fresh asphaltic mixtures where required. The roller shall not be allowed to stand on the surface course when it has not been fully compacted and allowed to cool. To prevent adhesion of the surface course to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water shall not be permitted. All rollers must be in good mechanical condition. All necessary precautions shall be taken to prevent the dripping of gasoline, oil, grease or other foreign matter on the surface course while the rollers are in motion or when standing. In areas where the surface course cannot be compacted with the rollers, hand tamps, lightly oiled, shall be used to secure the required compaction.

Each course, after final compaction, shall have a relative density of not less than 92-percent. The relative density will be determined using Tex-207-F Determining Density of Compacted Bituminous Mixtures and Tex-227-F Theoretical Maximum Specific Gravity of Bituminous Mixtures.

302.9.6.8. Surface Tests. The finished surface of the pavement after compression shall be smooth and true to the established line, grade and cross section. When tested with a 16-ft. straightedge placed parallel to the centerline of the roadway, the finished surface shall have no deviation in excess of $\frac{1}{16}$ -in-per-foot from the nearest point of contact. The maximum ordinate measured from the face of the straightedge shall not exceed $\frac{1}{4}$ -in. at any point. Any point in the pavement surface not meeting these requirements shall be immediately corrected.

302.9.6.9. Pavement Thickness Test. Upon completion of the work and before final acceptance and final payment shall be made, pavement thickness test shall be made by the OWNER or its authorized representative unless otherwise specified in the special provisions or in the plans. The number and location of tests shall be at the discretion of the OWNER. The cost for the initial pavement thickness test shall be at the expense of the OWNER. In the event a deficiency in thickness of pavement is revealed during normal testing operations, subsequent tests necessary to isolate the deficiency shall be at the CONTRACTOR'S expense. The cost for the additional coring test shall be at the same rate charged by commercial laboratories.

302.10. MEASUREMENT AND PAYMENT

Prime coat and tack coat shall not be measured for direct payment but shall be considered as subsidiary work pertaining to the placing of hot-mix asphalt mixtures of the type specified.

Hot-mix asphalt pavement material shall be measured complete in place by the ton (2,000-lb.) computed at 110-lb. per S.Y. surface area per inch thickness of course, or by the S.Y. of the type(s) and grade(s) used in the completed and accepted work. Weight shall be determined by a certified scale approved by the OWNER and recorded on serially numbered weight tickets, identifying the vehicle and presented to the OWNER'S representative on the job. Work performed and materials furnished as prescribed by this Item and measured as specified in this Item shall be paid for at the contract unit price bid for the type or types of courses and mixtures as shown in the proposal, which price shall be payment in full for quarrying, furnishing all materials, heating, mixing, hauling, cleaning existing base course or pavement, placing asphaltic mixtures, rolling and finishing, and all labor, tools, equipment and incidentals necessary to complete the work, including the work and materials involved in the application of prime coat and tack coat.

ITEM 303. PORTLAND CEMENT CONCRETE PAVEMENT

303.1. DESCRIPTION

This item shall consist of finished pavement constructed of Portland cement concrete on the prepared subgrade or other base course, in conformity with the plans, as herein specified and as supplemented and/or amended by special provisions and to the lines and grades as established by the OWNER. Concrete shall be considered of satisfactory quality, provided it is:

- (1) Made of materials acceptable to the job and meeting the requirements of [Item 303.2](#). Portland Cement Concrete Pavement Materials and special provisions and amendments thereto;
- (2) In the proportions approved by the OWNER; and
- (3) Mixed, placed, finished and cured in accordance with the requirements of these specifications and any special provisions.
- (4) No concrete shall be placed where the temperature of the mix exceeds 95 degrees Fahrenheit or where the time from being batched to placed exceeds the times shown in Table 303.5.5.(a) Concrete Placement.
- (5) All concrete utilized for street, alley, drive approach and sidewalk pavement shall be batch mixed unless another method is specifically approved by the OWNER.

303.2. PORTLAND CEMENT CONCRETE PAVEMENT MATERIALS

303.2.1. Aggregates for Portland Cement Concrete Pavement.

303.2.1.1. General Requirements. Aggregates for Portland cement concrete shall conform to the requirements contained in this Item and shall be approved by the OWNER prior to use. Aggregates shall be of such character that it shall be possible to produce workable concrete within the limits contained in this specification.

303.2.1.1.1. Storage. The manner of handling and storage of aggregates shall be such as to prevent intrusion of foreign materials and segregation of sizes. If materials are stored on the ground, the stockpile sites shall be grubbed, cleaned of all vegetation and leveled. In this case, the bottom six-in. layer of aggregate shall not be disturbed and shall not be used in the work.

Where two or more sizes or types of aggregates are delivered to the job, each size or type shall be stored separately.

Aggregates shall be stockpiled on the job or at a central batching plant for a minimum of 24-hours prior to use in the project. At the plant, the aggregate shall be wetted to a uniform moisture content of not less than three-percent below saturated surface dry condition before or while being loaded for shipment. Care shall be exercised to maintain this uniformity of moisture until the aggregates are used in the mix. Wetting of stockpiles to maintain the required percent moisture shall be performed at least 12-hours prior to use.

At the time of use, the aggregates shall be free from frozen material and foreign matter. All grass, wood, sticks, burlap, paper or other material which may have become mixed with the aggregates while stockpiled or in handling shall be removed.

303.2.1.1.2. Aggregate Measuring.

The fine and coarse aggregates shall be measured loose and separately.

By Weight. Aggregate weighing equipment shall conform to the requirements of ASTM C94 Standard Specification for Ready-Mixed Concrete and shall be approved by the OWNER prior to use.

By Volume. The volume measuring equipment shall consist of approved boxes, pans or mechanical devices, which, while in operation, shall give the required volumes of the different kinds of aggregates required for the several classes of concrete. Equipment shall also be so marked and designed that the OWNER can accurately and conveniently check the quantities of each aggregate being used.

Concrete made by continuous mixing shall conform to ASTM C685 Concrete Made by Volumetric Batching and Continuous Mixing.

303.2.1.1.3. Tests. Test of aggregates shall be made in accordance with the applicable current ASTM standards, listed in Table 303.2.1.1.3.(a) Aggregate Tests.

Table 303.2.1.1.3.(a) Aggregate Tests

ASTM Designation	Standard Specification or Standard Test Method (Title)
C29	Bulk Density ("Unit Weight") and Voids in Aggregate
C33	Concrete Aggregates
C40	Organic Impurities in Fine Aggregates for Concrete
C88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C123	Lightweight Particles in Aggregate
C125	Terminology Relating to Concrete and Concrete Aggregates
C127	Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
C128	Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregate
C131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C136	Sieve Analysis of Fine and Coarse Aggregates
C142	Clay Lumps and Friable Particles in Aggregates
C330	Lightweight Aggregates for Structural Concrete
C535	Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C641	Staining Materials in Lightweight Concrete Aggregates
D8	Terminology Relating to Materials for Roads and Pavements
D75	Sampling Aggregates
D422	Particle-Size Analysis of Soils
D4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
D2217	Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants

303.2.1.2. Fine Aggregates. Fine aggregate shall consist of natural sand, manufactured sand or a combination of the two, with or without mineral filler. The sand, or mixture of sand, comprising a single fine aggregate, shall consist of clean, hard, durable, uncoated grains and shall be essentially free from clay lumps.

303.2.1.2.1. Foreign Material and Deleterious Substances. The maximum permissible percentage, by weight, of deleterious substances shall not exceed the amounts in Table 303.2.1.2.1.(a) Deleterious Substances in Fine Aggregates.

The fine aggregate shall be free from an excess amount of salt or alkali and at the time of use shall be free from frozen and/or all foreign material.

Table 303.2.1.2.1.(a) Deleterious Substances in Fine Aggregates

Substance	Maximum % by Weight
Material removed by decantation	3.0% ¹
Other deleterious substances such as coal, shale, coated grains and soft flaky particles	3.0%

1. An additional loss of two-percent by decantation may be allowed, provided this new additional loss is material of the same quality as specified for fine aggregate or mineral filler.

303.2.1.2.2. Gradation. The fine aggregate shall be well graded from fine to coarse and when tested by standard laboratory sieves shall meet the requirements of Table 303.2.1.2.2.(a) Grading Requirements for Fine Aggregates.

Table 303.2.1.2.2.(a) Grading Requirements for Fine Aggregates

Sieve	Percent Passing by Weight
$\frac{3}{8}$ -in. sieve (9.5mm)	100%
No. 4 sieve (4.75mm)	95 to 100%
No. 8 sieve (2.36mm)	80 to 100%
No. 16 sieve (1.18mm)	50 to 85%
No. 30 sieve (600 μ m)	25 to 65%
No. 50 sieve (300 μ m)	10 to 30%
No. 100 sieve (150 μ m)	0 to 10%
No. 200 sieve (75 μ m)	0 to 3%

303.2.1.2.3. Mineral Filler. Stone dust or crushed sand may be added as a mineral filler, if so directed by the OWNER. Amounts of mineral filler shall not exceed 5-percent of the fine aggregate to improve the workability or quality specified for fine or coarse aggregates. When tested by standard laboratory sieves shall meet the requirements of Table 303.2.1.2.3.(a) Fine Aggregate Mineral Filler.

Table 303.2.1.2.3.(a) Fine Aggregate Mineral Filler

Sieve	Percent Passing
No. 30 sieve (600 μ m)	95 to 100%
No. 100 sieve (150 μ m)	70 to 100%

303.2.1.2.4. Rejection. Fine aggregates which fail to meet the requirements of these specifications may be rejected by the OWNER. Such rejection shall incur no cost to the OWNER.

Fine aggregates sources, from which materials with properties not meeting these specifications are delivered, may be rejected as further supply sources to the project by the OWNER. Such rejection shall incur no cost to the OWNER.

303.2.1.3. Coarse Aggregates. Coarse aggregates shall consist of durable particles of crushed gravel, crushed stone, crushed blast furnace slag meeting the requirements of ASTM C989 (Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars) Grade 100 or 120, recycled crushed Portland cement concrete, or a combination of these.

303.2.1.3.1. Foreign Material and Deleterious Substances. The maximum permissible percentage, by weight, of deleterious substances shall not exceed the amounts in Table 303.2.1.3.1.(a) Deleterious Substances in Coarse Aggregates.

Aggregates shall be free from injurious amounts of salt, alkali, vegetable matter, or other objectionable material either free or as an adherent coating. At the time of their use, aggregates shall be free from frozen and/or all foreign material that may have become mixed with them in the stockpile.

Table 303.2.1.3.1.(a) Deleterious Substances in Coarse Aggregates

Substance	Maximum % by Weight
Material removed by decantation	1.0%
Shale, slate or other similar material	1.0%
Clay lumps	0.25%
Soft fragments	3.0%
Other deleterious substances, including friable, thin, elongated or laminated pieces	3.0%
The sum of all deleterious substances, exclusive of material removed by decantation	5.0%

303.2.1.3.2. Gradation. Coarse aggregates shall be well graded in size from coarse to fine. When tested by standard laboratory methods, coarse aggregates shall meet the requirements in Table 303.2.1.3.2.(a) Grading Requirements for Coarse Aggregates for percentage passing each sieve by weight.

Coarse aggregates of different characteristics, though tested and approved, shall not be mixed with other aggregates; but shall be stored, batched and weighed separately.

The difference in percent passing between two adjacent sieve sizes shall not exceed 20%.

Maximum Size Aggregate. The maximum size aggregate is defined as the clear space between the sides of the smallest square openings through which 95-percent of the weight of the aggregate can be passed. The maximum size of aggregates for paving concrete shall not exceed 1½-inches, and shall be reduced in size to meet the following conditions:

- (1) one-fifth of the least dimension between forms of that part of the structure in which concrete is to be placed;
- (2) three-fourths of the clear space between reinforcement; and
- (3) one-third the depth of the slab.

Table 303.2.1.3.2.(a) Grading Requirements for Coarse Aggregates

Size No.	Nominal Size (Sieve with Square Openings)	Amounts Finer than Each Laboratory Sieve (Square-Opening), Mass Percent													
		100 mm (4 in.)	90 mm (3½ in.)	75 mm (3 in.)	63 mm (2½ in.)	50 mm (2 in.)	37.5 mm (1½ in.)	25.0 mm (1 in.)	19.0 mm (¾ in.)	12.5 mm (½ in.)	9.5 mm (¾ in.)	4.75 mm (No. 4)	2.36 mm (No. 8)	1.18 mm (No. 16)	0.30 mm (No. 50)
1	90 to 37.5 mm (¾ to 1½ in.)	100	90 to 100	—	25 to 60	—	0 to 15	—	0 to 5	—	—	—	—	—	—
2	63 to 37.5 mm (2½ to 1½ in.)	—	—	100	90 to 100	35 to 70	0 to 15	—	0 to 5	—	—	—	—	—	—
3	50 to 25.0 mm (2 to 1 in.)	—	—	—	100	90 to 100	35 to 70	0 to 15	—	0 to 5	—	—	—	—	—
357	50 to 4.75 mm (2 in to No. 4)	—	—	—	100	95 to 100	—	35 to 70	—	10 to 30	—	0 to 5	—	—	—
4	37.5 to 19.00 mm (1½ to ¾ in.)	—	—	—	—	100	90 to 100	20 to 55	0 to 15	—	0 to 5	—	—	—	—
467	37.5 to 4.75 mm (1½ in to No. 4)	—	—	—	—	100	95 to 100	—	35 to 70	—	10 to 30	0 to 5	—	—	—
5	25.0 to 12.5 mm (1 to ½ mm)	—	—	—	—	—	100	90 to 100	20 to 55	0 to 10	0 to 5	—	—	—	—
56	25.0 to 9.5 mm (1 to ¾ in.)	—	—	—	—	—	100	90 to 100	40 to 85	10 to 40	0 to 15	0 to 5	—	—	—
57	25.0 to 4.75 (1 to No. 4)	—	—	—	—	—	100	95 to 100	—	25 to 60	—	0 to 10	0 to 5	—	—
6	19.0 to 9.5 mm (¾ to ¾ in.)	—	—	—	—	—	—	100	90 to 100	20 to 55	0 to 15	0 to 5	—	—	—
67	19.0 to 4.75 mm (¾ in to No. 4)	—	—	—	—	—	—	100	90 to 100	—	20 to 55	0 to 10	0 to 5	—	—
7	12.5 to 4.75mm (½ in to No. 4)	—	—	—	—	—	—	—	100	90 to 100	40 to 70	0 to 15	0 to 5	—	—
8	9.5 to 2.36 mm (¾ in to No. 8)	—	—	—	—	—	—	—	—	100	85 to 100	10 to 30	0 to 10	0 to 5	—
89	9.5 to 1.18 mm (¾ in to No. 16)	—	—	—	—	—	—	—	—	100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5
9 ¹	4.75 to 1.18 mm (No. 4 to No. 16)	—	—	—	—	—	—	—	—	—	100	85 to 100	10 to 40	0 to 10	0 to 5

1. Although size 9 aggregate is defined in ASTM C125 Standard Terminology Relating to Concrete and Concrete Aggregates as a fine aggregate, it is included as a coarse aggregate when it is combined with a size 8 material to create a size 89, which is a coarse aggregate as defined by ASTM C125.

303.2.1.3.3. Tests. Results of tests performed according to the applicable standard test methods listed in Table 303.2.1.1.3.(a) Aggregate Tests shall meet the criteria specified by the OWNER. Coarse Aggregates shall have a percent wear of not more than 45 when tested by abrasion and impact in the Los Angeles machine, ASTM C131 and C535.

303.2.1.3.4. Rejection. Coarse aggregates which fail to meet the requirements of these specifications may be rejected by the OWNER. Such rejection shall incur no cost to the OWNER.

Coarse aggregate sources, from which materials with properties not meeting these specifications are delivered, may be rejected as further supply sources to the project by the OWNER. Such rejection shall incur no cost to the OWNER.

303.2.2. Portland Cement. Cement shall be of a standard brand of Portland cement which shall conform to the requirements of ASTM C150 Portland Cement, ASTM C595 Blended Hydraulic Cements, or other applicable test methods of the ASTM and shall be as approved by the OWNER.

303.2.2.1. Delivery. Cement delivered in bags shall be legibly marked on the bag with brand and name of the manufacturer, shall be in good condition at the time of delivery, and shall contain 94-pounds net. Bags of cement varying more than 5-percent from the specified weight may be rejected, and if the average net weight in any shipment, as determined by weighing 50 bags taken at random, is less than 94-pounds, the entire shipment may be rejected. Cement salvaged from discarded or used bags shall not be used.

Cement delivered in bulk may be used, provided the manner and method of handling is approved by the OWNER. When delivered in bulk, the brand name of the manufacturer contained in the shipping information accompanying the shipment shall be furnished to the OWNER prior to the use of the cement. Bulk cement shall be weighed on approved scales.

Cement from different manufacturers, although tested and approved, shall not be mixed, except as approved by the OWNER.

The CONTRACTOR, when required, shall furnish to the OWNER, with each shipment of cement, a statement as the specific surface of the cement expressed in square-centimeters-per-gram.

303.2.2.2. Cement Weighing Equipment. Bulk cement shall be batched by weight. The scales shall be either the beam or springless dial type, of substantial construction with a maximum allowable error of 0.5-percent of the net load and with minimum gradations of not greater than 5-pounds. Provisions shall be made for indicating to the operator that the required load in the weight box or container is being approached, which device shall indicate at least the last 50-pounds of the load. Dial type scales shall be provided with a pointer to the dial.

When a closed-type cement box is used, the cement-weighing scales shall be provided with a springless dial indicator or tare beam to indicate when the weigh box is empty. This indicator for the empty condition of the weigh box shall be in continuous operation. The weigh box shall be fitted with an approved vent and a tightly covered inspection opening of not less than 12-sq.in. The weigh box and scales shall be maintained in a satisfactory condition to meet the requirements for accuracy for weight.

303.2.2.3. Volume and Weight of Bag of Cement. A bag of cement as packed by the manufacturer and weighing 94-pounds shall be considered 1-cubic-foot.

303.2.2.4. Storage. Cement shall be stored in a suitable weathertight building which shall protect the cement from dampness, and placed in such manner that shall permit easy access for proper inspection and identification of each shipment.

303.2.2.5. Rejection. Cement may be rejected for failure to meet any of the requirements of this specification and shall be rejected under the following specific conditions:

- (1) any bag of cement which has partially set or which contains any lumps or cakes;
- (2) all cement salvaged from torn, discarded or used bags; or
- (3) bulk cement which has partially set or which contains any lumps or cakes.

303.2.3. Chemical Admixtures. Unless otherwise provided in the plans or special provisions, approved types of chemical admixtures to minimize segregation, to improve workability or to reduce the amount of mixing water may be used in the rate of dosage specified by the OWNER and in accordance with the manufacturer's recommendations.

Admixtures shall be dispensed in a form by an accurate mechanical dispenser designed for convenient confirmation of the accuracy of measurement. Dispensers shall have sufficient capacity to measure at one time the full quantity required for each batch. Two or more admixtures of different types, such as a water-reducing and air-entraining admixture, may not be compatible when mixed together. Where different admixtures are used, they should be added to the batch separately unless it is known that they can be mixed together satisfactorily. Dosage of admixtures shall not vary from the dosage order by the OWNER by more than 5-percent. In addition:

- (1) Chemical admixtures shall conform to ASTM C494 Chemical Admixtures for Concrete, Types “A”, “D”, “F” and “G” for concrete dosages in accordance with manufacturer’s recommendations as specified by the OWNER.

Water-reducing admixtures conforming to ASTM C494, Types “A” and “F”, shall be used to improve quality of concrete by obtaining specified strength at lower cement content and to increase slump without increasing water-cement ratio and may also be utilized in improving properties of concrete containing aggregates that are harsh or poorly graded.

Water-reducing, set retarding admixtures, conforming to ASTM C494, Type “D” and “G”, may be used during hot weather concrete placement, so as to keep concrete workable during the entire placing period, in order that succeeding placements may be made without development of cold joints or discontinuities in the structural unit.

- (2) OWNER’S option: High range water-reducing admixtures, super-plasticizers conforming to ASTM C494, Type “F” and “G”, may be used to greatly reduce water content to obtain dense concrete with higher early strengths and maintain high slump or flowing concrete while maintaining low water-cement ratio for concrete that must be placed under difficult conditions such as pump or tremie methods, etc.
- (3) Air-entraining admixtures shall conform to ASTM C260 Air-Entraining Admixtures for Concrete.

Dosage shall conform to recommendations of manufacturer, as specified by OWNER, and determined by field testing of concrete mixture by qualified testing personnel in accordance with ASTM C94 Ready-Mixed Concrete.

The CONTRACTOR shall secure the approval of the OWNER for the particular admixture which it proposes to incorporate into the concrete prior to actual use of the admixture. The CONTRACTOR shall furnish such information and evidence that the OWNER may require in its determination of the acceptability of the proposed admixture. When the CONTRACTOR proposes to use an air-entraining admixture which has been previously approved by the OWNER, it shall submit a certification stating that the admixture is the same as that previously approved.

Either prior to or at any time during construction, the OWNER may require that the air-entraining admixture selected by the CONTRACTOR be tested to determine its effect upon the strength of the concrete. When so tested, a 7-day compressive strength of concrete, made with cement and aggregates in proportions to be used in the work and containing the admixture in an amount sufficient to produce from 3- to 6-percent entrained air in the plastic concrete, shall be no less than 85-percent of the strength of concrete, made with the same materials and with the same cement content and consistency but without the admixture.

Any other admixtures for whatever purpose shall have the approval of the OWNER prior to incorporation into the concrete mix.

303.2.4. Mineral Admixtures. Fly ash shall conform to the requirements of ASTM C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete, with the exception that the “Loss on Ignition” requirements shall be a maximum of 3-percent. Fly ash shall be sampled and tested at a frequency schedule in accordance with the requirements of ASTM C311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete. All sources of fly ash for use in Portland cement concrete shall conform to the requirements of Texas Department of Transportation (TxDOT) Material Specification DMS-8900 Fly Ash.

With the approval of the OWNER, fly ash may be used in all classes of concrete to replace a portion of the Portland cement in a mix design. Unless otherwise approved by the OWNER, the maximum cement reduction shall not exceed 25-percent by weight per cubic-yard of concrete. If historical data and general practice in locality of usage substantiates fly ash concrete using higher percentages, CONTRACTOR may submit written request to OWNER for review. Fly ash replacement shall be on a weight basis. The minimum replacement ratio shall be 1.0-pounds of fly ash per 1.0-pounds of cement replaced.

The water-cement ratio of the concrete mix shall be based on total cementitious (cement plus fly ash) materials. Proposed concrete mix designs with materials certification data and laboratory or field mix test results on the properties of the fresh or hardened concrete shall be submitted to the OWNER for approval.

303.2.5. Mineral Filler. Mineral filler shall consist of stone dust, crushed sand or other inert material approved by the OWNER. Mineral filler may be added in amounts not to exceed 10-percent of the weight of

the sand or mixture of sands to improve the workability or plasticity of the concrete mix. Such mineral filler shall be of the quality specified for fine or coarse aggregate, and when tested by laboratory methods shall meet the requirements of Table 303.2.5.(a) Mineral Filler.

Where mineral filler is used, it shall be measured by volume or weighed and batched separately.

Table 303.2.5.(a) Mineral Filler

Sieve	Percent Retained on Sieve
No. 30 sieve (600µm)	0%
No. 200 (75 µm)	0% to 35%

303.2.6. Fibrous Reinforcement. At the OWNER'S option, fibrous reinforcement in concrete may be used unless otherwise shown on the plans or in the contract documents. Fibrous reinforcement shall not be used as a replacement for any reinforcement required for structural purposes.

303.2.6.1. Material. Fibers for reinforcement of concrete shall be in accordance with materials specified in ASTM C1116 Fiber-Reinforced Concrete and Shotcrete.

303.2.6.2. Length and Size. The fibers shall be length and size as specified in ASTM C1116.

303.2.6.3. Testing. Test methods ASTM C995 Time of Flow of Fiber-Reinforced Concrete Through Inverted Slump Cone, and ASTM C1018 Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading) in addition to applicable ASTM methods for the testing of concrete shall be used to test the fiber-reinforced concrete. Performance of fiber-reinforced concrete shall meet all requirements as specified in Section 21 of ASTM C1116.

303.2.6.4. Rejection. Fibrous reinforcement or fiber-reinforced concrete may be rejected for failure to meet any of the requirements of this specification or ASTM C1116.

303.2.7. Water. Water for use in concrete shall be reasonably clean and free of oil, acid, alkali, organic matter or other deleterious substances. Water which is suitable for drinking or ordinary household uses may be accepted for use without being tested.

303.2.7.1. Source. Water shall be obtained preferably from a domestic water supply. Where other source of supply is proposed, the approval of the OWNER must be obtained prior to using the water.

303.2.7.2. Measuring Devices. The device for measuring the quantity of water shall indicate the quantity in gallons or pounds and fractions thereof. The operating mechanism shall regulate the quantity required for any given batch within one-percent. The supply inlet shall be cut off automatically when the water is discharged into the mixer.

Upon approval of the OWNER, the water for any one batch in the mixer may be measured in approved cans, buckets or other containers, and no more than the required amount of water shall be introduced into the mixer. The measuring devices shall be checked at the beginning of each job.

303.2.7.3. Tests. If the water is of questionable quality, it shall be tested in accordance with the standard Method of Test of Quality of Water to be used in concrete, AASHTO T26.

303.2.7.4. Rejection. Water for use with cement may be rejected for failure to meet any of the requirements of this specification.

303.2.8. Dowel Bars. Dowel and tie bars shall be either straight or bent, smooth or deformed, as shown on the plans and shall conform to the requirements of [Item 303.2.9. Steel Reinforcement](#). The dowel bars shall be coated with either hot asphalt or an alternate coating, as designated on the plans, to the extent shown on the plans.

303.2.8.1. Dowel Caps. Caps for slip dowel bars shall be of the length shown on the plans and shall have an internal diameter sufficient to permit the cap to freely slip over the bar. In no case shall the internal diameter exceed the bar diameter by more than 1/8-in., and one end of the cap shall be closed. The cap shall be installed to allow the bar to move not less than 1 1/4-in. in either direction.

303.2.9. Steel Reinforcement. Concrete reinforcement is the metal (rods or fabric) imbedded in concrete in such a manner that the reinforcement and concrete act together in resisting forces.

303.2.9.1. Material. Unless otherwise specified or designated on the plans, the metal for all bar reinforcement shall be one of the following:

303.2.9.1.1. New Billet Steel. New billet steel shall meet the requirements of ASTM A615/A615M Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

303.2.9.1.2. Axle Steel. Axle steel shall meet the requirements of ASTM A996/A996M Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

303.2.9.1.3. Rail Steel. Axle steel shall meet the requirements of ASTM A996/A996M Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

The use of rail steel or axle steel shall not be permitted where bending of the bar is required.

Unless otherwise designated on the plans, all reinforcement steel bars shall be deformed in accordance with the requirements of ASTM A615/A615M or A996/A996M, as appropriate. Twisted bars are not considered deformed and shall not be used. The deformed bars shall provide a net sectional area at all points equivalent to that of plain square or round bars of equal nominal size.

Bars for spiral reinforcement shall be plain bars rolled from billets directly reduced from ingots and shall conform to the requirements of ASTM A615/A615M.

303.2.9.2. Sizes and Weights. The size and weight of reinforcing bars shall conform to the requirements of ASTM A615/A615M.

303.2.9.3. Bending. Reinforcement bars shall be bent cold to the shapes indicated on the plans. All bending of hard grade new billet steel shall be done in the shop. Bends shall be true to the shapes indicated, and irregularities shall be cause for rejection. Unless otherwise shown on the plans, bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar. Other bends shall be made according to the latest code of Standard Practice of the Reinforcing Steel Institute.

303.2.9.4. Storage. Reinforcement shall be stored above the ground surface upon skids, platforms or other supports, and shall be protected from mechanical injury and surface deterioration caused by exposure to the conditions producing rust. When placed in the work, the reinforcement shall be free from dirt, loose rust, scale, painting, oil or other foreign material.

303.2.9.5. Rejection. Reinforcement may be rejected for failure to meet any of the requirements of this specification. Additionally, reinforcement may be rejected for the following:

- (1) reinforcement exceeding the allowable variations,
- (2) reinforcement not bent in accordance with the details,
- (3) reinforcement with a coating of dirt, loose scale, paint, oil or other foreign substances which shall prevent bonding of the concrete and reinforcement,
- (4) twisted bars, or
- (5) reinforcement subjected to construction traffic.

303.2.10. Steel Wire Reinforcement. At the OWNER'S option the use of welded wire fabric may be used in lieu of deformed reinforcement bars unless otherwise shown on the plans or in the contract specifications.

Welded wire fabric shall be delivered to the job site in sheets. Rolls of wire fabric shall not be permitted.

The size of welded wire fabric shall be 12 x 12- W 4 x W 4 with a nominal diameter in inches of 0.225 and a nominal weight 0.136 lbs/linear foot.

303.2.10.1. Material. Wire for fabric reinforcement shall be cold-drawn from rods hot-rolled from billets and shall conform to the requirements of ASTM A82 Steel Wire, Plain, for Concrete Reinforcement. Welded wire fabric shall conform to the requirements of ASTM A185 Steel Welded Wire Reinforcement, Plain, for Concrete.

303.2.10.2. Sizes and Weights. The properties of wire fabric shall conform to the requirements of ASTM A82 or ASTM A185, as appropriate.

303.2.10.3. Storage. Reinforcement shall be stored above the ground surface upon skids, platforms or other supports, and shall be protected from mechanical injury and surface deterioration caused by exposure to the conditions producing rust. When placed in the work, the reinforcement shall be free from dirt, loose rust, scale, paint, oil or other foreign materials.

303.2.10.4. Rejection. Reinforcement may be rejected for failure to meet any of the requirements of this specification, and specifically for the following:

- (1) reinforcement exceeding the allowable variations,
- (2) reinforcement not bent in accordance with the details,
- (3) reinforcement with a coating of dirt, loose scale, paint, oil or other foreign substances which shall prevent bonding of the concrete and reinforcement, or
- (4) twisted bars.

303.2.11. Reinforcement Bar Chairs. Reinforcement bar chairs or supports shall be of adequate strength (if specified) to support the reinforcement bars and shall not bend or break under the weight of the reinforcement bars or CONTRACTOR'S personnel walking on the reinforcing bars.

Bar chairs may be made of metal (free of rust), precast mortar or concrete blocks or plastic. Pre-cast mortar or concrete blocks must be approved by the OWNER; and the CONTRACTOR shall supply test data showing the strength of the mortar or concrete blocks.

For approval of plastic chairs, representative samples of the plastic shall show no visible indications of deterioration after immersion in a 5-percent solution of sodium hydroxide for 120-hours.

303.2.11.1. Rejection. Bar chairs may be rejected for failure to meet any of the requirements of this specification.

303.2.12. Joint Filler. Joint filler is the material placed in concrete pavement and concrete structures to allow for the expansion and contraction of the concrete.

303.2.12.1. Material. Expansion joint materials shall consist of boards or a premolded asphalt board tested in accordance with ASTM D545 Test Methods for Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types).

Boards for expansion joint filler shall be of the required size, shape and type indicated on the plans or required in the specifications. Boards shall be of selected stock of redwood, cypress, gum, southern yellow pine, or Douglas fir timber. The boards shall be sound heartwood and shall be free from sapwood, knots, clustered birdseyes, checks and splits. Occasional sound or hollow birdseyes, when not in clusters, shall be permitted, provided the board is free from any other effects that shall impair its usefulness as a joint filler. With the exception of redwood and cypress, all boards shall be preservative treated according to American Wood-Preservers' Association (AWPA) Standards.

Asphalt boards for expansion joint filler shall be of the required size and uniform thickness and, when used in transverse joints, they shall conform approximately to the shape of the pavement crown shown on the plans and details. Asphalt boards shall consist of two liners of 0.016 asphalt impregnated kraft paper filled with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and straight throughout, and shall be sufficiently rigid to permit ease of installation. Boards shall be furnished in lengths equal to the width between longitudinal joints, and may be furnished in strips or scored sheet of the required shape.

Asphalt boards, when tested in accordance with the following described methods, shall not deflect from the horizontal more than $\frac{3}{4}$ -inches in $3\frac{1}{2}$ -inches. A sample of the board, 2-in. wide and 6-in. long, flat, straight and cut with its length parallel to the lay of the fiber, shall be clamped between two blocks in the direction of its thickness in such manner that $3\frac{1}{2}$ -in. length of the sample shall extend unsupported and at right angles from the common plane of the block faces. The samples and clamp so assembled shall be maintained at a temperature of 180°F for 2-hours, with the length and width of the clamped portion of the sample horizontal after which the deflection from the horizontal of the unclamped portion shall be immediately measured.

303.2.12.2. Dimensions. The thickness of the expansion joint filler shall be shown on the plans; the width shall be not less than that shown on the plans, providing for the top seal space.

303.2.12.3. Rejection. Expansion joint filler may be rejected for failure to meet any of the requirements of this specification.

303.2.13. Curing Materials. This specification shall govern the materials to be used in the curing of concrete. The materials when applied as elsewhere specified shall retain the moisture, present in the concrete at the time of application of curing material, within specified limits for the curing period.

303.2.13.1. Material. Materials for the curing of concrete shall conform to the following requirements:

303.2.13.1.1. Membrane-Forming Compounds. The membrane curing compound shall conform to the requirements of ASTM C309 Liquid Membrane-Forming Compounds for Curing Concrete, Type 2, white pigmented compound, unless otherwise specified or indicated. It shall be of such nature that it shall not produce permanent discoloration of concrete surfaces nor react deleteriously with the concrete.

The compound shall produce a firm, continuous uniform moisture-impermeable film free from pinholes and shall adhere satisfactorily to the surfaces of damp concrete. It shall, when applied to the damp concrete surface at the specified rate of coverage, dry to touch in 1-hour and dry through in not more than 4-hours under normal conditions suitable for concrete operations. It shall adhere in a tenacious film without running off or appreciably sagging. It shall not disintegrate, check, peel or crack during the required curing period.

The compound shall not peel or pick up under traffic and shall disappear from the surface of the concrete by gradual disintegration.

The compound shall be delivered to the job site in the manufacturer's original containers only, which shall be clearly labeled with the manufacturer's name, the trade name of the material and a batch number or symbol with which test samples may be correlated.

When tested in accordance with ASTM C156 Water Retention by Concrete Curing Materials, the liquid membrane-forming compound shall restrict the loss of water present in the test specimen at the time of application of the curing compound to not more than 0.01-oz.-per-in² of surface.

303.2.13.1.2. Cotton Mats. The cotton mats used for curing shall meet the following requirements:

Each mat shall have a finished width of approximately 5-ft. 6-in.; and after shrinkage shall be at least 6-in. longer than the width of the concrete to be cured.

The mats shall be composed of a single layer of cotton filler, completely enclosed in a cover of cotton cloth. The cotton filler shall be of low-grade cotton, cotton linters of such shall contain not less than $\frac{3}{4}$ -pound of cotton filler per square-yard of mat, uniformly distributed. The cotton cloth used for covering material shall be Osnaburg, weighing not less than $6\frac{3}{10}$ -ounces-per-square-yard.

All mats shall be stitched longitudinally with continuous parallel rows of stitching at intervals of not more than 4-in. or shall be tufted both transversely and longitudinally at intervals of not more than 3-in. The sewing or tufting shall not be done so tightly that the mat shall not contact the surface of the concrete at all points when saturated with water.

To insure the complete covering of the concrete where the mats fit together, there shall be a flap extending all along one side of each mat. This flap shall be composed of two thicknesses of the cover material and shall be at least 6-in. in width.

303.2.13.1.3. Waterproof Paper. Waterproof paper shall consist of two sheets of plain kraft paper cemented together with a bituminous material in which are imbedded cords or strands of fiber running in both directions of the paper, not more than 1 $\frac{1}{4}$ -in. apart. The paper shall be light in color; shall be free of visible defects; and shall have a uniform appearance. It shall be sufficiently strong and tough to permit its use under the conditions existing on streets and structural work without tearing or otherwise becoming unfit for the use for which it is intended. The paper shall conform to specifications for ASTM C171 Sheet Materials for Curing Concrete.

When tested in accordance with ASTM C156 Water Retention by Concrete Curing Materials, the paper shall restrict the loss of water present in the test specimen at the time of application of the waterproof paper to not more than 0.055-grams-per-square-centimeter of surface.

303.2.13.1.4. Polyethylene Film. Polyethylene film shall be opaque pigmented white in color; and shall be manufactured from virgin resin without additives or scrap. The film shall have a minimum thickness of 4-mils. The permissible moisture loss from the concrete, when tested in accordance with ASTM C156 Water Retention by Concrete Curing Materials, shall not exceed 0.055-grams-per-square-centimeter of surface. The film shall be sufficiently strong and tough to permit its use under the conditions existing on paving or structural projects without being torn or otherwise rendered unfit

for the use intended during the curing period. It shall be of uniform thickness throughout, free of pinholes and other blemishes.

303.2.13.2. Rejection. Concrete curing materials may be rejected for failure to meet any of the requirements of this specification.

303.2.14. Joint Sealant. Joint sealing compound shall consist of hot poured polymer or ready-mixed cold-applied sealant, silicone joint sealant or other material approved by the OWNER. It shall not crack or break when exposed to low temperatures. The cured sealant must not pick up or “track” at elevated road temperature.

303.2.14.1. Materials.

303.2.14.1.1. Hot Poured Polymer. The joint sealing compound shall melt to the proper consistency for pouring and shall solidify on cooling to atmospheric temperatures. At no time shall the material be heated to temperature exceeding 450°F; any material heated above 450°F shall be rejected.

Hot poured polymer shall be tested in accordance with TxDOT Test Method Tex-525-C Tests for Asphalt and Concrete Joint Sealers and shall meet the requirements in Table 303.2.14.1.1.(a) Hot Poured Polymer Sealant Requirements.

Table 303.2.14.1.1.(a) Hot Poured Polymer Sealant Requirements

Property	Test Parameters	Required Result
Penetration	32°F , 7-oz. , 60-sec.	Minimum 0.1-in.
	77°F , 5-oz., 5-sec.	0.45- to 0.3-in.
Flow	5-hours, 140°F, 75° incline	Maximum 0.2-in.
Bond extension	15°F, 5-cycles	No cracking of the joint sealing material or break in the bond between the joint sealer material and the mortar pieces.

303.2.14.1.2. Ready-Mixed Cold-Applied. This sealant shall be a single component and shall consist of a homogeneous blend of asphalt emulsion, polymer, and inert filler. The material shall be a resilient, adhesive compound capable of effectively sealing properly cleaned joints and cracks in concrete and asphalt pavements against infiltration of moisture throughout repeated cycles of contraction and expansion and which shall not be picked up by vehicle tires, particularly at summer temperatures.

This Item covers an emulsion composed principally of a semi-solid asphalt base, water and emulsifying agent suitable for sealing cracks at ambient temperatures of 40°F and higher. The emulsion shall be modified with a polymer and shall be smooth and homogeneous, with no evidence of polymer separation.

The cold-applied crack sealant shall meet the requirements in Table 303.2.14.1.2.(a) Cold-Applied Sealant Requirements. Material shall be free-flowing down to 40°F, such that routine pavement joints and cracks are filled to a depth of 1½-in. without the addition of heat.

The material shall be furnished in 55-gallon drums.

Table 303.2.14.1.2.(a) Cold-Applied Sealant Requirements

Property	Test Method	Required Result	
		Minimum	Maximum
Viscosity ¹ , Brookfield, 77°F	ASTM D2196 Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) Viscometer; Method A	6,000 Centipoise	25,000 Centipoise
Storage Stability Test, One-Day	AASHTO T59	-	1-Percent
Sieve Test	AASHTO T59	-	0.10-Percent
Evaporations ² and Tests on Residue			
Residue	See Note 2.	65-Percent	-
Penetration test on Residue, 77°F, 100g, 5-seconds	AASHTO T49	35 (0.1-mm)	75 (0.1-mm)
Softening Point test on Residue, R.&B.	AASHTO T53	140°F	-
Ductility test on Residue, 39.2°F, 5 cm/Min	AASHTO T51	100-cm	-

1. OWNER may require Viscosity Profile in lieu of single-spindle viscosity test, in which case the apparent viscosity shall be 10,000.

2. Residue may be obtained by the following evaporation procedure: Mass 200g of sealant into a 1000-ml beaker or a 1-quart can and place in a heating mantle designed for a 1000-ml beaker. During the evaporation the sealant should be stirred frequently to prevent foam-over or local overheating. The temperature shall be maintained between 260°F and 300°F for 3- to 5-minutes after the material is water free. Pour required specimen.

303.2.14.1.3. Thermoplastic Cold-Applied. If approved by the OWNER, thermoplastic cold-applied jointing material may be used according to manufacturer's recommendations.

303.2.14.2. Rejection. Materials may be rejected for failure to meet any of the requirements of this specification.

303.2.15. Elastomeric Materials. This material shall conform to the requirements of the TxDOT Item 435 Elastomeric Materials. This item shall govern for the materials, testing and fabrication of elastomeric materials, except as otherwise covered in other specifications or on the plans.

303.2.15.1. Rejection. Elastomeric materials may be rejected for failure to meet any of the requirements of this specification.

303.3. MIX DESIGN AND MIXING CONCRETE FOR PAVEMENT

303.3.1. Description. This section shall govern for the concrete in pavements.

303.3.2. Equipment. All machinery and equipment necessary for the prosecution of the work specified herein shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin operations on which the machinery or equipment is to be used. All machinery and equipment shall be maintained in good condition to insure the completion of the work without excessive delays for repairs and replacements.

303.3.3. Concrete Mix Design and Control. At least 10-days prior to the start of concrete paving operations, the CONTRACTOR shall submit to the OWNER a design of the concrete mix it proposes to use together with samples, if requested, of all materials to be incorporated into the mix and a full description of the source of supply of each material component. The proposed batch designs must be submitted to the OWNER on the approved form.

The design of the concrete mix shall produce a quality concrete complying with these specifications and meet the requirements of ACI 318 (most recent edition) - PART 3 Construction Requirements, CHAPTER 5, Concrete Quality, except as amended by these provisions. The concrete mix design shall include the following information:

- (1) Design Requirements and Design Summary
- (2) Material source
- (3) Dry weight of cement/cu. yd. and type
- (4) Dry weight of fly ash/cu. yd. and type, if used
- (5) Saturated surface dry weight of fine and coarse aggregates/cu. yd.
- (6) Design water/cu. yd.
- (7) Quantities, type, and name of admixtures with manufacturer's data sheets
- (8) Current strength tests or strength tests in accordance with ACI 318
- (9) Current Sieve Analysis and -200 Decantation of fine and coarse aggregates and date of tests
- (10) Fineness modulus of fine aggregate
- (11) Specific Gravity and Absorption Values of fine and coarse aggregates
- (12) L.A. Abrasion of coarse aggregates

All material samples submitted to the OWNER shall be sufficiently large to permit laboratory batching for the construction of test specimens to check the adequacy of the design. When the OWNER has approved the design mix, there shall be no change or deviation from the proportions thereof or sources of supply except as hereinafter provided. No concrete may be placed on the job site until the mix design has been approved by the OWNER in writing to the CONTRACTOR.

303.3.4. Quality of Concrete.

303.3.4.1. Consistency. In general, the consistency of concrete mixtures shall be such that:

- (1) the mortar shall cling to the coarse aggregate,
- (2) the aggregate shall not segregate in concrete when it is transported to the place of deposit,
- (3) the concrete, when dropped directly from the discharge chute of the mixer, shall flatten out at the center of the pile, but the edges of the pile shall stand and not flow,
- (4) the concrete and mortar shall show no free water when removed from the mixer,
- (5) the concrete shall slide and not flow into place when transported in metal chutes at an angle of 30° with the horizontal,
- (6) the surface of the finished concrete shall be free from a surface film or laitance, and
- (7) the concrete shall be uniform and workable.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When field conditions are such that additional moisture is needed for the final concrete surface finishing operation, the required water shall be applied to the surface by fog spray only; and shall be held to a minimum amount. The concrete shall be workable, cohesive, possess satisfactory finishing qualities and be of the stiffest consistency that can be placed and vibrated into a homogeneous mass. Excessive bleeding shall be avoided.

If the strength or consistency required for the class of concrete being produced is not secured with the minimum cement specified or without exceeding the maximum water/cement ratio, the CONTRACTOR may use, or the OWNER may require, an approved cement dispersing agent (water reducer); or the CONTRACTOR shall furnish additional aggregates, or aggregates with different characteristics, or the CONTRACTOR may use additional cement in order to produce the required results. The additional cement may be permitted as a temporary measure, until aggregates are changed and designs checked with the different aggregates or cement dispersing agent.

The CONTRACTOR is solely responsible for the quality of the concrete produced. The OWNER reserves the right to independently verify the quality of the concrete through inspection of the batch plant, testing of the various materials used in the concrete and by casting and testing concrete cylinders or beams on the concrete actually incorporated in the pavement.

303.3.4.2. Standard Classes. Unless otherwise shown on the plans or detailed specifications, the Standard Classes of Pavement Concrete shown in Table 303.3.4.2.(a) shall be used.

Streets, alleys, driveways, and inlets shall be constructed in accordance with these specifications using the classes of concrete, machine or hand finished, whichever is appropriate. Mass pour medians, noses, and islands shall use hand-finished concrete.

The testing does not in any way change the penalties imposed on the CONTRACTOR for deficient strength outlined elsewhere in these specifications.

Table 303.3.4.2.(a) Standard Classes of Pavement Concrete.

Class of Concrete ¹	Minimum Cementitious Lb./CY	28 Day Min. Compressive Strength ² psi	28 Day Min. Beam Strength ^{2,3} psi	Maximum Water/ Cementitious Ratio	Coarse Aggregate Maximum Size ⁴
A ⁵	470	3000	500	0.58	1½"
C	564	3600	600	0.53	1½"
P1 ⁶	517	4000	N/A	0.49	1½"
P2 ⁷	564	4500	N/A	0.45	1½"
M	As directed by the OWNER or as shown on the plans				

1. All exposed horizontal concrete shall have entrained – air.
2. Minimum Strength Required by OWNER [Compressive or Flexural]
3. ASTM C78 (Third-Point); Reduce by 10% when Type II Cement is Used
4. Smaller nominal maximum size aggregate may be used if strength requirement is satisfied
5. Sidewalks, separate curb and gutter, and 4-inch thick median pavement
6. Machine Finished
7. Hand Finished

303.3.4.3. Performance Classes. Performance Classes of structural concrete shall meet the requirements in Table 303.3.4.3.(a) Performance Classes of Pavement Concrete.

Table 303.3.4.3.(a) Performance Classes of Pavement Concrete

Class of Concrete ¹	Minimum Cementitious Lb./CY	28-Day Compressive Strength psi	28-Day Flexural Strength ^{2,3} psi	Maximum Water/ Cementitious Ratio ⁴	Coarse Aggregate Maximum Size ⁵
PA	423	3000 ⁶	425	0.58	1½"
PC	517	3600 ⁶	510	0.53	1½"
PP1 ⁷	517	4000	N/A	0.48	1½"
PP2 ⁸	564	4500	N/A	0.44	1½"
PM	As directed by the OWNER or as shown on the plans				

1. All exposed horizontal concrete shall have entrained – air.
2. ASTM C78 (Third-Point); Reduce by 10% when Type II Cement is used
3. For early form removal
4. Consistent with ACI 211.1 Table 6.3.4(a) Relationship between water-cementitious materials ratio and compressive strength of concrete
5. Smaller nominal maximum size aggregate may be used if Strength requirement is satisfied
6. Calculated Average Required Compressive Strength Considering ACI 318 - Sec. 5.3.2.1 shall be strength shown times 1.15
7. Machine Finish
8. Hand Finish

303.3.4.4. Slump. Slump requirements for pavement and related concrete shall be as specified in Table 303.3.4.4.(a) Pavement Concrete Slump Requirements. No concrete shall be permitted with slump in excess of the maximums shown. Any concrete mix failing to meet the above consistency requirements, although meeting the slump requirements, shall be considered unsatisfactory, and the mix shall be changed to correct such unsatisfactory conditions.

Table 303.3.4.4.(a) Structural Concrete Slump Requirements.

Concrete Use	Avg. Slump (in.)	Max. Slump (in.)
Slip Form Paving	3	4
Hand formed paving	4	5
Sidewalk, Separate Curb and Gutter, and Other Miscellaneous Concrete	As specified by OWNER	

303.3.5. Mixing and Delivery. The concrete shall be produced in an approved method conforming to the requirements of this specification and ASTM C94/C94M Standard Specification for Ready-Mixed Concrete or National Ready-mixed Concrete Association (NRMCA). Ready-mix concrete shall be permitted in lieu of the paver-mixer. When ready-mix concrete is used, sampling provisions of ASTM C94 Alternate Procedure 2 shall govern. If fiber-reinforced concrete is used, mixing shall be in accordance with ASTM C1116 Fiber-Reinforced Concrete and Shotcrete. All materials for concrete placed in pavements shall conform to the requirements of the governing item of this specification.

303.3.5.1. Batch Mixing. The concrete shall be mixed in a batch mixer and only in such quantities as are required for immediate use. The mixing of each batch, after all materials are in the drum, shall continue until it produces a thoroughly mixed concrete of uniform mass as determined by established mixer performance ratings and inspection, or appropriate uniformity tests as described in ASTM C94. The entire contents of the drum shall be discharged before any materials are placed therein for the succeeding batch. Retempering or remixing shall not be permitted.

303.3.5.1.1. Mixer. The mixer shall produce concrete of uniform consistency and appearance.

303.3.5.1.2. Cleaning. The mixer shall be cleaned thoroughly each time when out of operation for more than 30 minutes.

303.3.5.2. Transit Mixing. When transit mixing is used, the transit mixer shall be of an approved revolving drum or revolving blade type so constructed as to produce a thoroughly mixed concrete with a uniform distribution of the materials throughout the mass and shall be equipped with a discharge mechanism which shall insure the discharging of the mixed concrete without segregation.

303.3.5.2.1. Prevention of Leaking. The mixer drum shall be watertight when closed and shall be equipped with a locking device that shall automatically prevent the discharging of the mixer prior to receiving the required number of revolutions.

303.3.5.2.2. Mixing. The entire quantity of mixing water shall be accurately measured by a visible calibrated mechanism. Leaking water valves shall be considered as ample reason for condemnation of the mixer unit and removal from the job by the OWNER. Each batch shall be mixed not less than 70 nor more than 100 revolutions at the rate of rotation specified by the manufacturer as mixing speed. Any additional mixing shall be done at a slower speed specified by the manufacturer for agitation and shall be continuous until the batch is discharged.

303.3.5.2.3. Counters. Truck mixers shall be equipped with actuated counters by which the numbers of revolutions of the drum may be readily verified. The counters shall be actuated at the time of starting mixing at mixing speeds.

303.3.5.2.4. Delivery. The rate of delivery of the mixed concrete shall be such that the interval between loads shall not exceed 10-minutes. The concrete shall be delivered to the site of the work and discharged from the mixer before the drum has been revolved 300 revolutions, after the introduction of the mixing water with the dry materials.

303.3.5.3. Central Mixing Plant. A central mixing plant shall be allowed, provided the method of mixing and handling has first been approved by the OWNER.

303.3.5.4. Commercial Concrete Plants. In the event the CONTRACTOR elects to use concrete produced by a commercial concrete plant, an agreement shall be drawn and executed by the responsible executive management of said plant granting the OWNER ingress and egress to all parts of the plant with full authority to make any and all required tests of aggregates and to regulate and control

all batching plant and/or central mixing plant operations. This regulatory control shall be applicable only to the concrete produced by the commercial plant for the payment herein specified.

303.3.5.5. Delivery Tickets. For transit mix operations, the manufacturer of the concrete shall, before unloading, furnish to the purchaser with each batch of concrete at the site a delivery ticket on which is printed, stamped, or written, the following information to determine that the concrete was proportioned in accordance with the approved mix design:

- (1) Name of concrete supplier
- (2) Serial number of ticket
- (3) Date
- (4) Truck number
- (5) Name of purchaser
- (6) Specific designation of job (name and location)
- (7) Specific class, design identification and designation of the concrete in conformance with that employed in job specifications
- (8) Amount of concrete in cubic yards (or cubic meters)
- (9) Time loaded or of first mixing of cement and aggregates
- (10) Water added by receiver of concrete and his/her initials
- (11) Weight of cement
- (12) Weight of fly ash
- (13) Type and amount of admixtures
- (14) Information necessary to calculate the total mixing water added by the producer (total mixing water includes free water on the aggregates, water and ice batched at the plant, and water added by the truck operator from the mixer tank);
- (15) Maximum size of aggregate
- (16) Weights of fine and coarse aggregate

For on-site concrete plant operations, the CONTRACTOR shall supply to the OWNER a batch ticket with the following information and for each continuous paving operation, provide receipts and invoices to substantiate the amounts of cement and fly ash used in the placement.

- (1) At the beginning of each day's placement, a list of the actual batch weights to be used shall be given to the OWNER.
- (2) When any changes are made, a new list of weights shall be given to the OWNER.

303.4. EQUIPMENT

303.4.1. General. All equipment necessary for the construction of this item shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used.

303.4.2. Field Laboratory. A field laboratory structure shall be required only when specifically required and provided for in the special provisions.

303.4.3. Slip Form Paver. Slip form paving equipment shall be provided with traveling side forms of sufficient dimensions, shape and strength so as to support the concrete laterally for a sufficient length of time during placement to produce pavement of the required cross section. The equipment shall spread, consolidate, screed and float-finish the freshly placed concrete in such a manner as to provide a dense and homogeneous pavement.

303.4.4. Forms. The side forms shall be metal, of approved cross section and bracing, of a height not less than the prescribed edge thickness of the concrete section, and a minimum of 10-ft. in length for each individual form. Forms shall be of ample strength and shall be provided with adequate devices for secure setting so that when in place they shall withstand the impact and vibration of equipment imposed thereupon without appreciable springing or settlement. In no case shall the base width be less than 8-in. for a form 8-in. or more in height. The forms shall be free from warps, bends or kinks and shall show no variation from the true plane for face or top. Each 10-ft. length of forms shall be provided with at least 3 pins for securely staking in position. Sufficient forms shall be provided for satisfactory prosecution of the work. 10-ft. metal

form sections shall be used in forming curves with a 250-ft., and larger radius. For curves with a radius of less than 250-ft., acceptable flexible metal forms or wood forms may be used upon approval by the OWNER.

303.4.5. Mechanical Vibratory Equipment. All concrete placed for pavement shall be consolidated by approved mechanical vibrators operated ahead of the transverse finishing machine and designed to vibrate the concrete internally and/or from the surface. Unless otherwise shown on the plans, vibrators of the surface-pan type shall be used for full-depth placement. Both types of vibrators shall be furnished and may be used concurrently at the discretion of the OWNER. Vibratory members shall extend across the pavement practically to, but shall not come in contact with, the side forms. Mechanically-operated vibrators shall be mounted in such a manner as not to interfere with the transverse or longitudinal joints.

The internal-type vibrators shall be spaced at not more than 24-in. and shall be equipped with synchronized vibratory units. Separate Vibratory units shall be spaced at sufficiently close intervals to provide uniform vibration and consolidation to the entire width of the pavement. The frequency in air of the internal spud-type Vibratory units shall be not less than 8,000-cycles-per-minute and not less than 5,000-cycles-per-minute for tube types. The method of operation shall be as directed by the OWNER. The CONTRACTOR shall have a satisfactory tachometer available for checking the vibratory elements.

The pavement vibrators shall not be used to level or spread the concrete but shall be used only for purposes of consolidation. The vibrators shall not be operated where the surface of the concrete, as spread, is below the elevation of the finished surface of the pavement, except for the first lift of concrete where the double strike-off method of placement is employed. The vibrators shall not be operated for more than 15-seconds while the machine upon which they are installed is still.

The pan-type vibrator units shall apply the vibrating impulses directly to the surface of the concrete. The operating frequency shall not be less than 3,500-cycles- nor more than 4,200-cycles-per-minute in air. The CONTRACTOR shall have a satisfactory tachometer available for checking the speed of the vibratory elements.

Approved hand manipulated mechanical vibrators shall be furnished in the number required for provision of proper consolidation of the concrete along the forms, at joints and in areas not covered by mechanically controlled vibrators. These vibrators shall be sufficiently rigid to insure control of the operating position of the vibrating head.

Complete and satisfactory consolidation of the concrete pavement is a most important requirement of this specification. Cores taken as required by [Item 303.8](#). Pavement Testing and Evaluation shall be carefully examined for voids, honeycombing or other evidence of incomplete consolidation. If such evidence is present, changes in the consolidation procedures and/or equipment shall be made to insure satisfactory consolidation.

303.4.6. Vibrating Screed. The mechanically vibrated screed shall be provided with a template adjusted to the crown of the concrete section. The template shall be power vibrated, adjustable in height and mounted to ride on the forms. The mechanical vibration of one of the screeds on the transverse finishing machine specified in [Item 303.4.7](#). Transverse Finishing Machine shall be acceptable.

303.4.7. Transverse Finishing Machine. The transverse finishing machine shall be provided with two screeds accurately adjusted to the crown of the pavement, shall be power driven and mounted in a substantial frame equipped to ride on the forms. The machine shall be so designed and operated as to strike off and consolidate the concrete.

Finishing machines shall be maintained in a tight and good operating condition, accurately adjusted to the required crown or profile and free from deflection, wobble or vibration tending to affect the surface finish. Machines failing to meet these requirements shall be rejected by the OWNER, and the CONTRACTOR shall provide approved equipment.

303.4.8. Miscellaneous Finishing Equipment. The CONTRACTOR shall furnish a broom of the push broom type not less than 18-in. in width with stiff bristles for the final surface finish of concrete base or as the OWNER directs.

The CONTRACTOR shall furnish a sufficient number of bridges equipped to ride on the forms and span the pavement for finishing operations and for the installation and finishing of joints. The CONTRACTOR shall furnish, operate and maintain at least two standard 10-ft. steel straightedges and all necessary finishing and edging tools as may be required to complete the pavement in accordance with the plans and specifications.

303.5. CONSTRUCTION METHODS

303.5.1. Subgrade. When manipulation or treatment of subgrade is required on the plans, the work shall be performed in proper sequence with the preparation of the subgrade for pavement.

The roadbed shall be excavated and shaped in conformity with the typical sections and to the lines and grades shown on the plans or established by the OWNER. Material excavated in the preparation of the roadbed in excess of that needed to properly construct the subgrade, shoulders, slopes or parkway shall be wasted. If additional material is required, it shall be secured from sources indicated on the plans or designated by the OWNER. All holes, ruts and depressions shall be filled with suitable material and, if required, the subgrade shall be thoroughly wetted and reshaped. Irregularities of more than ½-in., as shown by straightedge or template, shall be corrected. The subgrade shall be uniformly compacted to at least 95-percent of the maximum density as determined by ASTM D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³). Moisture content shall be within minus-2%- to plus-4%-of-optimum. The prepared subgrade shall be wetted down sufficiently in advance of placing the pavement to insure its being in a firm and moist condition for at least 2-in. below the surface. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of the work. No hauling or equipment shall be permitted on the finished subgrade.

The CONTRACTOR shall notify the OWNER at least three working days in advance of its intention to place concrete pavement.

Density tests must be taken no more than 72-hours prior to placement of concrete. After the specified moisture and density are achieved, the CONTRACTOR shall maintain the subgrade moisture and density in accordance with [Item 301](#). Subgrade, Subbase, and Base Preparation until the pavement is placed. In the event that rain or other conditions may have adversely affected the condition of the subgrade or base, additional tests may be required as directed by the OWNER.

303.5.2. Placing and Removing Forms. Forms shall be set to line and grade at least 200-ft., where practicable, in advance of the paving operations. Forms shall be adequately staked with at least three pins per 10-ft. section and capable of resisting the pressure of concrete placed against them and the thrust and the vibration of the construction equipment operating upon them without appreciable springing or settlement. Forms shall be jointed neatly and tightly and set with exactness to the established grade and alignment. Forms must be in firm contact with the subgrade throughout their length and base width. If the subgrade becomes unstable, forms shall be reset, using heavy stakes, or other additional supports may be necessary to provide the required stability.

303.5.2.1. Settling. When forms settle over ¼-in. under finishing operations, paving operations shall be stopped, the forms reset to line and grade and the pavement then brought to the required section and thickness.

303.5.2.2. Cleaning and Oiling. Forms shall be thoroughly cleaned after each use and well-oiled before reuse.

303.5.2.3. Removal. Forms shall remain in place a minimum of twelve hours or more as required by the OWNER. At the time the forms are removed, any honeycomb shall be rubbed with grout and sealed with a curing compound.

303.5.2.4. Curb. Superimposed or monolithic curb shall be formed from the flowline of the gutter to the top of the curb. All expansion joints in the curbs shall conform to the joint locations in the slab.

303.5.3. Placing Reinforcing Steel, Tie, and Dowel Bars. When reinforcing steel, welded wire mesh, tie bars, dowels, etc., are required, they shall be placed as shown on the plans. All reinforcing shall be clean, free from rust in the form of loose or objectionable scale, and of the type, size and dimensions shown on the plans. Reinforcing bars shall be securely wired together at the alternate intersections and all splices and shall be securely wired to each intersection dowel and load-transmission unit intersected. All bars shall be installed in their required position as shown on the plans.

The storing of reinforcing or structural steel on completed roadway slabs generally shall be avoided and, where permitted, such storage shall be limited to quantities and distribution that shall not induce excessive stresses.

303.5.3.1. Installation. All reinforcing bars and bar mats shall be installed in the slab at the required depth below the finished surface and supported by and securely attached to bar chairs installed on prescribed longitudinal and transverse centers as shown by sectional and detailed drawings on the plans. After the reinforcing steel is securely installed above the subgrade, as specifically required by plans and as herein prescribed, there shall be no loading imposed upon (or walking upon) the bar mats or individual bars before or during the placing or finishing of the concrete.

303.5.3.2. Welded Wire Mats. Where welded wire fabric reinforcement mats are required by the plans, or permitted as an alternate by the OWNER, the concrete shall be placed and struck off by means of a template to the depth below the finished surface as specified for the location of the mesh. Welded wire mats, conforming to the specified side lap and end splice requirements as detailed on the plans, shall be placed upon the struck surface. The remainder of the concrete shall be placed thereupon with finishing operations proceeding immediately. There shall be no loading imposed upon the mesh mats after installation in the slab concrete.

303.5.3.3. Assembly. Expansion joints or dummy joints which may require an assembly of parts supported by special devices shall be completely assembled and rigidly supported in the correct position well in advance of the placing of concrete.

303.5.4. Joints.

303.5.4.1. Joint Dimensions. The width of the joint shall be shown on the plans, creating the joint sealant reservoir. The depth of the joint shall be shown on the plans. Dimensions of the sealant reservoir shall be in accordance with manufacturer's recommendations. Normal width/depth ratios are 1 to 1, not to exceed 1 to 1½. After curing, the joint sealant shall be ⅛-in. to ¼-in. below the pavement surface at the center of the joint.

303.5.4.2. Expansion Joints. Expansion joints shall be installed perpendicularly to the surface and to the centerline of the pavement at the locations shown on the plans.

Refer to [Item 702.5.4.1](#). Expansion Joints for more information.

303.5.4.2.1. Joint Filler. Joint filler shall be as specified in [Item 303.2.12](#). Joint Filler, as approved by OWNER, of the size and shape shown on the plans.

Board joint material with less than 25-percent of moisture at the time of installation shall be thoroughly wetted on the job. Green lumber of much higher moisture content is desirable and acceptable.

The joint filler shall be appropriately drilled to admit the dowel bars when required. The bottom edge of the filler shall extend to or slightly below the bottom of the slab. The top edge shall be held approximately ½-in. below the finished surface of the pavement in order to allow the finishing operations to be continuous. Where the joint filler is of a premolded asphaltic type, the top edge shall be protected, while the concrete is being placed and finished, by a metal cap of at least 10 gauge material having flanges not less than 1½-in. in depth. The channel cap may remain in place during the joint finishing operations to serve as a guide for tooling the edges of the joint. After the removal of the side forms, the ends of the joints at the edges of the slab shall be carefully opened for the entire depth of the slab.

303.5.4.2.2. Curb. Where a superimposed curb or a separate curb and gutter may be used, the expansion joints therein shall coincide and be continuous with the pavement joint and of the same size and type.

303.5.4.2.3. Proximity to Existing Structures. When the pavement is adjacent to or around existing structures, expansion joints shall be constructed in accordance with the details shown on the plans.

303.5.4.2.4. Dowel Bars. Dowel bars, where required on the plans, shall be installed through the predrilled joint filler and rigidly supported in true horizontal and vertical positions by an assembly of bar chairs and dowel holders welded to transverse bars extending across the slab and placed on each side of the joint. The chair assembly shall be similar and equal to that shown on the plans and shall be approved by the OWNER prior to extensive fabrication.

303.5.4.3. Contraction Joints. Contraction or dummy joints shall be installed at the locations and at the intervals shown on the plans in accordance with this section and [Item 402.3](#), Sawing. The joints shall be constructed by sawing to a ¼-in. width and to a depth of ¼ of the pavement thickness, or deeper if so indicated on the plans. Unless otherwise specified on the plans, joints shall be sawed into the completed pavement surface as soon after initial concrete set as possible so that some raveling of the green concrete is observed in order for the sawing process to prevent uncontrolled shrinkage cracking. If sharp edge joints are being obtained, the sawing process shall be sped up to the point where some raveling is observed. Damage by blade action to the slab surface and to the concrete immediately adjacent to the joint shall be minimized. Any portion of the curing membrane which has been disturbed by sawing operations shall be restored by spraying the areas with additional curing compound. The sawed groove shall immediately be thoroughly cleaned for the full depth and width of the joint and filled. The type of equipment and method for performing this work shall be approved by the OWNER.

303.5.4.4. Construction Joints. Construction joints formed at the close of each day's work or when the placing of concrete has been stopped for 30-minutes or longer shall be constructed by use of metal or wooden bulkheads cut true to the section of the finished pavement and cleaned and oiled. Wooden bulkheads shall have a thickness of not less than 1½-in. Longitudinal bars shall be held securely in place in a plane perpendicular to the surface and at right angles to the centerline of the pavement. Edges shall be rounded to ¼-in. radius. Any surplus concrete on the subgrade shall be removed upon the resumption of the work.

In no case shall an emergency construction joint be placed within 8-ft. following a regular installation of expansion or contraction joint. If the emergency construction joint should fall within this limitation, the concrete shall be removed back to the previously installed joint.

Refer to [Item 702.5.4.2](#), Construction Joints for more information.

303.5.4.5. Longitudinal Parting Strips. Longitudinal parting strips or planes of weakness, when required, shall be accurately placed as shown on the plans.

303.5.4.6. Longitudinal Construction Joints. Longitudinal construction joints shall be of the type shown on the plans. Longitudinal joints shall be constructed accurately to required lines in order to coincide with traffic lane lines. No width between longitudinal construction joints shall exceed 24-ft., unless specifically authorized or directed by the OWNER in writing.

303.5.4.7. Joint Sealing. Routine pavement joints shall be filled to a depth of 1½-in. Materials shall generally be handled and applied according to the manufacturer's recommendations, with additional requirements as stated herein.

303.5.4.7.1. Hot Poured Polymer. The sealing filler shall be melted in an approved oil-batch kettle with continuous mechanical agitation. The kettle shall be equipped with temperature indicators. The OWNER shall determine the optimum temperature for proper pouring fluidity, and the CONTRACTOR shall maintain the material within close range of optimum temperature. At no time shall the temperature exceed 450°F. Joint sealing compound shall not be poured at atmospheric temperatures below 32°F.

303.5.4.7.2. Ready-Mixed Cold-Applied. Permeation of joints shall principally be achieved without the task of squeegeeing. However, squeegeeing is recommended to assist permeation and to allow sealant to become rapidly tack-free. Sealant shall "set" in a fixed position within 40-minutes after application, to where traffic may be restored to the pavement without the effects of "tracking." "Tracking" shall be averted without the use of topping materials such as sand.

303.5.5. Placing Concrete. Unless otherwise shown on the plans, the concrete shall be placed using either forms or slipform paver. The concrete shall be rapidly deposited on the subgrade in successive batches and shall be distributed to the required depth and for the entire width of the pavement by shoveling or other approved methods. Any concrete not placed as herein prescribed within the time limits specified in Table 303.5.5.(a) Concrete Placement will be rejected.

**Table 303.5.5.(a) Concrete Placement
Temperature –Time Requirements**

Concrete Temp (at point of placement)	Max Time - minutes (no retarding agent)	Max Time – minutes (with retarding agent)¹
Non-Agitated Concrete		
All temperatures	30	45
Agitated Concrete		
Above 90°F	45	75
Above 75 F thru 90°F	60	90
75°F and Below	90	120

1. Normal dosage of retarder.

Where bar mats or wire mesh reinforcing is specified, method of concrete placement shall be in accordance with [Item 303.5.3](#), Placing Reinforcing Steel, Tie, and Dowel Bars. Rakes shall not be used in handling concrete. The placing operation shall be continuous. At the end of the day, or in case of unavoidable interruption or delay of more than 30-minutes, a transverse construction joint shall be placed in accordance with [Item 303.5.4.4](#), Construction Joints.

303.5.5.1. Honeycombing. Special care shall be taken in placing and spading the concrete against the forms and at all joints and assemblies so as to prevent honeycombing. Excessive voids and honeycombing in the edge of the pavement, revealed by the removal of the side forms, may be cause for rejection of the section of slab in which the defect occurs.

303.5.5.2. Weather Conditions. Except by specific written authorization of the OWNER, no concrete shall be placed when the air temperature is less than 40°F and falling but may be placed when the air temperature is above 35°F and rising, the temperature being taken in the shade away from artificial heat. When and if such permission is granted, the CONTRACTOR shall furnish sufficient protective material and devices to enclose and protect the fresh concrete in such a way as to maintain the temperature of the air surrounding the fresh concrete at not less than 50°F for a period of at least 5-days.

Except by specific written authorization of the OWNER, no concrete shall be placed when the concrete temperature is higher than 95°F. CONTRACTOR shall take appropriate measures including chilling and reduction of time intervals between batching and placing.

It is to be distinctly understood that the CONTRACTOR is responsible for the quality and strength of the concrete placed under any weather conditions. No concrete shall be placed on a frozen subgrade.

303.5.5.3. Time. Concrete shall not be placed before the time of sunrise and the surface finishing shall be completed prior to sunset unless otherwise authorized by the OWNER.

303.5.6. Finishing.

303.5.6.1. Machine. When the concrete has been deposited, it shall be approximately leveled and then struck off to such elevation that, when mechanically screeded and tamped, the concrete shall be thoroughly compacted and finished to the required line, grade and section with all surface voids filled. Where bar mats or wire mesh reinforcing is specified, method shall be in accordance with [Item 303.5.3](#), Placing Reinforcing Steel, Tie, and Dowel Bars.

303.5.6.1.1. Tolerance Limits. While the concrete is still workable, it shall be tested for irregularities with a 10-ft. straightedge placed parallel to the centerline of the pavement so as to bridge depressions and to touch all high spots. Ordinates measured from the face of the straightedge to the surface of the pavement shall at no place exceed $\frac{1}{16}$ inch-per-foot from the nearest point of contact. In no case shall the maximum ordinate to a 10-ft. straightedge be greater than $\frac{1}{8}$ -in. Any surface not within the tolerance limits shall be reworked and refinished.

303.5.6.1.2. Edging. The edges of slabs and all joints requiring edging shall be carefully tooled with an edger of the radius required by the plans at the time the concrete begins to take its "set" and becomes non-workable. All such work shall be left smooth and true to lines.

303.5.6.1.3. Stamp or Die. All concrete including curbs, curb with gutter, sidewalks, alleys, driveways and structures shall be marked by means of a substantial stamp or die so designed to make an impression in the finish of the concrete. The stamp or die shall designate the firm name or CONTRACTOR and the month and year in which the work was done. The design of the stamp or die shall be approved by the OWNER.

303.5.6.2. Hand. Hand finishing shall be permitted only in intersections and areas inaccessible to a finishing machine. The addition of one-sack of cement per cubic-yard shall be required for all hand finish concrete.

When the hand method of striking off and consolidating is permitted, the concrete, as soon as placed, shall be approximately leveled and then struck off and screeded to such elevation above grade that, when consolidated and finished, the surface of the pavement shall be at the grade elevation shown on the plans. The entire surface shall then be tamped and the concrete consolidated so as to insure maximum compaction and a minimum of voids. For the strike off and consolidation, both a strike template and tamping template shall be provided on the work. In operation the strike template shall be moved forward with a combined longitudinal and transverse motion and so manipulated that neither end of the template is raised from the forms during the striking-off process. A slight excess of material shall be kept in front of the cutting edge at all times.

The straightedge and joint finishing shall be as hereinabove prescribed.

303.5.7. Curing. The curing of concrete pavement shall be thorough and continuous throughout the entire curing period. Failure to provide proper curing as herein prescribed shall be considered as sufficient cause for immediate suspension of the paving operations. The curing method as herein specified does not preclude the use of any of the other commonly used methods of curing, and the OWNER may approve another method of curing if so requested by the CONTRACTOR. If any selected method of curing does not afford the desired results, the OWNER shall have the right to order that another method of curing be instituted. Immediately after the finishing of the surface, the pavement shall be covered with a continuous, uniform water-impermeable coating of the type specified in [Item 303.2.13](#). Curing Materials. After removal of the side forms, the sides of the slab shall receive a like coating before earth is banked against them. The solution shall be applied, under pressure with a spray nozzle, in such a manner as to cover the entire surfaces thoroughly and completely with a uniform film.

The rate of application shall be such as to insure complete coverage and shall not exceed 200-square-feet-per-gallon of curing compound. When thoroughly dry, it shall provide a continuous and flexible membrane, free from cracks or pinholes, and shall not disintegrate, check, peel or crack during the curing period. If for any reason the seal is broken during the curing period, it shall be immediately repaired with additional sealing solution.

When tested in accordance with ASTM C156 Water Retention by Concrete Curing Materials, the curing compound shall provide a film which shall have retained within the test specimen a percentage of the moisture present in the specimen when the curing compound was applied according to Table 303.5.7.(a) Water Retention by Curing Materials.

Table 303.5.7.(a) Water Retention by Curing Materials

Time	Minimum Retained Moisture
After 24-hours	97%
After 3-days	95%
After 7-days	91%

303.5.8. Opening Pavement to Traffic. All traffic shall be excluded from the pavement for a period of not less than 14-days or until field cured test specimens indicate concrete meets at least 75% of design strength, or as otherwise approved by the OWNER. In all cases the pavement shall be cleaned and joints shall be filled and trimmed before being opened to traffic.

303.5.8.1. Traffic Access. When it is necessary to provide for traffic across the pavement, the CONTRACTOR shall, at its own expense, construct suitable and substantial crossings over the concrete which shall be adequate for the traffic using same.

303.5.8.2. Time. Opening pavement to traffic shall not relieve the CONTRACTOR of responsibility for the work and shall not in any way affect the time charge on the entire project. The number of days stated in the contract shall govern for the completion of the entire work covered by the contract.

303.5.9. Monolithic Curb. Concrete for monolithic curb shall be the same as for the pavement and, if carried back from the paving mixer, shall be placed within 20-minutes after being mixed. Concrete may be placed from the separate mixer if desired but in any case must be placed while the pavement concrete is still plastic. After the concrete has been struck off and sufficiently set, the exposed surfaces shall be thoroughly worked with a float. The exposed edges shall be rounded by the use of an edging tool to the radius indicated on the plans. When the concrete in the curb has been sufficiently set, the inside form shall be carefully removed and the surface may be plastered with a mortar consisting of one part of Portland cement and two parts fine aggregate. The mortar shall be applied with a template or "mule" made to conform to curb dimensions. All exposed surfaces of curb shall be brushed to a smooth and uniform surface.

303.5.10. Superimposed Curb. When sawed joints are used, curbs shall be doweled as shown on the plans and poured after sawing. Doweled curbs which are placed with an extrusion machine shall have a mixture that conforms to [Item 303.3](#). Mix Design and Mixing Concrete for Pavement.

303.5.11. Slip Form Paving. At the option of the CONTRACTOR, and with the approval of the OWNER, concrete pavement may be constructed by the use of slip form paving equipment.

The concrete, for the full paving width, shall be effectively consolidated by internal vibration with transverse vibrating units or with a series of longitudinal vibrating units loaded with the specified thickness of pavement section and at a minimum distance ahead of the screed equal to the pavement thickness.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels offset to run a sufficient distance from the edge of the pavement to avoid breaking or cracking the pavement edge.

Final finishing for slip form pavement construction shall be to the tolerance as specified in [Item 303.5.6](#). Finishing.

303.6. ALLEY PAVING

Alley paving shall be constructed in accordance with the specifications for street paving hereinbefore described, in accordance with the details shown on the plans, and with the following additional provisions:

Alley paving shall be constructed to one of the typical cross sections shown on the plans.

Transverse expansion joints of the type shown on the plans shall be constructed at the property line on each end of the alley with a maximum spacing of 600-ft. Transverse contraction and dummy joints shall be placed at the spacing shown on the plans. Contraction and dummy joints shall be formed in such a manner that the required joints shall be produced to the satisfaction of the OWNER. All joints shall be filled with top seal in accordance with the requirements of [Item 303.5.4](#). Joints.

303.7. PAVEMENT LEAVEOUTS

Pavement leaveouts as necessary to maintain and provide for local traffic shall be provided at location indicated on the plans or as directed by the OWNER. The extent and location of each leaveout required and a suitable crossover connection to provide for traffic movements shall be determined in the field by the OWNER. Left or right-turn lanes and median openings shall not be considered as pavement leaveouts.

303.8. PAVEMENT TESTING AND EVALUATION

303.8.1. Testing of Materials. Samples of all materials for test shall be made at the expense of the OWNER, unless otherwise specified in the special provisions or in the plans. In the event the initial sampling and testing does not comply with the specifications, all subsequent testing of the material in order to determine if the material is acceptable shall be at the CONTRACTOR'S expense at the same rate charged by the

commercial laboratories. All testing shall be in accordance with applicable ASTM Standards and concrete testing technician must be ACI certified or equivalent.

303.8.2. Pavement Thickness Test. Upon completion of the work and before final acceptance and final payment shall be made, pavement thickness test shall be made by the OWNER. The number of tests and location shall be at the discretion of the OWNER, unless otherwise specified in the special provisions or on the plans. The cost for the initial pavement thickness test shall be the expense of the OWNER. In the event a deficiency in the thickness of pavement is revealed during normal testing operations, subsequent tests necessary to isolate the deficiency shall be at the CONTRACTOR'S expense. The cost for additional coring test shall be at the same rate charged by commercial laboratories.

Where the average thickness of pavement in the area found to be deficient in thickness by more than 0.20-in., but not more than 0.50-in., upon discretion of the OWNER payment shall be made at an adjusted price as specified in Table 303.8.2.(a) Concrete Pavement Deficiency.

Table 303.8.2.(a) Concrete Pavement Deficiency

Deficiency in Thickness Determined By Cores	Proportional Part of Contract Price
Inches	Allowed
0.00 — 0.20	100 percent
0.21 — 0.30	80 percent
0.31 — 0.40	70 percent
0.41 — 0.50	60 percent

Any area of pavement found deficient in thickness by more than 0.50-in. but not more than 0.75-in. or $\frac{1}{10}$ of the plan thickness, whichever is greater, shall be evaluated by the OWNER. If, in the judgment of the OWNER, the area of such deficiency should not be removed and replaced, there shall be no payment for the area retained. If, in the judgment of the OWNER, the area of such deficiency warrants removal, the area shall be removed and replaced, at the CONTRACTOR'S entire expense, with concrete of the thickness shown on the plans. Any area of pavement found deficient in thickness by more than 0.75-in. or more than $\frac{1}{10}$ of the plan thickness, whichever is greater, shall be removed and replaced, at the CONTRACTOR'S entire expense, with concrete of the thickness shown on the plans.

No additional payment over the contract unit price shall be made for any pavement of a thickness exceeding that required by the plans.

303.8.3. Pavement Strength Test.

303.8.3.1. For Standard Classes of Concrete. During the progress of the work, the CONTRACTOR shall cast test cylinders, in accordance with ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field, to maintain a check on the compressive strengths of the concrete being placed.

In accordance with ASTM C31 and ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete, four test cylinders shall be taken from a representative portion of the concrete being placed for every 150-cubic yards of concrete pavement placed, but in no case shall less than 2 sets of cylinders be taken from any one day's placement. For smaller placements, the testing frequency may be adjusted at the OWNER'S discretion.

After the cylinders have been cast, they shall remain on the job site and then transported, moist cured, and tested by the OWNER in accordance with ASTM C31 and ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

In each set, one of the cylinders shall be tested at 7-days, two cylinders shall be tested at 28-days, and one cylinder shall be held or tested at 56-days, if necessary.

If the 28-day test results indicate deficient strength, the CONTRACTOR may, at its option and expense, core the pavement in question and have the cores tested by an approved laboratory, in accordance with ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of

Concrete and ACI 318 protocol, except the average of all cores must meet 100% of the minimum specified strength, with no individual core resulting in less than 90% of design strength, to override the results of the cylinder tests.

The CONTRACTOR shall be responsible for the proper storage, maintenance, and any required curing of concrete test samples made by the OWNER. The CONTRACTOR shall provide and maintain curing facilities for the purpose of curing concrete test specimens on site in accordance with ASTM C31. The cost of all materials used in test specimens and the cost of storing, maintaining and of providing and maintaining curing facilities will not be paid for as a separate contract pay item, and the costs thereof shall be considered incidental to the contract pay items provided.

Cylinders and/or cores must meet minimum specified strength. Pavement not meeting the minimum specified strength shall be subject to the money penalties or removal and replacement at the CONTRACTOR'S expense as shown in Table 303.8.3.1.(a) Standard Class Concrete Deficiency Penalties.

Table 303.8.3.1.(a) Standard Class Concrete Deficiency Penalties.

Percent Deficient	Percent of Contract Price Allowed
Greater Than 0% — Not More Than 5%	95-percent
Greater Than 5% — Not More Than 10%	90-percent
Greater Than 10% — Not More Than 15%	80-percent
Greater Than 15%	60-percent or removed and replaced at the entire cost and expense of CONTRACTOR as directed by OWNER.

The amount of penalty shall be deducted from payment due to CONTRACTOR; such penalty deducted is to defray the cost of extra maintenance.

These requirements are in addition to the requirements of [Item 303.9](#). Measurement and Payment.

The strength requirements for structures and other concrete work are not altered by this special provision.

No additional payment over the contract unit price shall be made for any pavement of strength exceeding that required by plans and/or specifications.

303.8.3.2. For Performance Classes of Concrete. During the progress of the work, the CONTRACTOR shall cast test cylinders, in accordance with ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field, to maintain a check on the compressive strengths of the concrete being placed.

In accordance with ASTM C31 and ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete, four test cylinders shall be taken from a representative portion of the concrete being placed for every 150-cubic yards of concrete pavement placed, but in no case shall less than 2 sets of cylinders be taken from any one day's placement.

After the cylinders have been cast, they shall remain on the job site and then transported, moist cured, and tested by the OWNER in accordance with ASTM C31 and ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

In each set, one of the cylinders shall be tested at 7-days, two cylinders shall be tested at 28-days, and one cylinder shall be held or tested at 56-days, if necessary.

If the 28 day test results indicate deficient strength, the CONTRACTOR may, at its option and expense, core the pavement in question and have the cores tested by an approved laboratory, in accordance with ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete and ACI 318 protocol, to override the results of the cylinder tests.

The CONTRACTOR shall be responsible for the proper storage, maintenance, and any required curing of concrete test samples made by the OWNER. The CONTRACTOR shall provide and maintain curing facilities for the purpose of curing concrete test specimens on site in accordance with ASTM C31. The cost of all materials used in test specimens and the cost of storing, maintaining and of providing and maintaining curing facilities will not be paid for as a separate contract pay item, and the costs thereof shall be considered incidental to the contract pay items provided.

Cylinders and/or cores must meet the specified strength in accordance with ACI 318 protocol. Pavement not meeting the specified strength shall be subject to the money penalties or removal and replacement at the CONTRACTOR'S expense as shown in Table 303.8.3.2.(a) Performance Class Concrete Deficiency Penalties.

Table 303.8.3.2.(a) Performance Class Concrete Deficiency Penalties.

Percent Deficient	Percent of Contract Price Allowed
Greater Than 0% — Not More Than 5%	95-percent
Greater Than 5% — Not More Than 10%	90-percent
Greater Than 10% — Not More Than 15%	80-percent
Greater Than 15%	60-percent or removed and replaced at the entire cost and expense of CONTRACTOR as directed by OWNER.

The amount of penalty shall be deducted from payment due to CONTRACTOR; such penalty deducted is to defray the cost of extra maintenance.

These requirements are in addition to the requirements of [Item 303.9](#), Measurement and Payment.

The strength requirements for structures and other concrete work are not altered by this special provision.

No additional payment over the contract unit price shall be made for any pavement of strength exceeding that required by plans and/or specifications.

303.8.4. Random Drying Shrinkage Cracks and Stress Cracks. Random drying shrinkage cracks or stress cracks of widths greater than 0.025-inches in recently placed reinforced Portland cement concrete pavement placed on stabilized subbase or slabs on grade are subject to being removed and replaced at the discretion of the OWNER. Random drying shrinkage cracks or stress cracks of any nature in recently placed non-reinforced Portland cement concrete pavement placed on non-stabilized subbase or slabs on grade are subject to being removed and replaced at the discretion of the OWNER. Recently placed concrete pavement or slabs on grade are those for which the one-year maintenance bond has not expired. Routing, by any means, and sealing random cracks will not be permitted. When Portland cement concrete pavement or slabs on grade must be removed and replaced, the area of removal must extend from the nearest contraction or dummy joint or construction joint a minimum distance of 10-feet, measured parallel to the longitudinal axis of the pavement, and include that portion of the concrete pavement or slab on grade containing the random crack. A sawed dummy joint will be required to be sawed across the opposing, non-damaged, slab in line with the saw cut made for the removal of the damaged slab. The area of removal and replacement of slabs containing longitudinal random cracks will be determined by the OWNER. Randomly cracked Portland cement concrete sidewalks will require removal and replacement of only the five-foot long section or sections containing random cracks.

303.9. MEASUREMENT AND PAYMENT

Portland cement concrete pavement shall be measured by the square-yard of completed and accepted pavement. Measurement for reinforced concrete pavement shall be by the square-yard measured in its final position.

The work performed and material furnished as prescribed by this item and measured as provided in this item shall be paid for at the unit price bid per square-yard for concrete pavement or the adjusted unit price for pavement of deficient thickness as provided under Pavement Thickness Test and Pavement Strength Test, which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, hauling and handling all concrete ingredients, including all freight and royalty involved; for mixing, placing, finishing and curing all concrete; for furnishing and installing all reinforcing steel; for furnishing all materials and placing longitudinal, warping, expansion, and contraction joints, including all steel dowels, dowel caps and load transmission units required, wire and devices for placing, holding and supporting the steel bar, load transmission units, and joint filler material in the proper position; for coating steel bars where required by the plans; for all manipulations, labor, equipment, appliances, tools, traffic provisions and incidentals necessary to complete the work.

ITEM 305. MISCELLANEOUS ROADWAY CONSTRUCTION

305.1. CONCRETE CURB AND GUTTER

305.1.1. Description. Curb and gutter shall be of the type specified and shall be constructed to the size, shape, lines and grade as shown on the plans or as directed by the OWNER. Variations in size and shape may be made to fit individual special conditions.

305.1.2. Materials. All materials used in concrete herein specified shall conform to the requirements of the applicable sections of [Item 303](#). Portland Cement Concrete Pavement of these specifications and to additional requirements herein included.

305.1.3. Construction Methods.

305.1.3.1. Excavation. Excavation shall be as provided in [Item 203.2](#). Unclassified Excavation, and as shown on the plans. Asphalt millings or extra depth concrete shall be used to correct grade deficiencies identified after subgrade has been checked.

305.1.3.2. Reinforcing Steel. All steel reinforcement shall be accurately placed as shown on the plans and held in place during progress of concreting by such effective means that it shall not be moved out of true position. All bars shall be wired at their intersections and at all laps or splices. All bars at splices shall be lapped a minimum of 20-diameters of the bar or 12-in., whichever is greater.

All reinforcement necessary for a section of concrete shall be placed and approved by the OWNER before any concrete is deposited in the section. All steel must be free from paint and oil and all loose scale, rust, dirt and other foreign substances shall be completely removed before using.

305.1.3.3. Forms. All forms shall be of wood or steel, straight, free of warp and framed, braced or staked in a substantial and approved manner so as to insure perfect alignment and grade. All forms shall be clean and shall be oiled immediately before concreting. Care shall be taken in removing forms to prevent marring or spalling of the concrete. Forms shall extend the full depth of concrete and be a minimum of 1⁵/₈-in. in thickness or equivalent when wooden forms are used, or be of a gauge that shall provide equivalent rigidity and strength when metal forms are used.

For curves with a radius of less than 250-ft., acceptable flexible metal or wood forms shall be used.

All forms showing a deviation of 1/8-in. in 10-ft. from a straight line shall be rejected.

305.1.3.4. Expansion Joints. Expansion joints shall be constructed using expansion joint material of an approved type. Expansion joints shall be placed in the curb and gutter at 200-ft. intervals and at intersection returns and other rigid structures, or as otherwise specified by the OWNER. Tooled joints shall also be placed at 15-ft. intervals or matching abutting sidewalk joints and pavement joints to a depth of 1/4 the thickness of the curb. Expansion joints shall also be placed at all intersections with concrete driveways, curbs, buildings and other curbs and gutters. All expansion joints shall be not less than 1/2-in. in thickness, extending the full depth of the concrete and shall be perpendicular and at right angles to the face of the curb. Any expansion material extending above the finished work shall be neatly trimmed to the surface of the finished work. The expansion joints in concrete pavement shall coincide with the expansion joints in the curb and gutter and sidewalk. Longitudinal dowels, across the expansion joints in the curb and gutter, shall be required. There shall be three No. 4 round, smooth bars for dowels at each expansion joint, spaced in accordance with standard reinforcement steel specifications. The dowel shall be a minimum of 24-in. in length. One-half of the dowel shall be coated with asphalt and terminated with an expansion cap. The cap shall provide a minimum of 1-in. free expansion. Dowels shall be supported by an approved method to provide a true horizontal and longitudinal alignment.

In the event that concrete pavement is to be placed in the street, the contraction (dummy) joints in the curb, gutter and/or combined curb and gutter shall be in strict alignment with the contraction (dummy) joints in the pavement and may be marked with an approved tool to the depth designated by the OWNER. If the joints are not constructed by marking, they shall be sawed at the time of sawing joints in the concrete slab and to the same depth as those in the slab. Expansion joints of the size of those in the pavement shall be placed through the curb and gutter at the point of, and in strict alignment with, expansion joints in the pavement.

All joints through the gutters (not curb) shall be sealed with hot-poured polymer sealer unless otherwise specified.

All joints shall be constructed in a neat and workmanlike manner, with edges rounded, in conformity with the plans and specifications and at location as shown on the plans or as designated by the OWNER.

305.1.3.5. Concrete Placement. Concrete shall be placed in accordance with [Item 303](#). Portland Cement Concrete Pavement.

Concrete shall be deposited so as to maintain a horizontal surface and shall be thoroughly and continuously worked into all spaces and around any reinforcement so as to form a dense voidless mass. The coarse aggregate shall be worked away from contact with the forms so as to form a smooth, hard exposed concrete surface.

The concrete for curb and gutter shall preferably be placed continuously between expansion joints. If construction joints are allowed at other locations by the OWNER, they shall be properly constructed with wooden bulkheads so as to completely separate adjacent concrete sections.

Integral curb, with or without gutter, when designated in the plans or specifications, shall be placed while the concrete in the base or pavement is still plastic and shall be spaded and consolidated with the concrete slab in order that a thorough bond shall be obtained.

Integral curb, with or without gutter, shall be placed in sections equal to the adjoining concrete slab length, with expansion joints provided as specified herein.

Where curb and gutter is not adjacent to new pavement, 2-in. of sand cushion shall be used. After the fine grading has been completed, a 2-in. layer of sand or suitable gravel cushion shall be evenly spread over the subgrade for curb and gutter, thoroughly wetted and tamped into place to the satisfaction of the OWNER. The forms shall be placed upon this sand or gravel base. A screed shall be used to shape the sand cushion to fit a plane parallel to the top of gutter. A curb and gutter machine may be used, if approved by the OWNER.

305.1.3.6. Finishing. After the concrete has been struck off and while it is still plastic, the exposed surfaces may be plastered with ¼-in. mortar topping. The mortar topping shall be applied with a steel “mule,” or a finishing tool or method which produces results equivalent to that obtained with the mule. All exposed surfaces shall then be floated or troweled and lightly brushed as required by the OWNER to produce a smooth and uniform finish. Excess working of the surfaces shall be avoided. Excess water, laitance and inert materials shall be removed from the surfaces.

The top of all the work and the face of all curbs shall be checked for irregularities as soon as the surface is finished, using a 10-ft. straightedge, and the maximum distance from the straightedge to the concrete shall not exceed ¼-in. All variations greater than ¼-in. shall be immediately corrected. All honeycombed areas disclosed by removal of forms shall be immediately chipped out and patched with Portland cement mortar.

305.1.3.7. Curing. After finishing operations are completed, the concrete surface shall be sprayed with concrete curing compound. The surface of the concrete shall be kept thoroughly damp between the completion of the finishing operations and the application of the curing compound. The curing compound shall be applied under pressure, by means of a spray nozzle, at a rate not to exceed 200-sq.-ft.-per-gallon. A minimum of 72-hours curing time shall be required.

Forms shall remain in place at least 12 hours after completion of the concrete placement for the curb and gutter. Should the CONTRACTOR elect to remove the forms before the minimum curing time has elapsed, it shall apply curing compound to the newly exposed vertical faces. Forms for inside curb faces may be removed in approximately 3-hours, provided that the concrete has set sufficiently to permit form removal without curb damage.

305.1.3.8. Finishing Exposed Surfaces. Exposed surfaces of curb and gutter shall receive the type of finish as specified by the OWNER in accordance with [Item 702.5.13](#). Finishing Exposed Surfaces.

305.1.4. Measurement and Payment. Curb and gutter shall be measured by the linear foot in place complete.

The work performed and materials furnished as prescribed in this item, measured as provided in this item, shall be paid for at the contract unit prices bid for curb and gutter, which shall be full compensation for

preparing the subgrade; furnishing and placing all materials, including foundation course, reinforcing steel and expansion joint material; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

305.2. CONCRETE SIDEWALKS, DRIVEWAY APPROACHES, AND BARRIER FREE RAMPS

305.2.1. Description. This item shall govern the construction of barrier free access ramps, concrete sidewalks, driveways and approaches conforming to the lines, grades, locations and designs as indicated on the plans and specifications or as established by the OWNER.

305.2.2. Materials.

305.2.2.1. Concrete. All materials and requirements for concrete shall conform to the requirements of [Item 303](#). Portland Cement Concrete Pavement.

305.2.2.2. Reinforcement. Driveway approaches and walk reinforcing, when required, shall be No. 3 bars on 24-in. centers or No. 4 bars on 30-in. centers. No. 6 gauge, 6-in. x 6-in. wire fabric conforming to [Item 303.2.10](#). Steel Wire Reinforcement may be used only as approved by the OWNER. Sidewalk reinforcing (except in driveway approach) may be No. 3 bars on 24-in. centers or No. 10 gauge, 6-in. x 6-in.

305.2.3. Construction Methods.

305.2.3.1. General. Concrete sidewalks shall have a minimum thickness of 4-in., except that sidewalks constructed in driveway approach sections shall have a minimum thickness equal to that of driveway approach or as called for by plans and specifications within the limits of the driveway approach. Standard slope for walks shall be 1/4-in.-per-ft. in the direction of the curb or street with a tolerance of 1/8-in.-per-ft. The construction of the driveway approach shall include the variable height radius curb in accordance with the plans and details. The drive approach shall have a minimum thickness equal to the thickness of the adjacent street or 6-in., whichever is greater.

Ramps shall comply with provisions of Texas Accessibility Standards including location, slope, width, shapes, texture and coloring.

At the locations shown on the plans or at locations designated by the OWNER, the separate curb, integral curb or curb and gutter shall be laid down to a uniform width of not less than the specified height of the curb from the back of the curb line for access to future driveways. The return radii and partial curb return shall be built from the face of the curb to the back of the curb lay-down.

Where a driveway approach or ramp is to be constructed at a location where there exists a separate curb and gutter, said curb and gutter shall be removed for the full width of the gutter to the nearest joint or to a sawed point at the point of radius. On concrete pavement with monolithic curb, the breakout line shall be 12-in. from the face of the curb line and shall be parallel to it and form a right angle with the concrete surface. The breakout line shall be a sawed groove in accordance with the requirements of [Item 402.3](#). Sawing. Alternately, the OWNER may approve use of equipment designed to cut concrete curbs. All faces and edges exposed as a result of cutting shall be smoothed.

305.2.3.2. Excavation. Excavation required for the construction of sidewalks and driveways shall be to the lines and grades as established by the OWNER or as shown on the plans.

305.2.3.3. Fine Grading. The CONTRACTOR shall do all necessary filling, leveling and fine grading required to bring the subgrade to the exact grades specified and compacted to at least 90-percent of maximum density as determined by ASTM D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³). Moisture content shall be within minus-2- to plus-4-of-optimum. Any over-excavation shall be repaired to the satisfaction of the OWNER.

305.2.3.4. Forms. Forms shall be of wood or metal, of a section satisfactory to the OWNER, straight, free from warp and of a depth equal to the thickness of the finished work. Forms shall be securely staked to line and grade and maintained in a true position during the depositing of concrete.

305.2.3.5. Reinforcement. Steel bar reinforcement, when required, shall be placed according to the methods in [Item 303.2.9](#). Steel Reinforcement. If wire fabric is permitted, it shall be placed in accordance with [Item 303.2.10](#). Steel Wire Reinforcement.

305.2.3.6. Concrete Placement. Concrete placement shall be in accordance with the relevant provisions of [Item 303](#). Portland Cement Concrete Pavement.

305.2.3.7. Finishing. Concrete sidewalks and driveway approaches shall be finished to a true, even surface. They shall be troweled and then brushed transversely to obtain a smooth uniform brush finish. Joint and sides shall be edged with suitable tools.

305.2.3.8. Joints. Expansion joints for sidewalks and driveways shall be formed using expansion joint material of an approved type and shaped to the section. Expansion joints shall be placed in the sidewalk at 40-ft. intervals or as otherwise specified by the OWNER. Expansion joints shall also be placed at all intersections, sidewalks with concrete driveways, curbs, formations, other sidewalks and other adjacent old concrete work. Similar material shall be placed around all obstructions protruding into or through sidewalks or driveways. All expansion joints shall be ½-in. in thickness. Edges of all construction and expansion joints and outer edges of all sidewalks shall be finished to approximately a ½-in. radius with a suitable finishing tool. Sidewalks shall be marked at intervals equal to the width of the walk with a marking tool. When sidewalk is against the curb, expansion joints and tooled grooves shall match those in the curb.

305.2.3.9. Curing. Sidewalks and driveways shall be cured in accordance with the requirements of [Item 303](#). Portland Cement Concrete Pavement.

305.2.4. Measurement and Payment. Measurement for sidewalks, driveway approaches and ramps complete and in place shall be by the square-yard. Measurement of driveway approaches shall start at the back of the laydown curb line and shall include the area of the curb radii. Curbs on driveways shall not be measured separately but shall be included as a part of the driveway concrete. Concrete sidewalks and driveways shall be paid for at the contract unit price bid, which price shall be full compensation for excavating and preparing the subgrade; furnishing and placing all materials, including gravel base and expansion joint materials; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

305.3. CONCRETE MEDIANS

305.3.1. Description. This item shall consist of concrete medians in accordance with these specifications and in conformance with the lines and grades established by the OWNER and details shown on the plans.

305.3.2. Materials. All material requirements for constructing concrete medians shall conform to the requirements of [Item 303](#). Portland Cement Concrete Pavement. Where a monolithic concrete median is indicated, concrete and reinforcement shall match the adjacent pavement.

305.3.3. Construction Methods.

305.3.3.1. Excavation. Excavation and fine grading shall be done according to [Item 203.2](#). Unclassified Excavation, and shall be subsidiary to the item.

305.3.3.2. Forms. Forms, where required, shall conform to the requirements of [Item 303](#). Portland Cement Concrete Pavement and shall be of a depth equal to the depth of the required section. Forms shall be securely staked to line and grade and maintained in a true position during the depositing of concrete.

305.3.3.3. Concrete Placement. Concrete placement shall be in accordance with the relevant provisions of [Item 305.1](#). Concrete Curb and Gutter.

305.3.3.4. Finishing. The surface shall be finished with a float and lightly brushed to obtain a uniform finish. Tooled joints shall be placed longitudinally and transversely at intervals not to exceed 6-ft. center to center, as shown on the plans, or as directed by the OWNER. Joints in the median shall coincide with joints in curb and gutter. Expansion joint material shall be placed between the median and the back of curb and around all obstructions protruding through the concrete median.

305.3.4. Measurement and Payment. Concrete median shall be measured by the square-yard complete in place.

The work performed and materials furnished as prescribed by this item, measured as provided for in this item, shall be paid for at the contract unit price bid for "concrete median," which price shall be full compensation for constructing concrete median and for preparing the subgrade; furnishing and placing all

materials, including sand cushion, reinforcement and expansion materials; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

305.4. REINFORCED CONCRETE HEADERS

This item shall govern the construction of reinforced concrete header to the size, shape and at the location shown on the plans.

Material requirements shall be the same as those for [Item 303](#). Portland Cement Concrete Pavement.

Concrete header shall be constructed at the location(s) shown on the plans and shall be constructed as shown on the plans in accordance with [Item 303](#). Portland Cement Concrete Pavement.

Concrete header shall be paid by the linear-foot complete in place.

The work performed and materials furnished as prescribed by this item, measured as provided for in this item, shall be paid for at the contract unit price bid for concrete header. This payment shall be full compensation for necessary excavation, reinforcing steel, furnishing and placing concrete, and for all labor, tools, equipment and incidentals necessary to complete the work.

ITEM 402. PAVEMENT CUT, EXCAVATION, AND REPAIR

402.1. GENERAL REQUIREMENTS

Also refer to Standard Drawings 3070A – 3070D for more information.

402.1.1. Marking All pavement cut repairs shall be marked with the CONTRACTOR'S name if required by the OWNER.

402.1.2. Thoroughfares. No interference with traffic flow on the thoroughfares shall be permitted during the hours of 6:30 a.m. to 9:30 a.m. and 3:30 p.m. to 6:30 p.m., Monday through Friday, unless directed otherwise by the OWNER. Emergency closures during these hours shall be with the approval of the OWNER. Notice of street closures should be provided to the appropriate emergency and/or other department personnel.

Streets shall be maintained in accordance with [Item 201.3](#), Maintenance of Streets and Rights of Way During Construction. When work is stopped for the day, all lanes of arterial or collector streets shall be opened to traffic in accordance with the traffic control plan. A traffic lane shall be considered satisfactorily open if it is paved with hot-mix or cold-mix asphalt paving, or paved with another suitable material approved by the OWNER, or covered.

If the cut is to be covered, the CONTRACTOR shall use steel plates of sufficient strength and thickness to support all the traffic. A transition of hot-mix or cold-mix asphalt conforming to the requirements of [Item 302](#), Asphalt Pavement shall be constructed from the top of the steel plate to the existing pavement to create a smooth riding surface.

Exceptions to these specifications must be approved by the OWNER.

402.2. MINIMUM SIZE OF REPAIR

The following dimensions are minimums and may be superseded by site-specific factors or OWNER requirements. Exact pavement removal locations must be approved by the OWNER prior to construction.

If multiple repairs are closer than 10-ft. apart from edge of one repair to the edge of a second repair, a continuous section shall be replaced.

402.2.1. Sidewalk, Driveway, and Curb and Gutter. Sidewalks shall be removed and replaced to the nearest existing joint.

No sidewalk or driveway section to be replaced shall be smaller than 30-in. in either length or width unless otherwise approved by the OWNER.

A gutter of at least 12-in. may remain, provided that the curb and gutter is not damaged by the construction activity. Damaged curbs shall be replaced at the expense of the CONTRACTOR.

402.2.2. Dimension Parallels the Centerline (Along the Street/Alley). In a concrete paved street or alley, no horizontal dimension of any cut along the street path shall be less than 3-ft. or no less than 1-ft. from the edge of the trench on each end, whichever is greater. In an asphalt paved street or alley, no horizontal dimension of any cut along the street path shall be less than 4-ft. or no less than 2-ft. from the edge of the trench on each end, whichever is greater. Where saw-cut locations coincide with or fall within 3-ft. of the present location of either dummy joints, cold joint, construction joints, expansion joints, or edge, removal shall be to the existing joint or edge. See Standard Drawings 3070C and 3070D.

402.2.3. Dimension Perpendicular to the Centerline (Across the Street) – Multiple Lanes. See Standard Drawing 3070D.

402.2.3.1. Concrete. If the trench edge or point repair is located greater than 1-ft. from a lane line on the side of the line closest to the curb, pavement shall be removed and replaced from the curb to the lane line. If the edge of a trench or point repair is located less than 1-ft. from a lane line on the side of the line closest to the curb, pavement shall be removed and replaced from the curb to the 2nd lane line beyond the trench edge or point repair.

402.2.3.2. Asphalt. If the edge of a trench or point repair is located less than or equal to ½-lane-width but greater than 2-ft. from a lane line, the lane-width of pavement shall be removed and replaced. If the edge of a trench or point repair is located less than 2-ft. from a lane line, the pavement shall be removed and replaced to ½-lane-width on each side. In the lane along the curb, if the trench edge or

point repair plus 2-ft. toward the lane line is less than $\frac{1}{2}$ -lane-width, pavement shall be removed and replaced from the curb to $\frac{1}{2}$ -lane-width.

402.2.4. Dimension Perpendicular to the Centerline (Across the Street/Alley) – Residential Street or Alley. See Standard Drawing 3070C.

402.2.4.1. Concrete. In any concrete residential street or alley, if the trench edge or point repair is less than 1-ft. from the street or alley centerline, pavement shall be removed and replaced on each side from the trench edge or point repair to a distance 10-ft. from curb, and a minimum of 1-ft. from the trench edge or point repair. If the 1-ft. minimum causes the repair to be closer than 10-ft. from a curb, replace to the curb.

In a concrete residential street or alley less than 30-ft. wide, if the trench edge or point repair is between 1-ft. and 5-ft. from the street or alley centerline, the pavement shall be removed and replaced from the curb to the centerline.

In a concrete residential street or alley 30-ft. wide or greater, if the trench edge or point repair is greater than 5-ft. from the centerline, the pavement shall be removed and replaced from the curb to a distance 10-ft. from the curb. If the trench edge or point repair is more than 1-ft. but less than 5-ft. from the centerline, pavement shall be removed and replaced from the centerline to a distance 10-ft. from the curb.

402.2.4.2. Asphalt. In any asphalt residential street or alley, if the trench edge or point repair is less than 2-ft. from the street or alley centerline, pavement shall be removed and replaced on each side from the trench edge or point repair to a distance 10-ft. from curb, and a minimum of 2-ft. from the trench edge or point repair. If the 2-ft. minimum causes the repair to be closer than 10-ft. from a curb, replace to the curb.

In an asphalt residential street or alley less than 30-ft. wide, if the trench edge or point repair is between 2-ft. and 5-ft. from the street or alley centerline, the pavement shall be removed and replaced from the curb to the centerline.

In a concrete residential street or alley 30-ft. wide or greater, if the trench edge or point repair is greater than 5-ft. from the centerline, the pavement shall be removed and replaced from the curb to a distance 10-ft. from the curb. If the trench edge or point repair is more than 2-ft. but less than 5-ft. from the centerline, pavement shall be removed and replaced from the centerline to a distance 10-ft. from the curb.

402.3. SAWING

402.3.1. Description. This item shall apply in the removal of bituminous or concrete pavement, curb, gutter, sidewalk or driveways. This item shall also govern for the sawing of weakened plane joints (contraction joints). Sawing shall be in accordance with the requirements of this item unless otherwise shown on the plans or in the special provisions.

The removal and replacement of portions of permanent pavement (Portland cement concrete or hot-mix asphalt), drives, slabs, sidewalks, etc. shall require a full-depth of pavement cut to be sawed by the use of an approved power-driven concrete saw in accordance with this specification or as directed by the OWNER.

402.3.2. Equipment. The saw shall be power driven, shall be manufactured especially for the purpose of sawing pavement, shall be suitable for the work to be performed including dust control and shall be maintained in good operating condition.

Saw blades shall make a clean, smooth cut, producing a groove $\frac{1}{8}$ -in. to $\frac{1}{4}$ -in. wide and to the full depth required by these specifications or as shown on the plans.

The saw, with its control devices, shall be mounted on a sturdy frame supported on rubber-tired wheels.

402.3.3. Construction Methods. Dust and residues from sawing shall be prevented from entering the atmosphere or storm drain.

The edge of pavements, curb, gutter, sidewalk and/or driveways shall be neatly sawed. Saw cuts shall be made perpendicularly to the surface to full pavement depth or as directed by the OWNER. The edges of pavement and appurtenances damaged subsequent to sawing shall again be saw cut to neat straight lines for the purpose of removing the damaged areas. Such saw cuts shall be parallel to the original saw cut.

Concrete sidewalk or driveway to be removed shall be neatly sawed in straight lines either parallel to the curb or at right angles to the alignment of the sidewalk.

402.3.4. Measurement and Payment. Sawing shall be considered subsidiary to the items requiring sawing if no pay item exists in the Contract.

If a pay item exists in the contract for "Saw Cuts," it shall be measured and paid in linear feet of groove actually cut in accordance with the specifications and as directed by the OWNER.

402.4. REPLACING PAVED SURFACES

402.4.1. General. Repairs are to be made as rapidly as possible. Use of fast setting concrete and similar techniques are encouraged. Completion of the job, including replacement of pavement and cleanup, shall normally be accomplished within 10-working-days after the repair work involving the cut is made.

Removal of unsatisfactory work shall begin within 15-days and replacement shall be completed within 30-days of written notification by the OWNER.

The existing pavement shall be sawed in accordance with [Item 402.3](#). Sawing.

The OWNER shall approve embedment specified in accordance with [Item 504.5](#). Embedment, or the embedment standards of the utility owner. The OWNER shall approve embedment compaction. Final backfill shall meet the requirements of [Item 504.2.3.4](#). Flowable or Stabilized Backfill or [Item 504.2.3.3](#). Type "B" Backfill, as determined by the OWNER. Type "B" Backfill shall be compacted to 95% Standard Proctor density.

Parkways shall be treated in accordance with [Item 204](#). Landscaping, including a minimum of 6-in. topsoil and protection and replacement of plants in areas disturbed by construction.

402.4.2. Temporary Pavement Repair. In the event it is necessary to place a temporary surface on any cut opening, it shall be composed of permanent type paving material, specifically excluding gravel or flexible base as the surface material, unless approved by the OWNER. Temporary surfaces shall be adequately compacted and sealed to prevent degradation of the repair during the temporary period. Any temporary surface that fails to provide a nondegraded riding surface shall be removed and replaced at the CONTRACTOR'S expense.

402.4.3. Replacing Curb, Gutter, Sidewalks, Driveways, Etc. Curb, curb with gutter, sidewalks, drives, etc. shall be replaced with Class A or Class PA concrete (Class determined by the OWNER), unless specified otherwise by the OWNER. Replacement shall meet current OWNER standards.

402.4.3.1. Measurement for Replacement of Curb, Gutter, Sidewalks, Driveways, Etc. Removed curb, curb with gutter, sidewalks, drives, etc. shall be measured for payment in square-yard or linear feet as specified in the bid item. The removal or replacement of curbs, curbs and gutters, sidewalks, driveways, etc. in excess of that specified or approved by the OWNER shall be at the expense of the CONTRACTOR.

402.4.4. Replacing Reinforced Concrete Pavement. Pavement shall be removed to a line 12-in. back of the firm banks of the trench or, if within 3-ft. of an existing joint, to the joint. The concrete replacement shall be reinforced with like-size bars as the existing pavement, #4 minimum, drilled 12-in. deep and epoxied in place, spaced on a minimum of 24-in. centers each way.

The concrete shall be Class P2 or Class PP2 (as determined by the OWNER), unless another class is specified by the OWNER. The replacement concrete shall match the thickness of the existing concrete pavement, minimum of 6-in. thick or the minimum thickness of current OWNER standard for the street type.

The new concrete pavement shall be protected from vehicular traffic for a minimum of 7 days or until a minimum flexural strength of 500-psi is obtained or until a compressive strength of 3000-psi is obtained.

402.4.4.1. Measurement of Reinforced Concrete Pavement. Replacement of the reinforced concrete pavement shall be measured at the specified trench width plus 2-ft., thickness in inches, and length in linear feet. Additional reinforced concrete pavement ordered by the OWNER to be placed will be measured as the thickness in inches, and length and width in linear feet.

402.4.5. Replacing Concrete Pavement and Asphalt Overlay. The existing pavement shall be removed to a neat line at least 12-in. back of the firm banks of the trench or, if within 3-ft. of an existing joint, to the joint.

The concrete replacement shall be reinforced with like-size bars as the existing pavement, #4 minimum, drilled 12-in. deep and epoxied in place, spaced on a minimum of 24-in. centers each way.

The asphalt surface course shall be hot-mix asphalt pavement of the type and class indicated on the plans meeting the requirements of [Item 302](#), Asphalt Pavement. Thickness shall match existing pavement or meet the minimum thickness of current OWNER standard for the street type. The joint formed at the interface of the existing pavement and the repair shall be sealed with a material approved by the OWNER.

402.4.5.1. Measurement of Concrete Pavement and Asphalt Overlay. Replacement of the reinforced concrete pavement shall be measured at the specified trench width plus 2-ft., thickness in inches, and length in linear feet. Additional reinforced concrete pavement ordered by the OWNER to be placed will be measured as the thickness in inches, and length and width in linear feet.

Hot-mix asphalt pavement shall be measured at the specified trench width plus 2-ft., thickness in inches, and the length measured in linear feet. Additional asphalt pavement ordered by the OWNER to be placed will be measured as the thickness in inches, and length and width in linear feet.

If paid for, crack sealer shall be measured as indicated on the plans.

402.4.6. Replacing Full Depth Hot-Mix Asphalt Pavement. Unless otherwise specified by the OWNER, the existing hot-mix asphalt shall be cut back to produce a vertical edge for the full depth of the paving. The cut shall extend 24-in. back of the firm banks of the trench.

All courses of hot-mix asphalt pavement shall be of the types and classes as indicated on the plans. Thickness of each course shall match existing courses or meet the minimum thickness of each course of current OWNER standard for the street type. The joint formed at the interface of the existing pavement and the repair shall be sealed with a material approved by the OWNER.

402.4.6.1. Measurement for full depth Hot-Mix Asphalt Pavement. Hot-mix asphalt pavement shall be measured at the specified trench width plus 4-ft., thickness in inches, and the length measured in linear feet. Additional asphalt pavement ordered by the OWNER to be placed will be measured as the thickness in inches, and length and width in linear feet.

If paid for, crack sealer shall be measured as indicated on the plans.

402.4.7. Replacing Hot-Mix Asphalt Pavement on a Flexible Base. Unless otherwise specified by the OWNER, the existing hot-mix asphalt shall be sawed 24-in. back from the firm banks of the trench. The cut shall be replaced with a compacted flexible base, as specified in [Item 301.5](#), Flexible Subbase or Base (Crushed Stone/Concrete), to match the existing thickness of the base, 6-in. minimum.

All courses of hot-mix asphalt pavement shall be of the types and classes as indicated on the plans.

402.4.7.1. Measurement for Hot-Mix Asphalt Pavement on a Flexible Base. Hot-mix asphalt pavement shall be 2-in. thick, specified ditch width plus 4-ft., and the length measured in linear feet. The flexible base shall be measured at the specified trench width only, 6-in. thick or the depth of the existing flexible base, and the length measured in linear feet.

402.4.8. Replacing One- or Two-Course Surface Treatment or Penetration Type Pavement. The pavement shall be replaced as specified by the OWNER in accordance with [Item 404](#), Surface Treatments.

402.4.9. Replacing Gravel Pavement on a Dirt Base. The existing gravel pavement shall be replaced with compacted flexible base, as specified in [Item 301.5](#), Flexible Subbase or Base (Crushed Stone/Concrete). The minimum thickness of flexible base shall be 8-in. unless otherwise specified by the OWNER.

402.4.9.1. Measurement. The flexible base shall be measured at specific trench width only, 8-in. thick, and the length measured in linear feet.

402.4.10. Payment for Pavement Replacement. If paid for by the OWNER, replacement curb, curb with gutter, sidewalks, drives, etc. shall be paid at the contract unit price per square-yard or linear feet as specified in the bid item, complete in place.

If paid for by the OWNER, replacement of pavement(s) and base(s) shall be paid at the contract unit price per square-yard of respective thickness, complete in place.

If paid for by the OWNER, replacement of one- or two-course surface treatment or penetration type pavement surface shall be paid in accordance with [Item 404](#). Surface Treatments.

The contract unit price shall be total compensation for furnishing and placing all materials, including excavation, compaction, rolling and finishing, for disposal of all surplus material, and for all labor, tools, equipment and incidentals necessary to complete the work, all in accordance with the plans and specifications.

ITEM 403. ASPHALTIC PAVEMENT REPAIR

403.1. DESCRIPTION

Asphaltic Pavement Repair shall be used only for patching utility cuts, potholes and temporary pavement repairs.

403.2. MATERIALS AND MIXING

403.2.1. Performance Guaranty. The supplier of the material shall guarantee the performance of the patching mix to meet the following requirements:

- (1) The material shall remain workable, in an uncovered stockpile, if applicable, for a period of not less than 12-months.
- (2) Containerized material, if applicable, shall have a shelf life and remain workable for a period of not less than 12-months.
- (3) Repaired potholes shall not show any significant signs of shoving, rutting, tracking, kick-up, or ravel-out within a period of 12-months from the time of repair.

403.2.2. Rejection. In the event a material furnished does not meet all of the specified requirements (regardless of weather, test's acceptability, methods of repair, or other conditions), the material shall be removed and replaced at no cost to the OWNER.

The OWNER shall determine the quantity of unacceptable material and the CONTRACTOR shall be required to deliver an equal quantity of acceptable material. The material shall be delivered to the location(s) designated by the OWNER within 14-days from the date of written notification from the OWNER.

In the event that the material CONTRACTOR cannot provide acceptable material, the OWNER shall determine the quantity of the unacceptable material and the CONTRACTOR shall reimburse the OWNER based on the unit bid price. The reimbursement shall be submitted to the OWNER in the form of a cashier's check or other form of payment as approved by the OWNER within 28-days from the date of written notification from OWNER.

403.2.3. Hot-Mix, Cold-Laid Asphaltic Concrete (Cold Mix). Hot-Mix, Cold-Laid Asphaltic Concrete shall consist of surface mix.

403.2.3.1. Asphaltic Mixture. The asphaltic material shall form from 4% to 7.5% of the mixture by weight. Asphalt for the mixture shall be a bituminous material in accordance with [Item 302.3.](#) Bituminous Materials as determined by the mix manufacturer and OWNER. The grade of asphalt to be used shall be determined by the OWNER after design tests have been made using the mineral aggregate approved for use in the construction. The CONTRACTOR shall notify the OWNER of asphaltic material source prior to production of the asphaltic mixture, and this source shall not be changed during the course of the project except by written permission of the OWNER.

403.2.3.2. Tack Coat. The liquid asphalt material used for tack coat should be MS-2 or SS-1 in [Item 302.3.4.](#) Emulsified Asphalt, Restorative Seal in [Item 302.3.6.](#) Specialty Emulsions or one of the other various grades of materials (selected by the OWNER) listed under [Item 302.3.4.](#) Emulsified Asphalt.

403.2.3.3. Primer. When approved by the OWNER, the use of an asphaltic primer will be permitted. When used, the primer shall be added as directed by the OWNER during the mixing.

403.2.3.4. Mineral Aggregate. The material shall be crushed and screened as necessary to meet the requirements hereinafter specified and shall consist of durable coarse aggregate particles mixed with approved binding materials.

Unless otherwise specified, the grading of mineral aggregate shall conform to the limitations as shown in Table 403.2.3.4.(a) Aggregate Grading for Cold Mix Asphalt Repair.

Table 403.2.3.4.(a) Aggregate Grading for Cold Mix Asphalt Repair

Sieve	% Aggregate by Weight
Passing 3/8-in. sieve	100%
Passing 1/4-in. sieve	80 to 100%
Passing 1/4-in. sieve, retained on No. 10 sieve	27 to 58%
Total retained on No. 10 sieve	42 to 58%
Passing No. 10 sieve, retained on No. 40 sieve	6 to 32%
Passing No. 40 sieve, retained on No. 80 sieve	4 to 32%
Passing No. 80 sieve, retained on No. 200 sieve	3 to 32%
Passing No. 200 sieve	1 to 8%

403.2.3.5. Water. Water in an amount not to exceed 3% by weight of the mixture may be used in preparing the mixture. In the event water is used in the mixing operation, adequate measuring devices as approved by the OWNER shall be used, and the water shall be administered to the mix through an approved spray bar.

When used, the water shall be added as directed by the OWNER during the mixing.

403.2.3.6. Mixture Preparation. The materials may be mixed on the job or at a central mixing plant and shipped ready for use. Mixtures that do not remain workable a sufficient period of time to permit unloading by normal means, proper spreading, blading and rolling shall not be acceptable.

403.2.3.6.1. Mixing Plants. Mixing plants may be either the weight-batching type plant, the continuous mixing type plant, or the drum mixing type plant as described in [Item 302.9.5](#). Mixing Plants.

403.2.3.6.2. Equipment. Equipment for storage, weighing and heating of materials shall be as described in [Item 302.9.4](#). Equipment.

403.2.4. High Performance Cold Mix Asphaltic Concrete. This specification shall govern for asphaltic concrete mixture intended primarily as a cool to cold wet-weather, high-performance, pothole-patching mix for maintenance. It is primarily crushed stone, asphaltic concrete with asphalt additives.

When shown on the plans or requisition, the mixture shall be provided in airtight, resealable plastic buckets of 4- to 5-gal. capacities.

403.2.4.1. Mixture Performance Criteria. The patching mix shall not require the use of a tack coat or a primer for adherence to the patch area. The mix shall be capable of being placed in air temperatures from -15°F to 100°F and shall maintain adhesive qualities in areas that are damp or wet at the time of application. The repaired areas shall remain flexible and cohesive to an air temperature of -15°F and shall have the capability of immediately being opened to traffic with no kick-up or ravel-out.

403.2.4.2. Mixture Properties. The mixture shall comply with the following requirements.

403.2.4.2.1. Aggregate. Aggregate shall have a maximum particle size of 1/2-in.

403.2.4.2.2. Resistance to Water Damage. Tests shall be conducted according to TxDOT methods. The as-received mix shall be evaluated for resistance to water damage by soaking a 3.5-oz. representative sample of the total mixture in 7-fluid-ounces of distilled or deionized water at 140 ± 2°F for 24 ± 2 hours. The soaking test shall be accomplished in a glass beaker of approximately 14-fluid-ounces. Upon completion of the 24-hour period, the mixture shall be evaluated while submerged in the testing water. The material shall show no visible evidence of stripping.

403.3. METHODS

If OWNER requires base, subbase, and/or subgrade repair by a separate method than the asphaltic patch, the base, subbase, and/or subgrade shall be repaired as specified by the OWNER. Otherwise, repair of the base, subbase, and/or subgrade may be accomplished using the asphaltic patch material when it is specifically designed to do so.

CONTRACTOR shall use all repair material(s) as instructed by its respective manufacturers.

403.4. MEASUREMENT AND PAYMENT

Repair of base, subbase, and/or subgrade if by a separate method than the asphaltic patch shall be measured as specified by the OWNER. Asphaltic patches shall be measured per each, which repair shall include all materials, work, equipment and incidentals necessary to accomplish patching as instructed by the manufacturers.

Payment for Asphaltic Pavement Repair, measured as provided for, shall be paid for at the unit price bid.

ITEM 404. SURFACE TREATMENTS

404.1. DESCRIPTION

This Item provides specifications for the construction and quality control required for the proper application of pavement surface treatments.

404.2. GENERAL

404.2.1. Environmental Conditions. Surface treatments shall not be applied when the air temperature is below 60°F and is falling but may be applied when the air temperature is above 50°F and is rising, the air temperature being taken in the shade and away from artificial heat. If the air temperature does not meet these criteria, the OWNER shall evaluate the asphaltic material for applicability. Surface treatments shall not be applied when the temperature of the surface to which the surface treatment is to be applied is below 60°F. When latex modified asphalt cement is specified, surface treatments shall not be applied when the air temperature is below 80°F and is falling, but may be applied when the air temperature is above 70°F and is rising and shall not be applied when the temperature of the surface on which the surface treatment is to be applied is below 70°F. Asphaltic material shall not be placed when, in the opinion of the OWNER, general weather conditions are not suitable.

Slurry seal or micro-surfacing shall only be applied between March 1st and December 1st. Neither treatment shall be applied under any of the following conditions:

- (1) In the period following precipitation with water remaining on the surface to be coated
- (2) In foggy conditions
- (3) If there is a threat of rain before the treatment can fully cure
- (4) If there is danger that the finished product will freeze within 24-hours of application
- (5) If weather conditions could delay opening to traffic beyond the time specified by the OWNER.

404.2.2. Storage and Stockpiling. Precautions shall be taken to insure aggregate does not become contaminated with over-sized rock, clay, silt or excessive amounts of moisture during storage. The stockpile shall be kept in areas that have good drainage. Segregation of aggregates proposed for use and as supplied to the mixing plant shall be avoided.

The CONTRACTOR shall be required to provide a suitable storage facility for all equipment and materials needed to perform the work. This site should be located as close as possible to the area of work being done to reduce turnaround time and insure an acceptable rate of work. The OWNER shall subject any site selected to final approval.

Temporary stockpiling of aggregates on the roadways shall be permitted, provided the stockpiles are spaced not less than 1,000-ft. apart and are so placed that they neither obstruct traffic nor interfere with roadway drainage. The CONTRACTOR shall be responsible for the proper preparation of all stockpile material necessary for protection of the aggregate and to prevent any contamination thereof.

404.3. SLURRY SEALS AND MICRO- (RE) SURFACING

The surface treatment shall consist of a mixture of an approved emulsified asphalt, mineral aggregate, mineral filler, water, and specified additives, proportioned, mixed and uniformly spread over a properly prepared surface. The completed slurry seal shall leave a homogenous mat, adhere firmly to the prepared surface and have a skid resistant surface texture.

404.3.1. Laboratory Evaluation. Before work commences, the CONTRACTOR shall submit a signed original of a mix design containing the test results and proportioning of the specific materials to be used on the project. A qualified laboratory must have performed this design. Previous lab reports covering the exact materials to be used may be accepted provided they were made during the calendar year. This initial mix design shall be done at the CONTRACTOR'S expense. Upon receipt of the original mix design, an independent qualified laboratory selected by the OWNER shall perform tests using the same materials as used in the initial mix design for verification of the results. This testing shall be done at the OWNER'S expense. No work shall begin until all materials and/or mix design proportions have met the specifications as required. Once the materials are approved, no substitution shall be permitted unless first tested and approved by the methods stated above.

404.3.2. Materials.

404.3.2.1. Mineral Filler. Mineral filler shall be a recognized brand of non-air-entrained Type I or II Portland that meets the requirements of ASTM D242 Mineral Filler For Bituminous Paving Mixtures, if required by the mix design. 0.5% to 2% by dry weight of aggregate shall be the range of mineral filler in the mix design. The mineral filler shall be considered as part of the dry aggregate.

404.3.2.2. Water. All water shall be potable and compatible with the slurry mix. The CONTRACTOR must insure compatibility. The percent of water in the mix design shall be as required to produce proper mix consistency.

404.3.2.3. Additives. The mix design laboratory as part of the mix design shall approve any additive used to accelerate or retard the break-set of the surface treatment materials. The amount and type of additive (if needed) shall be shown on the mix design and approved by the OWNER.

404.3.2.4. Aggregate. The mineral aggregate shall consist of natural or manufactured crushed stone such as granite, slag, limestone or other high quality aggregates or a combination thereof that conforms to the quality requirement of ASTM D1073 Fine Aggregate for Bituminous Paving Mixtures, and shall be free of dirt, organic matter, clay balls, adherent films of clay, dust or other objectionable material. If the OWNER accepts aggregate that is not free of dirt, organic matter, clay balls, adherent films of clay, or dust, the OWNER shall have the option to evaluate and accept or reject chemical modifiers of the asphaltic material. The aggregate shall contain no free water. Smooth textured sands of less than 1.25-percent water absorption shall not exceed 50-percent (by weight) of the total aggregate blend. For heavy-duty surface requirements, 100% crushed material is required.

The aggregate shall meet the gradations as shown in the Table 404.3.2.4.(a) Slurry Seal Aggregate Requirements or Table 404.3.2.4.(b) Micro-Surface Aggregate Requirements, as appropriate, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieves or vice versa. The gradation type to be used shall be as designated by the OWNER.

Table 404.3.2.4.(a) Slurry Seal Aggregate Requirements

Sieve Size	Percent Passing
3/8-in.	100
No. 4	70-90
No. 8	45-70
No. 16	28-50
No. 30	19-34
No. 50	12-25
No. 100	7-8
No. 200	5-15

Table 404.3.2.4.(b) Micro-Surface Aggregate Requirements

Sieve Size	Percent Passing
3/8-in.	99-100
No. 4	86-94
No. 8	45-65
No. 16	25-46
No. 30	15-35
No. 50	10-25
No. 100	7-18
No. 200	5-15

404.3.2.5. Emulsified Asphalt. The asphalt emulsion shall be homogeneous and show no separation after mixing.

404.3.2.5.1. Slurry Seal. As directed by the OWNER, one of the following two grades of emulsion shall be selected. Grade CQS-1h (Quick Set) shall be specified on streets where the amount of time the street can be closed is restricted.

Grade SS-1h: Conforming to the requirements specified in ASTM D977 for Emulsified Asphalt.

Grade CQS-1h: Conforming to the requirements specified in ASTM D2397 for Cationic Emulsions (Quick Set).

Any emulsion used for slurry will be with 4% polymer modifier content based on bitumen weight, certified by the emulsion supplier, which shall be milled into the emulsion or blended into the asphalt prior to the emulsification process. It shall pass all applicable storage and settlement tests. The cement-mixing test shall be waived.

404.3.2.5.2. Micro-Surface. Emulsified asphalt for micro-surfacing shall be a quick-set polymer modified cationic type CSS-1h emulsion and conform to the requirements specified in AASHTO M208 and ASTM D2397 Cationic Emulsified Asphalt. It shall pass all applicable storage and settlement tests. A minimum of 3% polymer modifier content based on bitumen weight content, certified by the emulsion supplier, along with special quick-setting emulsifier agents, shall be milled into the asphalt emulsion. The cement mixing test shall be waived. The emulsified asphalt shall be so formulated that when the paving moisture is applied with the relative humidity at no more than 50% and ambient air temperature of at least 75°F, it will cure sufficiently such that rolling traffic can be allowed in one-hour with no damage to the surface.

404.3.2.6. Mixture Tests. Mixtures shall meet the requirements in Table 404.3.2.6.(a) Slurry Seal Mixture Requirements or Table 404.3.2.6.(b) Micro-Surface Mixture Requirements, as appropriate when tested by the given methods.

Table 404.3.2.6.(a) Slurry Seal Mixture Requirements

Characteristic	Test Method	Value
Consistency test	ASTM D3910 Standard Practices for Design, Testing, and Construction of Slurry Seal	2- to 3-cm Flow
Set time	ASTM D3910 (same as above)	12-hours maximum
Cure time	ASTM D3910 (same as above)	24-hours maximum
Wet stripping test	ISSA TB114	80%-coating minimum
Wet track abrasion test	ASTM D3910 (same as above)	75-g/ft ² maximum

Table 404.3.2.6.(b) Micro-Surface Mixture Requirements

Characteristic	Test Method	Value
Set time	ASTM D6372 Standard Practice for Design, Testing, and Construction of Micro-Surfacing	12-hours maximum
Cure time	ASTM D6372 (same as above)	24-hours maximum
Wet stripping test	ISSA TB114	80%-coating minimum
Wet track abrasion test	ASTM D6372 (same as above)	75-g/ft ² maximum
Marshall stability Flow units	ASTM D5581 Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen)	1800-lbs. minimum 6- to 16-units
Hveem stability, exceeding a height twice the maximum aggregate size	ASTM D1560 Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus	35 minimum
Set Time 30-minute Blotter test Displacement test Water resistance test @ 30-Minutes	ISSA TB102	No Brown Stain No Displacement No Discoloration

404.3.3. Equipment. All methods and equipment employed in performing the work shall be subject to the approval of the OWNER before work is started and whenever found unsatisfactory they shall be changed and improved as required. All equipment must be maintained in a satisfactory condition.

The CONTRACTOR will provide suitable crack and pavement cleaning equipment, hand tools and any support equipment as necessary to perform the work.

404.3.3.1. Calibration. Each piece of equipment to be used shall be calibrated in the presence of the OWNER prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted provided they were made during the calendar year. No machine will be allowed to work on the project until the calibration has been completed and/or accepted.

404.3.3.2. Verification. Test strips shall be laid (location to be determined by the OWNER) before construction begins. The OWNER will observe the test strip for verification or rejection according to the specifications. Upon failure of any test, additional test strips will be laid at no cost to the OWNER. The square-yards of the first test strip will be measured and paid for at the contract unit price.

A field test shall be made to check consistency of the surface treatment. If a line made through the surface treatment fills up, the mixture is too wet, which the CONTRACTOR shall correct. If the line stays, the slurry has a proper consistency.

404.3.3.3. Mixing Equipment.

404.3.3.3.1. Slurry Seal. The slurry seal mixing equipment shall be continuous flow mixing unit as to give a uniform and complete circulation of the batch in the mixer, so as not to segregate the aggregates, but will provide a thorough and uniform free flowing mix with the asphalt and water. The units shall be equipped with a water pressure system and nozzle type spray bar adequate for completely fogging the surface with 0.05- to 0.15-gallons-per-square-yard immediately ahead of the spreader box.

Application rate of aggregate, based on dry weight of aggregate, shall be 15- to 21-lbs-per-square-yard complete in place.

The residual asphalt content, based on % weight of dry aggregate, shall be 8% to 12%.

404.3.3.3.2. Micro-Surface Mixing Equipment. The material shall be mixed by a self-propelled micro-surfacing mixing machine which shall be a continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler and water to a revolving multi-blade mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler and water to maintain an adequate supply to the proportioning controls. The machine shall be equipped with self-loading devices which provide for the loading of all materials while continuing to lay micro-surfacing, thereby minimizing construction joints.

Individual volume or weight controls for proportioning each material to be added to the mix shall be provided. Each material control device shall be calibrated and properly marked.

The mixing machine shall be equipped with a water pressure system and nozzle type spray bar to provide a water spray immediately ahead of and outside the spreader box with 0.05- to 0.15-gallons-per-square-yard.

The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time. The mixing machine shall be equipped with an approved fines feeder that shall provide a uniform accurately metered, predetermined amount of the specified mineral filler. Application rate of aggregate, based on dry weight of aggregate, shall be 22- to 28-lbs-per-square-yard complete in place.

The emulsion pump shall be a positive displacement type and shall be equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time. The residual asphalt content, based on % weight of dry aggregate, shall be 6% to 11.5%.

404.3.3.4. Spreading Equipment.

404.3.3.4.1. Slurry Seal. The spreader box shall be equipped to prevent loss of slurry seal from all sides and with a flexible rear strike-off capable of being adjusted. It shall have suitable means for side tracking to compensate for deviations in pavement geometry. The box shall be kept free of built-up asphalt and aggregate. The strike-off drag shall be kept completely flexible at all times.

404.3.3.4.2. Micro-Surface. The surface mixture shall be spread uniformly by means of a mechanical type spreader box attached to the mixer, equipped with paddles to agitate and spread the materials throughout the box. A front seal shall be provided to insure no loss of the mixture at the road contact point. The rear seal shall act as final strike off and shall be adjustable. The mixture shall be spread to fill cracks and minor surface irregularities and leave a uniform skid resistant application of material on the pavement. The longitudinal joint where two passes join shall be neat appearing, uniform and lapped. All excess material shall be removed from the job site prior to opening the road. The spreader box shall have suitable means provided to side shift the box to compensate for variations in pavement geometry.

404.3.4. Preparation. Any breakdowns, base failures, or other defects shall be properly repaired by the OWNER before application of the surface treatment. No work shall commence on any location until approval by the OWNER.

Immediately prior to applying the surface treatment, CONTRACTOR shall thoroughly clean the pavement of all loose materials, vegetation, soil and objectionable material. The CONTRACTOR shall cover manholes, valve boxes, raised pavement markers and other designated objects to insure their integrity. All pavement cleaning and covering of appurtenances shall be subject to the final approval and acceptance of the OWNER.

If required, the CONTRACTOR shall apply a tack coat or a second coverage of treatment on brick, concrete, or other highly absorbent or polished pavements. If a tack coat is required, a 1-part emulsion, 3-part water tack coat of the same asphalt emulsion type and grade as specified for the surface treatment is required. Rate of application of tack coat material shall be 0.05- to 0.10-gallons-per-square-yard. All debris and unused material shall be removed.

404.3.5. Surface Treatment Application. Surface treatments shall be placed on the location and within the time limit as specified by the OWNER.

404.3.5.1. Fogging. If conditions require, the pavement shall be pre-wetted by fogging ahead of the slurry/spreader box. Water used in fogging the surface shall be applied so that the entire surface is damp with no flowing water in front of the box. Rate of spray shall be 0.05- to 0.15-gallons-per-square-yard or as directed by the OWNER. No streaks, lumps, balls or unmixed aggregated shall be permitted.

404.3.5.2. Mix Stability. The mix shall be sufficiently stable during the spreading period so that the emulsion does not break, there is no segregation of the fines from the coarser aggregate and the liquid of the mix does not float to the surface.

404.3.5.3. Lines and Joints. Straight lines along curb gutters and shoulder will be required. No runoff on these areas will be permitted. Lines at intersections must be kept straight to provide a good appearance. Surface treatment shall be placed at the lip of the gutter or at a distance from the face of the curb as directed by the OWNER.

No excessive buildup or unsightly appearance shall be permitted on longitudinal or transverse joint. An excessive overlap will not be permitted on longitudinal joints. The CONTRACTOR shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the project. Longitudinal joints shall be placed on lane lines when possible. If half passes are used, they shall not be the last passes on any paved area.

404.3.5.4. Rolling. If required, specified areas shall be rolled by a self-propelled 10-ton pneumatic roller with tire pressure of 50-psi and equipped with a water spray system. The slurried pavement shall be subjected to a minimum of 5 full coverages by the roller. Rolling should not commence until the slurry has cured enough so that it will not pick up on the tires. In areas of high traffic volume and subject to slow turning, e.g. major intersections, rolling may be feasible.

404.3.5.5. Hand Work. In areas where the spreader box cannot be used, hand squeegees to provide complete and uniform coverage shall apply the surface treatment. Any joint cracks not filled by the mix shall be corrected by use of hand squeegees. Handwork shall be completed during the machine applying process. Due to the difficulty in hand working micro-surfacing material because of the quick-set nature of the emulsion, hand work for micro-surface treatment shall be kept to a minimum.

404.3.5.6. Curing and Finishing. All traffic shall be kept off the treated area until it has cured to a firm condition that will prevent damage to the surface treatment. Any uncured areas damaged will be repaired satisfactory to the OWNER at the CONTRACTOR'S expense.

After completion of surface treatment placement, the CONTRACTOR shall remove covered objects (manhole covers, valve covers, raised traffic markers, etc.) so the object protected will remain fully functional. All objects not to have been covered shall be restored to original integrity. Any objects damaged by the CONTRACTOR'S work activities shall be repaired or replaced at no cost to the OWNER.

Any work directed by the OWNER to correct any appearance defect shall be subject to the final approval of the OWNER.

The CONTRACTOR shall remove all unused material and debris from the site prior to final acceptance.

404.3.6. Measurement and Payment. The treated area on each street shall be field measured and calculated in square-yards. Payment shall be approved if the amount of emulsion and aggregate fall within the specified application range per square-yard. Payment per square-yard shall be full compensation for grass removal, cleaning the existing pavement, all material (including mineral filler, water, modifiers and additives) labor, tools, equipment, maintenance of traffic and notification of adjacent property owners and incidentals necessary to complete the work.

404.4. BITUMINOUS SURFACE TREATMENT (CHIP SEAL)

404.4.1. Description. This item shall consist of a wearing surface composed of one, two or three applications of asphaltic materials, each covered with aggregate, constructed on the prepared base course or surface in accordance with the requirements as shown on the plans and these specifications.

404.4.2. Materials.

404.4.2.1. Asphaltic Materials. The asphaltic materials used shall be of the type and grade as specified by the owner and shall meet the requirements of [Item 302.3](#). Bituminous Materials.

WARNING TO CONTRACTOR: Attention is called to the fact that asphaltic materials are highly flammable. The utmost care shall be taken to prevent open flames from coming in contact with the asphaltic materials or the gases of same. The CONTRACTOR shall be responsible for any fires or accidents that may result from heating the asphaltic materials.

404.4.2.2. Aggregate. Aggregate shall be composed of dry, sound, durable particles of processed stone or steel slag having a percent of wear of not more than 35 when tested in accordance with ASTM C131 Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine. Crushed gravel shall not be allowed. The aggregate shall be free from organic matter, clay, loam, or coated pebbles and shall contain no more than five-percent of slate, shale, schist, or soft particles.

The aggregate used shall be of the type and grade or types and grades selected from those prescribed in [Item 301.5](#). Flexible Subbase or Base (Crushed Stone/Concrete). The particular type and grade or types and grades shall be as provided on the plans or as required by the OWNER.

Aggregate when tested by standard laboratory methods shall meet the grading requirements in Table 404.4.2.2.(a) Chip Seal Aggregate Gradations. Prior to shipping aggregate to the project, the CONTRACTOR shall furnish the OWNER with samples of the proposed aggregate.

Table 404.4.2.2.(a) Chip Seal Aggregate Gradations

Sieve Size	% Retained, by weight	Sieve Size	% Retained, by weight
FIRST APPLICATION			
Small Aggregate "SB"		Large Aggregate "LB"	
5/8-in.	0%	1-in.	0%
1/2-in.	0 - 10%	3/4-in.	15 - 45%
1/4-in.	70 - 100%	1/2-in.	85 - 100%
No. 10	95 - 100%	1/4-in.	98 - 100%
SECOND APPLICATION			
Small Aggregate "ST"		Large Aggregate "LT"	
3/8-in.	0%	3/4-in.	0%
1/4-in.	2 - 20%	1/2-in.	0 - 10%
No. 10	70 - 100%	1/4-in.	65 - 85%
No. 20	95 - 100%	No. 10	90 - 100%
		No. 20	98 - 100%

404.4.2.2.1. Precoated Aggregate. The grade of aggregate specified shall meet all other requirements of [Item 404.4.2.2](#). Aggregate prior to the application of precoat or fluxing material. Materials that are not uniformly and/or properly coated, in the opinion of the OWNER, shall not be accepted for use.

Precoated aggregate shall be aggregate of the type and grade specified, coated with 0.5- to 1.5-percent (by weight) of residual bitumen from a precoating material. When limestone rock asphalt is used, it shall be fluxed with 0.5- to 1.5-percent (by weight) of fluxing material. The materials may be mixed on the job or at a central mixing plant and shipped ready for use. Mixes that do not maintain flow qualities such that the precoated aggregate may be satisfactorily spread by approved mechanical spreading devices will not be acceptable.

Precoated aggregate will show no stripping when tested in accordance with TxDOT test method Tex-530-C Effect of Water on Bituminous Paving Mixtures. If antistripping additives are required to meet this requirement, they shall meet the requirements of TxDOT Item 301 Asphalt Antistripping Agents.

404.4.3. Construction Methods.

404.4.3.1. Equipment and Preparation. All storage tanks, piping, retorts, booster tanks, and distributors used in storing or handling asphalt shall be kept clean and in good operating condition at all times. They shall be operated in such a manner that there shall be no contamination of the asphalt with foreign material.

The area to be treated shall be cleaned of dirt, dust or other deleterious matter by sweeping or other approved methods. If it is found necessary by the OWNER, the surface shall be lightly sprinkled just prior to the application of the asphaltic material.

404.4.3.2. Application of Asphalt. The OWNER shall select the temperature of application based on the temperature-viscosity relationship that shall permit application of the asphalt with the limits recommended in [Item 302.5](#). Storage, Heating and Application Temperature of Bituminous Materials. The CONTRACTOR shall apply the asphalt at a temperature within 15°F of the temperature selected. It shall be the responsibility of the CONTRACTOR to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

Asphaltic material may be placed by preheating aggregate to 280°F when the air temperature is 70°F and falling or when the air temperature is 50°F and rising.

Asphaltic material of the type and grade shown on the plans shall be applied on the clean surface by an approved type of self-propelled pressure distributor so operated as to distribute the material in the quantity specified, evenly and smoothly, under a pressure necessary for proper distribution. The CONTRACTOR shall provide all necessary facilities for determining the temperature of the asphaltic materials in all of the heating equipment and in the distributor, for determining the rate at which they are

applied, and for securing uniformity at the junction of two distributor loads. The distributor shall have been recently calibrated and the OWNER shall be furnished an accurate and satisfactory record of such calibration. After beginning the work, should the yield on the asphaltic materials appear to be in error, the distributor shall be recalibrated in a manner satisfactory to the OWNER before proceeding with the work.

Asphaltic materials for each course may be applied for the full width of the surface treatment in one application, unless the width exceeds 26-ft. No traffic or hauling shall be permitted over the freshly applied asphaltic materials. Asphaltic materials shall not be applied until immediate covering with aggregate is assured.

404.4.3.3. Application of Aggregate. Aggregate, of the type and grade shown on the plans for the first course, shall be immediately and uniformly applied and spread by approved calibrated mechanical spreaders, operated on the rear of the aggregate trucks or as a separate power-driving unit. These spreader units shall be approved by the OWNER prior to the start of the work. The aggregate shall be applied at the approximate rates indicated on the plans, within the limits shown in Table 404.4.3.4.(a) Chip Seal Rates of Application, and as directed by the OWNER. The entire surface shall then be broomed, bladed or raked as required by the OWNER and shall be thoroughly rolled with both pneumatic tire and steel wheel (3- to 6-tons) rollers to insure proper embedding into the bitumen. The rolling shall be continued until no more aggregate can be worked into the surface. Rolling shall meet the governing specifications for [Item 301.1.2](#), Rolling of Embankment, Subgrade or Flexible Base.

404.4.3.4. Rates of Application. The asphalt and aggregates shall be applied at the approximate rates indicated on the plans within the following limits, as directed by the OWNER. The rates of application and the estimated quantities of aggregate are based on the usual or average gradation of known materials. Prior to shipping aggregate to the project, the CONTRACTOR shall furnish the OWNER with samples of the proposed aggregate so that the gradation may be determined and rate of application changed if necessary.

Table 404.4.3.4.(a) Chip Seal Rates of Application

Application	Asphalt gal/yd ²		Aggregate yd ³ per yd ²	
	Minimum	Maximum	Minimum	Maximum
SMALLER AGGREGATE				
First, Aggregate "SB"	0.20	0.30	1:100	1:75
Second, Aggregate "ST"	0.30	0.40	1:200	1:150
LARGER AGGREGATE				
First, Aggregate "LB"	0.25	0.35	1:75	1:50
Second, Aggregate "LT"	0.35	0.45	1:150	1:100

404.4.3.5. Multiple Courses. Where double or triple surface courses are specified on the plans, each succeeding course shall be constructed by the procedures as prescribed for the first course. The rates of asphaltic material and aggregate for multiple-course construction shall be as shown on the plans within the limits shown in Table 404.4.3.4.(a) Chip Seal Rates of Application or as directed by the OWNER.

404.4.3.6. Maintenance and Completion. The CONTRACTOR shall be responsible for the maintenance of the surface and distribution of the excess aggregate until final completion and acceptance of the entire project by the OWNER. All holes or failures in the surface shall be repaired per each course by use of additional asphalt and aggregate. All fat or bleeding surfaces shall be covered with approved cover material per each course in such a manner that the asphaltic material will not adhere to or be picked up by the wheels of vehicles.

404.4.4. Measurement and Payment. Bituminous surface treatments shall be measured by the square-yard of surface area of completed and accepted per bid item “One-, “Two-, or “Three-Course Surface Treatment.”

Rolling shall not be measured for payment but shall be considered as subsidiary to the Items of “Asphalt” and/or “Aggregate.” Work performed and materials furnished as prescribed by this item and measured as provided in this item shall be paid for at the unit price bid for “One-, “Two-, or “Three-Course Surface Treatment,” which price shall be full compensation for cleaning and sprinkling the surface to be treated; for furnishing, preparing, hauling and placing all materials; for all blading, brooming, rolling; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

ITEM 501. UNDERGROUND CONDUIT MATERIALS

501.1. GENERAL

All pipe and fittings shall be new.

The OWNER shall at all times have free access to the manufacturer's plant while production is in progress, and may at any time refuse to accept pipe made when the plant is failing to follow the stipulations of the specifications in regard to workmanship, or failing in provisions to insure a uniform product coming within the permissible variations of the specifications. The OWNER may reject pipe if adequate means and methods are not provided so as to insure the manufacture of a product of uniform high quality.

Pipe shall be color coded according to the American Public Works Association Uniform Color Code (i.e. blue for water, green for wastewater or storm drain lines, violet for reclaimed water, etc.) or labeled with labeling tape identifying its specific use. Where feasible, permanent identification of the piping service shall be provided by co-extruding color stripes into the pipe outside surface. The striping shall be of the same material except for the color. For co-extruded markings, IPS sized pipe shall have four equally spaced, longitudinal color stripes and DIPS sized pipe shall have three equally spaced pairs of longitudinal color stripes. The color or marking shall be visible on top of buried pipe when pipe is excavated.

Pipe shall be acceptable by the Underwriters' Laboratories, Inc. or Factory Mutual Research when specifically requested and shall be acceptable by the State Fire Insurance Commission for use in water distribution systems when used for fire protection without penalty. Potable water pipe shall also bear the seal of approval (or "NSF" mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe.

Installation shall be performed in accordance with relevant portions of Division 500 Underground Conduit Construction and Appurtenances.

501.1.1. Rejection. Pipe, joints, fittings, or coatings may be rejected for failure to meet any of the requirements of this specification or for any manufacturing, transportation and/or handling defects that may cause pipe, joints, fittings or coatings to be unsuitable for intended use(s). When approved by the OWNER, materials may be re-tested to establish conformity. All rejected materials shall be plainly marked by the Engineer and shall be replaced by the CONTRACTOR with materials which meets the requirements of these specifications. Such rejected materials shall be removed immediately from the site of the work.

501.1.2. Damaged Pipe. Pipe that is damaged during installation will be repaired only by a method approved by the OWNER. If, in the opinion of the OWNER, a satisfactory repair cannot be made by the method(s) suggested by the CONTRACTOR or pipe manufacturer, the damaged pipe shall be removed and replaced with sound pipe that meets the specifications of the contract. Repairs or replacement will be at no cost to the OWNER including costs associated with removing and replacing non-damaged pipe for the purpose of removing damaged pipe.

501.2. CLAY WASTEWATER PIPE.

501.2.1. General. Clay wastewater pipe shall conform to ASTM C700 Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated, having compression joints and bell and spigot ends or compression couplings for plain-end pipe.

501.2.2. Class. Extra strength vitrified clay wastewater pipe shall be used unless otherwise designated.

501.2.3. Fittings. Fittings shall be of the same test strength as the pipe as ordered or shown on plans.

501.2.4. Joints. Factory-fabricated compression joints and joints for fittings shall meet the requirements of ASTM C425 Compression Joints for Vitrified Clay Pipe and Fittings.

501.2.5. Pipe Tests. Tests of the pipe shall be made in accordance with ASTM C301 Test Methods for Vitrified Clay Pipe.

501.3. VITRIFIED CLAY PIPE USED IN TRENCHLESS APPLICATIONS

501.3.1. General. Clay pipe used for microtunneling, sliplining, pipe bursting, and tunnels shall conform to ASTM C1208 (C1208M) Vitrified Clay Pipe and Joints for Use in Microtunneling, Sliplining, Pipe Bursting, and Tunnels. The pipe shall have a minimum compressive strength of 7000-psi.

501.3.2. Pipe Joints. The pipe joint collar shall be manufactured of Series 316 stainless steel or better and compression discs are required to distribute the jacking forces.

501.3.3. Pipe Tests. Tests of the pipe shall be made in accordance with ASTM C1208 (C1208M).

501.4. CONCRETE PRESSURE PIPE AND FITTINGS

501.4.1. General. These specifications cover the manufacture of concrete pressure pipe designed for internal pressures from a minimum of 20-psi to a maximum of 350-psi. Products shall conform to relevant standards as noted in Table 501.4.1.(a) Standards for Concrete Pressure Pipe and Fittings.

Table 501.4.1.(a) Standards for Concrete Pressure Pipe and Fittings

Item Reference No.	AWWA Standard	Description
501.4.5	C301	Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
	C304	Design of Prestressed Concrete Cylinder Pipe
501.4.6	C303	Bar-Wrapped Concrete Cylinder Pipe

Items 501.4.2. through 501.4.4., inclusive, shall apply to each type of pipe in [Item 501.4](#) Concrete Pressure Pipe and Fittings. Concrete Pressure Pipe and Fittings shall be provided in accordance with ANSI/AWWA C301. In accordance with C301, Section III.A – Purchaser Options and Alternatives, the purchasers are advised that, while the standard presents information on materials and procedures for manufacture of the pipe, it may not contain all of the engineering information needed to prepare a complete specification for a particular pipeline installation. A specific pipeline installation may require provisions more restrictive than those in the standard and will likely require additional design and installation details.

Reference to AWWA Manual M9 - Concrete Pressure Pipe, should be considered as a supplement to the use of the C301 standard, and information in the manual should not be regarded as superseding any portion of the C301 standard. Purchaser options and alternatives shall be provided by the specifier, including working pressure, surge pressure, field-test pressure, external loading conditions, method of bedding and backfilling, manner of storage and delivery (if required by the manufacturer), tabulated layout schedules, and detailed shop drawings and schedules submitted to the OWNER for review. Purchaser options and alternatives shall be specified in the supplemental conditions, plans, or technical specifications.

The type of pipe to be supplied shall be as shown on the plan and/or in the special provisions for each project.

The manufacturer shall submit a successful experience record in the design and construction of the type of concrete pressure pipe involved. Each type of pipe shall have the complete approval of the Underwriters' Laboratories, Inc., for the manufacture of the pipe specified and diameters required. Pipe shall have NSF61 standard approval for potable water applications.

Upon award of the Contract, the CONTRACTOR shall furnish OWNER with shop drawings showing the pipe and fittings to be furnished and shall include a tabulated layout schedule with reference to the stationing of the contract drawings with plan and profile drawings. Such drawings shall be subject to the approval of the OWNER and fabrication of pipe and fittings shall not be commenced until such drawings have been approved by the OWNER. Such approval by the OWNER shall not relieve the CONTRACTOR of any responsibility of providing pipe and/or fittings in accordance with the OWNER's plans and specifications.

No cracks will be permitted in the mortar lining of the pipe, except for minor hairline cracks. Pipe with cracks through the mortar wall or damaged bells, spigots or joint grooves shall not be accepted without manufacturer-approved repair. Cracks in the vicinity of the spigot of the pipe and those cracks in the vicinity of the circumferential wrappers and outlets shall not be allowed. Cracks up to 0.010-in in the lining of the pipe are acceptable if they are not excessive in length (should be less than 2 ft.).

All cracks to the mortar coating shall be repaired according to the manufacturer's specification prior to installation.

501.4.2. Fittings and Specials. The manufacturer shall furnish all fittings and special pieces required for closures, bends, branches, manholes, air valves, blow offs and connections to mainline valves and other fittings shown on the contract drawings or as set out in the specifications conforming with AWWA C301,

AWWA C303, or AWWA C304 as applicable. All openings in the pipe for fittings, manholes, taps, blow offs, etc. shall have the interior and exterior surfaces of the steel lined and coated with mortar. The lining thickness shall be a minimum of 0.5-inches for sizes 16-in. and smaller, and 0.75-in. minimum lining thickness for sizes larger than 16-in. The minimum coating thickness shall be 1-in. The type of fittings and details covering the design of fittings and specials shall be furnished by the manufacturer and subject to the approval of the OWNER. The fittings and specials shall comply in all respects with the requirements of AWWA with modifications as herein set forth.

501.4.3. Flanged Outlets. Flanged outlets shall be insulated at all points where external valves, pipe, fittings, etc., are connected to the line. The CONTRACTOR shall furnish an insulating flange kit, flange gaskets, insulating sleeves, and two plastic washers for each bolt approved by the OWNER. Bolts, nuts, and washers for flanged outlet connections shall be carbon steel.

501.4.4. Tests. All pipe shall be tested in accordance with applicable specifications and AWWA Standards. In addition to certification of all applicable tests required by governing AWWA Standards, the following tests or certifications of tests may be required.

501.4.4.1. Steel Cylinder Pipe. The manufacturer shall submit for approval the specified details of materials and methods of welding it proposes to use before any welding is done.

The manufacturer shall furnish one specimen for tensile tests of welds from each 3,000-ft. of pipe. If tests indicate the welding is unsatisfactory, additional samples as required shall be furnished. Two test cylinders out of each day's pour of the concrete used, or as required by the OWNER, shall be furnished for testing by an independent laboratory. The cost of such a test shall be borne by the OWNER. Certified test reports made by the manufacturer shall be acceptable in lieu of the test cylinders, provided such test certificates show that they cover pours from which the purchased pipe is made.

Mill test reports on each heat from which steel cylinders and reinforcing are rolled shall be furnished by the OWNER, if required.

Test certificates showing the physical properties of the compound used in the gaskets shall be furnished by the OWNER, if required.

501.4.4.2. Three-Edge Bearing Test. The manufacturer of concrete cylinder pipe supplied in accordance with the provisions of [Item 501.4](#). Concrete Pressure Pipe and Fittings shall have demonstrated, or shall demonstrate as may be required, that the pipe when tested in a three-edge bearing test as described in ASTM C497 (C497M) Concrete Pipe, Sections or Tile under a load equivalent to the design ditch load shall not deflect more than 0.1-percent. At the above specified load, there shall be no continuous cracks wider than 0.002-in. for a length of 12-in.

501.4.5. Prestressed Concrete Cylinder Pipe, AWWA C301.

501.4.5.1. General. The pipe shall comply in all respects with the requirements of AWWA C301 Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids. The pipe may be of two types of prestressed concrete steel cylinder pipe as specified on the plans and/or specifications or special conditions:

- (1) the lined cylinder type with a core composed of a steel cylinder lined with concrete and subsequently wire-wrapped directly on the steel cylinder and coated with the mortar.
- (2) the embedded cylinder type with a core composed of a steel cylinder encased in concrete and subsequently wire-wrapped on the exterior concrete surface and coated with concrete or mortar.

501.4.5.2. Design Pressures and Stresses. Design pressure shall be that shown on plans and/or specifications. The size of the high-tensile wire and the spacing and tension under which it is wound shall be such that the conditions required by AWWA C304 Design of Prestressed Concrete Cylinder Pipe are met.

501.4.6. Bar-Wrapped Concrete Cylinder Pipe, AWWA C303.

501.4.6.1. General. The pipe shall consist of a welded sheet-steel or plate-steel cylinder, manufactured by the spiral or straight seam method with joint rings attached, inside of which a cement mortar lining is centrifugally spun; a mild steel bar spirally wrapped under measured tension on the steel cylinder and protective cement mortar coating applied to the outside of the cylinder and spirally-wrapped rod.

The manufacturer shall furnish pipe in uniform lengths except lengths ordered as specials.

The pipe shall comply in all respects with the requirements of AWWA C303, with the following addition.

501.4.6.2. Design Pressures and Stresses. Design pressure shall be that shown on the plans and/or specifications. Steel cylinder and bar reinforcement shall be designed in accordance with AWWA Manual M9, Concrete Pressure Pipe.

501.5. REINFORCED CONCRETE WASTEWATER PIPE WITH RUBBER GASKET JOINTS

501.5.1. General. Except as applicable to [Item 501.5.2](#), Alternate Concrete Pipe D-Load Design, reinforced concrete pipe manufactured under these specifications shall conform to ASTM C76 (C76M) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; or ASTM C655 (C655M) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe, and by a plant certified by the American Concrete Pipe Association, Texas Department of Transportation, or other recognized authority, with the following additions:

- (1) All pipe shall be machine made by a process which shall provide for uniform placement of zero slump concrete in the form and compaction by mechanical devices which shall assure a dense concrete in the finished product.
- (2) Aggregates for the concrete shall comply with requirements ASTM C33 Concrete Aggregates, with the additional requirement that the aggregate shall have a minimum of 50-percent of calcium carbonate equivalent.
- (3) Pipe furnished under this specification shall be steam cured in accordance with methods prescribed in ASTM C76 (C76M) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe except that the steam curing time shall be not less than eight-continuous-hours.
- (4) The pipe and connecting joints shall be subject to the hydrostatic tests set forth in ASTM C443 (C443M) Joints for Concrete Pipe and Manholes, Using Rubber Gaskets, both for pipes in straight alignment and for pipes in maximum deflected position without leakage either in the pipe or in the joints.

501.5.2. Alternate Concrete Pipe D-Load Design. When bedding is specified in accordance with [Item 504.5.2.16](#), Alternate Embedment for Concrete Pipe, reinforced concrete pipe shall conform to ASTM C1417 (C1417M) Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design. This specification covers the manufacture and acceptance of precast concrete pipe designed to conform to the OWNER's design requirements and to ASCE 15-93, ASTM C655 (C655M) Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe, or an equivalent design specification. Conditions 501.5.1. (1) through (4) apply to pipe provided under this specification and appropriate corrosion protection shall be furnished for pipe used in wastewater applications.

501.5.3. Steel Reinforcement. All steel reinforcement shall be in accordance with ASTM C76 (C76M) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe and shall be circular in shape. No elliptical reinforcement shall be permitted. Where Class III pipe of sizes larger than 30-in. in diameter are specified, the manufacturer may, at its option, furnish pipe manufactured with either Wall "B" or Wall "C" minimum thicknesses, and the applicable minimum steel area as listed for circular cages in Table II of ASTM C76 may be substituted, at the manufacturer's option, for those listed in Table III of ASTM C76, provided test strength requirements for Class III pipe are satisfactorily met.

Where Class IV or V pipe is specified, the steel as called for in the wall as designated shall be furnished. Quadrant reinforcement shall be acceptable. As an alternate the pipe may be designed as detailed in ASTM C655 (C655M) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe. Proof of design must be submitted.

501.5.4. Joints. Connecting joints shall be made using a flexible watertight rubber-type compression gasket. The rubber gasket shall be the sole element of the joint depended upon to provide water tightness.

501.5.4.1. Rubber Gaskets. All rubber-type gaskets shall be of the round profile design. The rubber gasket shall be required to meet and be tested in accordance with ASTM C443 (C443M) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

501.5.4.2. Deflection. The joint design shall provide for the deflection of a pipe unit by opening one side of the outside perimeter of the joint ½-inch wider than the full "home" position without reducing its

water tightness. Where greater deflections are required that provided by the joint design, beveled joints or elbows shall be provided.

501.5.4.3. Joint Approval. A detailed design of the joint or joints, including design and durometer hardness of the rubber gasket proposed to be furnished under this specification, shall be approved by the OWNER prior to installation. The design shall also include minimum and maximum interior joint opening in the assembled position in straight alignment and the maximum interior joint opening in the maximum deflected position. Joint dimensions (waste bell and spigot) should be addressed in shop drawings.

501.5.5. Fittings and Specials. Component parts for all specials such as bends, wyes, tees, etc. shall be manufactured on machines and in the same manner as straight joint concrete wastewater pipe under these specifications, except that joint lengths may be shorter than minimum listed.

501.5.6. Coatings and Linings. Coatings and liners called for in the specifications or as indicated on the plans shall meet the requirements of [Item 502.9](#), Corrosion-Resistant Coatings and Liners for Wastewater Conduit and Appurtenances and shall be installed or applied by the pipe manufacturer.

501.5.7. Repairs. Repairs shall be permitted as set out in ASTM C76 and/or ASTM C655 except field repairs shall be permitted only with prior approval of the OWNER. Repairs to pipe and shall be done in strict conformity with all applicable specifications, instructions and recommendations of the manufacturer to ensure material warranty. If, in the opinion of the OWNER, repairs should not be made, the section of pipe shall be rejected and removed from the construction site and not repaired or returned to any of the OWNER'S projects. Rejected pipe shall be marked in a manner mutually agreed upon by the OWNER and the pipe manufacturer.

Field repairs on damage to the gasket bearing area shall not be allowed without prior approval of the OWNER.

501.5.8. Markings. Each length of pipe shall bear the initials or name of the person, company or corporation by whom it was manufactured; date of manufacture; and the class of pipe. The markings shall be indented or stenciled on the exterior or interior of the barrel near the bell and shall be plainly legible for purpose of identification.

501.5.9. Tests. The pipe shall be required to meet and be tested in accordance with ASTM C76 (C76M) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, or ASTM C655 (C655M) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe, as applicable.

The connecting joints shall be subject to the hydrostatic tests set forth in ASTM C443 (C443M) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

The rubber gasket shall be required to meet and be tested in accordance with ASTM C443 (C443M).

501.5.10. Rejection. The pipe may be rejected for having defects or failure to meet the requirements as follows:

- (1) variations in any dimension exceeding the permissible variations prescribed,
- (2) a piece broken out of the bell or spigot or tongue or groove end of such size that the water tightness of the joint should be impaired,
- (3) a shattering or flaking of concrete or other conditions indicating an improper concrete mix,
- (4) lack of uniformity in placement of steel which might preclude all joints being typical of those tested,
- (5) cracks sufficient to impair the strength, durability or serviceability of the pipe,
- (6) failure to conform with any of the specifications herein set forth or referenced,
- (7) the complete absence of distinct web-like markings, which may be indicative of a deficiency of water in the concrete mix, from the external surface of the pipe made by any process in which the forms are removed immediately after the concrete has been placed, unless specimens submitted for test that do not have such web-like markings shall have passed the physical tests required by these specifications,
- (8) failure of pipe to go completely "home" due to binding of spigot against bell or tongue against groove,
- (9) failure to pass any of the tests in [Item 501.5.9](#), Tests,
- (10) joint sections with spalls, cracks, fractures, or other imperfections that could adversely affect the performance of the joint,
- (11) failure to meet the requirements for coatings and linings.

501.6. REINFORCED CONCRETE CULVERT, STORM DRAIN, PIPE AND BOX SECTION

This item shall govern reinforced concrete culvert, storm drain, pipe and precast reinforced concrete box sections. Pipe shall be cured in accordance with the applicable ASTM Designations for each type of pipe as referred to below.

501.6.1. Reinforced Concrete Culvert, Storm Drain, and Pipe.

501.6.1.1. General. Except as applicable to [Item 501.6.1.1.1](#), Alternate Concrete Pipe D-Load Design, circular reinforced concrete pipe shall conform to ASTM C76 (C76M) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; arch pipe shall conform to ASTM C506 Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe; elliptical pipe shall conform to ASTM C507 Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe, of the class as designed on the plans subject to the following modifications:

- (1) All pipe shall be machine-made by a process which shall provide for uniform placement of zero slump concrete in the form and compaction by mechanical devices which shall assure a dense concrete in the finished product.
- (2) Sizes larger than 60-in. diameter shall be manufactured using two lines of circular reinforcement.
- (3) Where Class III pipe of sizes larger than 60-in. diameter are specified, the manufacturer may at its option furnish pipe manufactured with either Wall "B" or Wall "C" minimum thicknesses and the applicable minimum steel area as listed for circular cages in Table II of ASTM C76 (C76M), provided tests strength requirements for Class III pipe are satisfactorily met.

501.6.1.1.1. Alternate Concrete Pipe D-Load Design. When bedding is specified in accordance with [Item 504.5.2.16](#), Alternate Embedment for Concrete Pipe, reinforced concrete pipe shall conform to ASTM C1417 (C1417M) Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design. This specification covers the manufacture and acceptance of precast concrete pipe designed to conform to the OWNER's design requirements and to ASCE 15-93, ASTM C655 (C655M) Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe, or an equivalent design specification. Conditions of [501.6.1.1](#), modifications (1) and (2) apply to pipe provided under this specification.

501.6.1.2. Sizes and Permissible Variations. Variations in diameter, size, shape, wall thickness, reinforcement, placement of reinforcement, laying length and the permissible underrun of length shall be in accordance with the applicable ASTM specification for each type of pipe as referred to previously.

Where rubber gasket pipe joints are to be used, the design of joints and permissible variations in dimensions shall be in accordance with ASTM C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets, Sections 5 and 6.

501.6.1.3. Joints. Pipe to be placed along curves shall consist of whatever pipe joint lengths or beveled end joints of pipe or combination thereof that are required to place the pipe on the designated centerline curve with no more than one-half of the tongue length of the pipe exposed from its normal fully closed joint position.

501.6.1.3.1. Flexible Joint Sealant. Unless otherwise specified on the plans or in the special provisions, pipe joints shall be sealed with one of the following types of gaskets; Flexible Joint Sealant manufactured in accordance with ASTM C990, Expanded Cellular Rubber Gaskets in accordance with ASTM D1056 Flexible Cellular Materials – Sponge or Expanded Rubber, Class 2C1, or Elastomeric Seals. Each joint shall require one continuous gasket conforming to the joint shape. Gasket cross-sectional diameters shall be in accordance with the manufacturer's recommendations.

Cold-Applied Preformed Plastic Gaskets. Plastic gasket 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.

Expanded Cellular Rubber Gaskets. Expanded Cellular Rubber Gaskets shall be produced from tubular cross sections of a blend of nitrile and vinyl polymers meeting the physical requirement of ASTM D1056, Flexible Cellular Materials – Sponge or Expanded Rubber, Class 2C1.

Elastomeric Seals for Joining Concrete Structures. Elastomeric seals shall be produced from natural or synthetic rubber meeting the requirements of ASTM C1619 Standard Specification for Elastomeric Seals for Joining Concrete Structures.

501.6.1.4. Workmanship and Finish. Pipe shall be substantially free from fractures, large or deep cracks and surface roughness. The ends of the pipe shall be normal to the walls and centerline of the pipe within the limits of variations allowed as stated previously.

501.6.1.5. Pipe Marking. Markings shall be indented on the pipe section or painted thereon with waterproof paint. The following information shall be clearly marked on each section of pipe:

- (1) the class of pipe,
- (2) the date of manufacture,
- (3) the name or trademark of the manufacturer,
- (4) where elliptical reinforcement is used, one end of each section or joint of pipe shall be clearly marked during the process of manufacture or immediately thereafter on the inside and the outside of opposite walls to show the location of the “top” or “bottom” of the pipe as it should be installed.

501.6.1.6. Tests. The acceptability of the pipe in all diameters, strengths and classes shall be determined by such material tests performed as required in ASTM C76 (C76M), C506 or C507; by the results of the three-edge bearing test for the load to produce a 0.01-in. crack and ultimate load and by absorption tests on selected samples from the wall of the pipe in accordance with ASTM C497 (C497M) Concrete Pipe, Manhole Sections, or Tile; and by inspection of the finished pipe to determine its conformance with the design prescribed in these specifications and its freedom from defects.

Testing rates shall be as follows, except that in no case fewer than two specimens shall be furnished:

- (1) If subjected to three-edge-bearing tests for the 0.01-in. crack only, testing shall be performed on 0.8-percent of the number of pipe sections of each size included in the order. Pipes that have been tested only to the formation of a 0.01-in. crack and that meet the 0.01-in. test load requirements shall be accepted for use.
- (2) If subjected to three-edge-bearing tests for both the 0.01-in. crack and the ultimate load, testing shall be performed on 0.2-percent of the number of pipe sections of each size included in the order.

As an alternate to the three-edge-bearing test, concrete pipe 60-in. in diameter and over may be accepted, at the option of the manufacturer, on the basis of material tests and inspection of the completed product. Acceptability of pipe on this basis shall be determined by the results of material tests as required in ASTM C76, C506 or C507; by crushing tests on cores taken from the barrel of the completed and cured pipe; by absorption tests on samples from the wall of the pipe; and by inspection of the finished pipe, including amount and placement of reinforcement, to determine its conformance with the design prescribed in these specifications and its freedom from defects.

The manufacturer shall furnish facilities and personnel for taking the cores from the pipe barrel and for determining the compressive strength of the samples. When the cores cut from a section of pipe successfully meet the strength requirement, the core-holes shall be plugged and sealed by the manufacturer in a manner such that the pipe section shall meet all of the test requirements of ASTM C76, C506 or C507. Pipe sections, so sealed, shall be accepted for use.

Tested pipe accepted for use shall be marked “TEST” or otherwise appropriately identified. Should any of the test specimens fail to meet the test requirements, two consecutive joints in the same mix series shall be tested and results shall be a basis of accepting or rejecting the pipe of the series.

501.6.1.7. Rejection of Pipe. All rejected pipe shall be plainly marked by the OWNER and shall be replaced by the CONTRACTOR with pipe that meets the requirements of these specifications. Such rejected pipe shall be removed immediately from the site of the work.

501.6.2. Precast Reinforcement Concrete Box.

501.6.2.1. General. Precast reinforced concrete box sections shall conform to ASTM C1433 (C1433M) Standard Specifications for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains and Sewers and ASTM C1577 Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO

LRFD. More information may be found in ASTM C877 Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.

501.6.2.2. Concrete. Boxes shall be machine-made or cast by process which will provide for uniform placement of concrete in forms and compaction by mechanical devices to produce dense, structurally sound concrete. Use concrete mixed in central batch plant or other batching facility from which quality and uniformity of concrete can be assured. Transit-mixed concrete is not acceptable. Representatives of the Engineer will inspect manufacturer's plant and casting operations as deemed necessary.

501.6.2.3. Joints. Joints shall conform to ASTM C990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants, Expanded Cellular Rubber Gaskets meeting the physical requirement of ASTM D1056, Flexible Cellular Materials - Sponge or Expanded Rubber, Class 2C1, ASTM C1677 Standard Specification for Joints for Concrete Box, Using Rubber Gaskets. For joints conforming to C1677, the elastomeric (gasket) material shall conform to ASTM C1619 Standard Specification for Elastomeric Seals for Joining Concrete Structures, Class C requirements. Gaskets which require oil resistant properties (e.g. Nitrile) shall meet Class D requirements. Gasket material for sealing tongue & groove joints shall be performed flexible butyl rubber meeting the requirements of ASTM C990 Section 6.2 Butyl Rubber Sealant, or Expanded Cellular Rubber Gaskets. Gasket width shall be in accordance with the joint material manufacturer's recommendations, and large enough to properly seal the entire perimeter of the tongue and groove joint.

501.6.2.4. Lifting Holes. For precast boxes, no more than 4 lifting holes shall be in each section. Lifting holes may be cast, cut into fresh concrete after form removal, or drilled. Lifting holes of sufficient size shall be used for adequate lifting based on the size and weight of the box section. Lifting holes larger than 3 inches in diameter are not acceptable. More than 1 longitudinal wire or 2 circumferential wires per layer of reinforcing steel may not be cut when locating lifting holes. Spalled areas around lifting holes shall be repaired when discovered.

501.6.2.5. Quality. Fine cracks on the surface of the member that do not extend to the plane of the nearest reinforcement are acceptable unless the crack are numerous and extensive.

501.6.2.6. Repairs. Cracks that extend into the plane of the reinforcement steel shall be repaired in an approved manor. Excessive damage, honeycombing, or cracking will be subject to structural review. The OWNER MAY accept box repairs that are sound, properly finished and cured in conformance with pertinent specifications.

501.7. DUCTILE-IRON PRESSURE PIPE AND FITTINGS

501.7.1. General. Ductile-iron pressure pipe 4-in. through 64-in. shall conform to the American National Standard for Ductile-Iron Pipe Centrifugally Cast for Water or Other Liquids, AWWA C151. In accordance with C151, Section III.A, purchaser options and alternatives shall be provided by the specifier, including pipe size, joint type, special joints, thickness or class, and laying length. Purchaser options and alternatives shall be specified in the supplemental conditions, plans, or technical specifications. Polyethylene encasement for ductile iron pipe systems shall conform to [Item 502.8](#). Polyethylene Wrap for Metal Pipe and Fittings. The CONTRACTOR shall protect the polyethylene wrap and prevent damage during embedment and backfill installation.

The ductile iron shall conform in all respects to the specifications set forth in ASTM Standard A377, Standard Index of Specifications for Ductile Iron Pressure Pipe. The specific grade of ductile iron used shall be Grade 60-42-10, with a Minimum Tensile Strength of 60,000 psi, a Minimum Yield Strength of 42,000 psi, and a Minimum Elongation in 2" of 10%.

501.7.2. Joints. All ductile-iron pressure pipe shall be furnished with one of the types of joints indicated in Table 501.7.2.(a) Ductile Iron Pressure Pipe Joint Types and as described in the proposal or bid request.

Bolts and nuts for mechanical joints or flanged ends (if used underground) shall be of a high-strength low-alloy corrosion-resistant steel and shall conform to ASTM F3125 (F3125M) High Strength Structural Bolts.

All threaded flanges shall be ductile iron.

Table 501.7.2.(a) Ductile Iron Pressure Pipe Joint Types

Type Joint	AWWA Standard
Push-on	AWWA C111 Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
Mechanical Joint	AWWA C111 (same as above)
Flanged Ends	AWWA C110 Ductile-Iron and Gray-Iron Fittings, 3 in.-48 in., for Water, or AWWA C115 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
Grooved Ends	AWWA C606 Grooved and Shouldered Joints

501.7.3. Coating and Lining. All ductile-iron pipe shall be bituminous coated outside and cement mortar lined inside. The cement mortar lining shall be seal coated in accordance with the latest revision of ANSI / AWWA C104 / A21.4 American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water. All ductile iron pipe shall require an exterior polywrap corrosion protection system as defined in the latest version of ANSI / AWWA C105 / A21.5 American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems. In the event of tears, pinches, breaches, or other damage to the initial external polywrap protection layer, the use of dual layer external polywrap protection meeting the above standards shall be required. If this specification conflicts with manufacturer's installation recommendations, follow manufacturer's recommendations for ductile iron pipe installation.

501.7.4. Fittings. Fittings shall be of ductile-iron and shall conform to AWWA C110 ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in. for Water, or conform to AWWA C153 ANSI Standard for Ductile-Iron Compact Fittings for Water Service, 3-in. through 64-in., unless otherwise specified in the proposal, special specification or in the plans.

Welded-on outlets may be used in lieu of the tees shown on the plans. Outlet pipe shall be special thickness class 53. All weldments must be 55% nickel iron and each outlet pipe shall be air tested to 15-psi to insure weld integrity. The outlet branches must be made from ductile iron pipe.

All fittings shall be rated for a minimum of 250-psi working pressure unless otherwise specified.

Special fittings using end condition combinations of bells, spigots, mechanical, integrally restrained or push-on joints, flanges, or special internally locked joints shall be dimensioned in accordance with AWWA C110 or C153.

Bolts and nuts for mechanical joints or flanged ends shall be of a high-strength, corrosion-resistant low-alloy steel and shall conform to ASTM A325 (Type 3) or shall be stainless steel in accordance with ASTM A304 Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements.

The OWNER shall determine whether fittings shall be bituminous coated outside and cement-mortar lined inside with seal coat in accordance with AWWA C104 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water or whether the interior and exterior surfaces shall be protected consistent with AWWA C116 Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.

501.7.5. Tests. All ductile-iron pipe and fittings shall be tested in accordance with the applicable provisions of the specifications relating thereto.

501.7.6. Markings. Class, weight, and casting period shall be shown on each pipe.

501.8. SECTION HELD FOR FUTURE USE

501.9. STEEL PIPE AND FITTINGS

501.9.1. General. Steel pipe, fittings and specials shall conform to the details as shown on the plans or included in the specifications and as specified below. Steel Pipe and Fittings shall be provided in accordance with AWWA C200. In accordance with C200, Section III.A, purchaser options and alternatives shall be provided by the specifier, including pipe size, joint type, special joints, thickness or class, and laying length. Purchaser options and alternatives shall be specified in the supplemental conditions, plans, or technical specifications.

501.9.2. Applicable Standard Specifications. Except as modified or supplemented herein, all steel pipe, fittings and specials shall conform to the applicable requirements of the standard specifications indicated in Table 501.9.2.(a) Standards for Steel Pipe and Fittings.

Table 501.9.2.(a) Standards for Steel Pipe and Fittings

Standard	Designation
AWWA C200	Steel Water Pipe—6 in. and Larger
AWWA C203	Coal Tar Protective Coatings and Linings for Steel Water Pipeline — Enamel and Tape — Hot Applied
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe — 4 in. and Larger — Shop Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 in.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipe
AWWA C210	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings
AWWA C602	Cement-Mortar Lining of Water Pipelines in Place—4 in. and Larger
AWWA C606	Grooved and Shouldered Joints
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A139	Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
NSF/ANSI 61	Drinking Water System Components

CONTRACTOR shall submit a written certification that the pipe has been manufactured and tested in accordance with the applicable standards. The pipe shall be manufactured, fabricated, coated and lined by a single manufacturer being a certified member in good standing of the Steel Plate Fabricators Association (SPFA).

501.9.3. Pipe and Fittings Requirements. Fabricated pipe and fittings shall be made of steel plate conforming to ASTM A283, Grade D, or ASTM A139, Grade B, C, or D in accordance with AWWA C200. Mill-type pipe and fittings shall be Grade B conforming to AWWA C200.

Nominal pipe diameter shall be as specified in the plans. Nominal diameters for steel pipe sizes under 24-in. are outside diameters and for sizes 24-in. and over are inside diameters per AWWA M11 Steel Pipe—A Guide for Design and Installation.

The pipe wall thickness shall be as specified in the plans.

Pipe sections shall be furnished in not less than 20 ft. lengths except for specials and closures sections as may be required.

501.9.4. Joints. Steel pipe and fittings shall be joined with any of the end types as specified below, unless a particular end type is specified. Flange ends shall be used only where specifically noted on drawings.

Welded joints shall conform to and be tested in accordance with AWWA C206.

Rubber gasketed joints may be used up to 72-in. in diameter and shall conform to, and be tested in accordance with AWWA C200.

Grooved and shouldered joints shall conform to, and be tested in accordance with AWWA C606.

Mechanically coupled joints shall consist of Dresser Couplings Style 38 or equal or as specified on the drawings.

Flanged joints shall conform to the AWWA C207, Class D. The thickness of flanges shall be as specified in Table 1 or 2 of AWWA C207, or as specified on the drawings.

501.9.5. Lining and Coating. Steel pipe and fittings shall be lined in accordance with any of the standards indicated in Table 501.9.5.(a) Lining and Coating for Steel Pipe and Fittings, unless a particular specification is shown on the plans.

The exterior surface of steel pipe and fittings to be installed underground shall be coated in accordance with AWWA C214. If coated in accordance with AWWA C214, then the fittings will be coated in accordance with AWWA C209. The exterior surface of steel pipe and fittings to be installed above ground shall be cleaned, primed and coated, all in accordance with either AWWA C222 or C210.

Table 501.9.5.(a) Lining and Coating for Steel Pipe and Fittings

Standard	Topic
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe — 4 In. and Larger — Shop Applied
AWWA C210	Liquid-Epoxy Coating Systems for Interior and Exterior of Steel Water Pipelines
AWWA C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings
AWWA C602	Cement-Mortar Lining of Water Pipeline — 4 In. and Larger — in Place

501.9.6. Testing. All steel pipe shall be hydrostatically tested to a pressure that will induce a stress of 75% of the minimum yield strength of the steel in accordance with AWWA C200. Fittings fabricated from hydrostatically tested pipe shall not require shop hydrostatic testing. Welds for fittings that were not previously hydrostatically tested shall require hydrostatic testing, air testing, or other ASTM nondestructive testing.

501.10. SEAMLESS COPPER TUBING

501.10.1. General. These specifications pertain only to Type K, annealed (soft) copper water tubing for use with solder, flared, or compression-type fittings. The copper tubing shall conform to ASTM B88 Seamless Copper Water Tube.

501.10.2. Quality. The vendor shall be responsible for submission of a laboratory analysis of the products supplied. The manufacturer's own laboratory analysis is acceptable. The certificate of analysis shall state size and type of analysis and results obtained. A statement shall be made and validated that tests confirm compliance with the requirements of this specification.

The OWNER reserves the right to conduct or cause to have conducted independent laboratory tests. Where the results of such tests prove the quality requirements have not been met: (1) the costs of tests shall be charged to the vendor's account, and (2) the entire shipment may be rejected on the basis of such tests.

501.11. CORRUGATED METAL PIPE OR PIPE ARCH SHAPES

501.11.1. General. This item shall govern the furnishing of corrugated metal pipe for culverts and storm water conduit for the locations and designations as shown on the plans and contract specifications as herein outlined.

Pipe having a design hydraulic head exceeding 5-ft. of water will have helical corrugations and the lock seam shall be either continuously welded or caulked with a neoprene or mastic seal during fabrication. Caulked helical pipe shall be fabricated by applying a uniform bead of neoprene or mastic compound to the lock seam in such a manner that the inner surfaces of the lock seam are free of voids.

Shell Data shall specify diameter, classification (Type), material, gage and corrugation. This information shall be designated on the plans and/or contract specifications.

501.11.2. Pipe Manufacture. Corrugated metal pipe or pipe arch shapes shall meet the requirements of ASTM A760 (A760M) Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains, ASTM B745 (B745M) Corrugated Aluminum Pipe for Sewers and Drains, or ASTM A742 (A742M) Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe. All pipe shall be manufactured with a minimum of two re-rolled ends

501.11.2.1. Steel Pipe. Galvanized or aluminized steel pipe shall be full circle or arch pipe conforming to AASHTO Designation M36, Type I, Type II or Type III as specified in the plans.

501.11.2.2. Aluminum Pipe. Aluminum pipe shall conform to the requirements of AASHTO Designation M196, Type I, Type II or Type III pipe arch as specified on the plans.

Aluminum pipe may be placed bare of any precoating, but any portions of aluminum pipe that are to be in contact with a metal other than aluminum or in contact with concrete containing chlorides, shall be insulated from this other metal or concrete by a coating of bituminous material or a plastic coating, such as asphalt mastic or polymeric coating. The coating applied to the aluminum pipe or pipe arch to provide an insulation between the aluminum and other metal shall extend a minimum distance of 1 ft. beyond the area of contact.

501.11.2.3. Precoated Galvanized or Aluminized Steel Pipe. Pipe shall be full circle or arch pipe conforming to AASHTO Designation M245, Type I, Type II or Type III as specified in the plans.

501.11.3. Classification (Type). Corrugated metal pipe shall be classified on the plans and/or specifications with the notations as set forth in ASTM A760 (A760M), ASTM B745 (B745M) and ASTM A742 (A742M) and indicated in Table 501.11.3.(a) Corrugated Metal Pipe Type.

Table 501.11.3.(a) Corrugated Metal Pipe Type

Type	Description
Type I	Pipe with a full circular cross section with a singular thickness of corrugated sheet, fabricated with annular or helical corrugations.
Type IA	Pipe with a full circular cross section, with an outer shell of corrugated sheet fabricated with helical corrugations and an inner liner of smooth (uncorrugated) sheet attached to the shell at helical lock seams. Unless otherwise shown on the plans or contract specifications, the inner liner of smooth (uncorrugated) sheets shall be 18-gage, polymer coated per ASTM A762 (A762M) Grade 10/10 or 20-gage, polymer coated per ASTM A762 (A762M) Grade 10/10.
Type IR	Pipe with a full circular cross section, with a single thickness of smooth sheet, fabricated with helical ribs projecting outward.
Type II	Type I pipe which has been reformed into a pipe-arch, having an approximately flat bottom.
Type IIA	Type IA pipe which has been reformed into a pipe-arch, having an approximately flat bottom.
Type IIR	Type IR pipe which has been reformed into a pipe-arch, having an approximately flat bottom.
Type III	Type I pipe which has been perforated to permit the inflow and outflow of water, intended for use as underdrains.
Type IIIA	Pipe shall consist of semi-circular cross section having a smooth bottom with a corrugated top shield which has been perforated, intended for use as deck drains.

501.11.4. Material. Corrugated metal pipe or pipe arch shapes shall be fabricated from corrugated sheets conforming to one of the styles indicated in Table 501.11.4.(a) Corrugated Sheets for Pipe or Pipe Arch Shapes.

Table 501.11.4.(a) Corrugated Sheets for Pipe or Pipe Arch Shapes

Metal		Standards
GALV	Galvanized Steel	ASTM A760 (A760M) Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ALT2	Aluminized Type 2 Steel	ASTM A760 (A760M) (same as above)
POLY	Polymeric Steel	ASTM A762 (A762M) Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains (Grade 10/10)
ALUM	Aluminum Alloy	ASTM B744 (B744M) Aluminum Alloy Sheet for Corrugated Aluminum Pipe

501.11.5. Gage. Where reference is made to gage of metal, the reference is to U.S. Standard Gage for uncoated sheets in ASTM A929 (A929M) Steel Sheet, Metallic-Coated by the Hot-Dip Process for

Corrugated Steel Pipe. Unless otherwise shown on the plans or contract specifications, minimum gages shall be as required by TxDOT *Standard Specifications for Construction of Highways, Streets and Bridges*, Item 460.4. Selection of Gages.

501.11.6. Corrugation. Corrugated configurations shall be governed by dimensional tolerances set forth in ASTM A760 (A760M). The corrugations as shown in Table 501.11.6.(a) Corrugation Configurations shall only be valid with their respective classifications (type).

Table 501.11.6.(a) Corrugation Configurations

Type	Configuration
Type 1	2 $\frac{2}{3}$ -in. x $\frac{1}{2}$ -in.; 3-in. x 1-in.; 5-in. x 1-in.
Type IA	2 $\frac{2}{3}$ -in. x $\frac{1}{2}$ -in.; 3-in. x 1-in.
Type IR	$\frac{3}{4}$ -in. x $\frac{3}{4}$ -in. x 7 $\frac{1}{2}$ -in.; $\frac{3}{4}$ -in. x 1-in. x 11 $\frac{1}{2}$ -in.
Type II	2 $\frac{2}{3}$ -in. x $\frac{1}{2}$ -in.; 3-in. x 1-in.; 5-in. x 1-in.
Type IIA	2 $\frac{2}{3}$ -in. x $\frac{1}{2}$ -in.; 3-in. x 1-in.
Type IIR	$\frac{3}{4}$ -in. x $\frac{3}{4}$ -in. x 7 $\frac{1}{2}$ -in.; $\frac{3}{4}$ -in. x 1-in. x 11 $\frac{1}{2}$ -in.
Type III	2 $\frac{2}{3}$ -in. x $\frac{1}{2}$ -in.; 3-in. x 1-in.

501.11.7. Repairs. All damage incurred in fabrication will be repaired at the fabrication location. Damage incurred during handling and placement will be repaired, inspected and approved by the OWNER prior to backfilling the pipe.

501.11.7.1. Galvanized Steel Pipe. Damaged spelter coating shall be repaired by thoroughly wire brushing the damaged area and removing all loose, cracked or weld burned spelter coating. The cleaned area shall be painted with a zinc dust-zinc oxide paint conforming to Federal Specifications TT-P-641.

501.11.7.2. Aluminized Steel Pipe. Damaged areas of aluminized coating, including saw cut ends and welds, shall be cleaned and repaired by brush coating of aluminized paint to the damaged, cut or welded area to a minimum thickness of 0.005-in.

501.11.7.3. Precoated Pipe. Damaged or cut areas of polymeric coatings shall be repainted by the application of a polymeric coating similar and compatible with the polymeric coating on the pipe and to a minimum 10-mil thickness.

Damaged areas of bituminous coated galvanized steel shall be repaired by repair of any damaged areas of spelter coatings in accordance with [Item 501.11.7.1](#). Galvanized Steel Pipe before repairing the bituminous coating by applying asphalt mastic to the same thickness as the original coating.

501.11.8. Pipe Marking. The following information shall be clearly marked on each section of pipe:

- (1) Date of manufacture of the pipe.
- (2) The name or trademark of the manufacturer of the pipe.
- (3) Gage or thickness of metal.
- (4) Alloy number (aluminum pipe only).

501.11.9. Couplings.

501.11.9.1. Coupling Bands. Except as may be otherwise required, coupling bands shall be of the same base material(s) as the pipe. Coupling bands shall lap evenly on each of the pipes being connected and shall fit securely into a least one full circumferential corrugation to form a tightly closed joint. Pipe end circumferential corrugations shall be the corrugation width and depth as shown on the plans or as specified by the Engineer.

All pipe shall be field jointed with corrugated locking bands. Coupling bands shall not be more than three nominal sheet thicknesses lighter than the pipe to be connected and in no case thinner than 0.052-in. The minimum width of the corrugated locking bands shall be as shown in Table 501.11.9.1.(a) Corrugated Locking Band Width for the corrugation which corresponds to the end circumferential corrugations on the pipe being joined.

Table 501.11.9.1.(a) Corrugated Locking Band Width

Corrugation	Minimum Band Width
2 $\frac{2}{3}$ -in. x $\frac{1}{2}$ -in.	10 $\frac{1}{2}$ -in.
3-in. x 1-in.	12-in.
6-in. x 1-in.	18-in.

When it is necessary to join a new pipe of helical corrugations to an existing pipe which was installed with no circumferential end corrugations, the two pipes shall be field jointed with helically corrugated bands. The width of helically corrugated bands shall conform to the minimum widths in Table 501.11.9.1.(b) Helically Corrugated Band Width.

Table 501.11.9.1.(b) Helically Corrugated Band Width

Helical End Corrugation	Minimum Band Width
$\frac{1}{2}$ -in. deep	12-in.
1-in. deep	14-in.

All coupling bands 12-in. wide or less shall be drawn together by means of a minimum of two $\frac{1}{2}$ -in. diameter bolts through angles or bar and strap device suitably welded; coupling bands greater than 12-in. wide shall have a minimum of three $\frac{1}{2}$ -in. diameter bolts.

501.11.9.2. Bell-and-Spigot Coupling. Except as may otherwise be required, bell-and-spigot couplings shall be of the same base material as the pipe, and in no case thinner than 0.052-in.

Couplings shall be bell and spigot type. The bell shall have a corrugation to engage the rerolled annular corrugation in the pipe, with a flare to receive the spigot end of the next section of pipe. The bell shall have factory-welded lap(s) applied after snugging the bell corrugation into the pipe rerolled annular corrugation.

Gaskets, if required, shall be polyisoprene (or similar) with a durometer of 45 $\pm$ 5. The gasket on the spigot end shall be fluted with two flutes to prevent rolling when assembled in the field and to resist pull out from the bell.

501.12. STRUCTURAL PLATE STRUCTURES

501.12.1. General. Structural plate conduit, pipe arch, box culverts and special shapes shall meet the requirements of TxDOT *Standard Specifications for Construction of Highways, Streets and Bridges* Item 461 Structural Plate Structures and be in accordance with ASTM A761 Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches for galvanized steel structures or ASTM B221 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes, for aluminum alloy structures.

501.12.2. Plates. Steel plates shall consist of structural units of corrugated galvanized metal. Single plates shall be furnished in standard sizes to permit structure length increments of 2-ft. Aluminum plate shall consist of structural units of corrugated aluminum alloy. For aluminum alloy structures, cut plates shall be furnished on structure ends to permit structure length increments of 1-ft.

Plates shall be formed to provide bolted lap joints. The bolt holes shall be so punched that all plates having like dimensions, curvature, and the same number of bolts per foot of seam shall be interchangeable. Each plate shall be curved to the proper radius so that the cross-sectional dimensions of the finished structure will be as indicated on the plans. Joints shall be staggered so that not more than 3 plates are joined at any one point. Unless otherwise specified, bolt holes along those edges of the plates that will form longitudinal seams in the finished structure shall be:

- (1) staggered in rows 2-inches apart, with one row in the valley and one in the crest of the corrugations and not less than 4-bolts-per-foot for galvanized steel structures, or
- (2) in rows 1 $\frac{3}{4}$ -in. apart with 2 bolts in each valley and on each crest and not less than 16-bolts-per-3-feet for aluminum alloy structures.

Bolt holes along those edges of the plates that will form circumferential seams in the finished structure shall provide for a bolt spacing of not more than 12-in. The minimum distance from center of hole to edge of the plate shall be not less than $1\frac{3}{4}$ -times the diameter of the bolt. The diameter of the bolt holes in the longitudinal seams shall not exceed the diameter of the bolt by more than $\frac{1}{4}$ -in. Plates for forming skewed or sloped ends shall be cut so as to give the angle of skew or slope specified. Burned edges shall be free from oxide and burrs and shall present a workmanlike finish and legible identification numerals shall be placed on each plate to designate its proper position in the finished structure.

501.12.3. Corrugations. Permissible corrugations of metal plates to be furnished for each structure shall be shown on the plans. Corrugations for steel structures shall have a pitch of 6-in. with a tolerance of $\frac{1}{4}$ -in. and a depth of 2-in. with a tolerance of $\frac{1}{8}$ -in. The radius on the inside of the corrugations shall be at least $1\frac{1}{16}$ -in. for steel structures. Corrugations for aluminum alloy structures shall have a pitch of 9-in. with a tolerance of $\frac{3}{8}$ -in. and a depth of $2\frac{1}{2}$ -in. with a tolerance of $\frac{1}{8}$ -in. The radius of the inside of the corrugation shall be at least 2-in. for aluminum alloy structures.

501.12.4. Gauge Determination and Tolerances. The gage or minimum thickness of metal plates to be furnished for each structure shall be shown on the plans. The gauge and tolerances of aluminum plates shall conform to those in ASTM B221 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes. The thickness of galvanized steel plates shall conform to those in ASTM A929/A929M Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe.

501.12.5. Metal Headwalls. The material for metal headwalls shall comply with requirements shown on plans. When required, aluminum alloy inverts, toewalls footings and closure plates shall conform to the material requirements herein. Extruded aluminum transverse stiffeners shall conform to ASTM B221 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes, Alloy 6061-T6.

501.12.6. Fasteners. Fasteners for steel structural plate shapes shall be high strength bolts $\frac{3}{4}$ -in. diameter, hot-dip galvanized, meeting ASTM A449 Quenched and Tempered Steel Bolts and Studs. Nuts shall conform to ASTM A563 Carbon and Alloy Steel Nuts, Grade C. Fasteners for aluminum structural plate shapes shall be $\frac{3}{4}$ -in. diameter, hot-dip galvanized steel, meeting ASTM A307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength with the zinc coating in accordance with ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware. Nuts shall conform to ASTM A563, Grade A.

Bolt lengths shall be such as to result in at least "full nuts" when tightened in place.

501.12.7. Anchor Bolts. Anchor bolts for anchoring the ends of structural plate conduits into concrete headwall, footings or toewalls, as shown on the plans, shall be $\frac{3}{4}$ -in. diameter conforming to ASTM A307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength with the zinc coating in accordance with ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware. The length, shape and placement of these anchor bolts shall be as shown on the plans or approved by the Engineer.

501.12.8. Identification. No plates shall be accepted unless the metal is identified by a stamp on each plate in accordance with AASHTO M167 for Steel Structural Plate or AASHTO M219 for Aluminum Alloy Structural Plates.

501.12.9. Inspections. If the Engineer so elects, it may have the material inspected and sampled in the rolling mill or in the shop where fabricated. Engineer may require from the mill the chemical analysis of any plate. The inspection, either in the mill or in the shop, shall be under the directions of the Engineer. The Engineer or its representative shall have free access to the mill or shop for inspection and every facility shall be extended to the Engineer or representative for this purpose. Any material that has been previously rejected at the mill or shop and included in a later lot will be cause for rejection unless it has been satisfactorily repaired.

The CONTRACTOR shall furnish an itemized statement of the number and size of plates in each shipment. From this list a visual inspection shall include an examination of the plates for deficiency in size, radius of curvature specified, and any evidence of poor workmanship as outlined herein. The inspection may include the taking of samples for chemical analysis and determination of weight of spelter coating on steel plates. The plates making up the shipment shall fully meet the requirements of these specifications. Any plates failing to do so will be rejected.

501.12.10. Rejection. In addition to the provisions of [Item 501.1.1](#), Rejection, structures shall be rejected on which the spelter coating has been bruised or broken either in the shop or in shipping, or which shows defective workmanship. The requirement applies not only to the individual plates but also to the shipment on any contract as a whole. Among others, the following defects are specified as constituting poor workmanship, and the presence of any or all of them in any individual culvert plate or in general in any shipment shall constitute sufficient cause for rejection:

- (1) elliptical shaping,
- (2) variation from a straight centerline,
- (3) ragged edges,
- (4) unevenly lined or spaced bolt holes,
- (5) illegible brands,
- (6) bruised, scaled or broken spelter coating,
- (7) dents or bends in the metal itself, or
- (8) uneven laps.

501.13. TUNNEL LINER PLATES

501.13.1. General. This specification covers the material, galvanizing, coating, shapes and gauge requirements of tunnel liner plates for use in tunneling under railroads, highways and streets.

501.13.2. Plates. The plates shall be fabricated from steel sheets conforming to the requirements of ASTM A1011 Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability. In addition, the flat plates before cold forming shall have mechanical properties indicated in Table 501.13.2.1.(a) Tunnel Liner Plate Requirements.

501.13.2.1.(a) Tunnel Liner Plate Requirements

Property	Minimum Value
Tensile Strength	42,000-psi
Yield Strength	28,000-psi
Elongation, 2-in.	30-percent

501.13.3. Bolts and Nuts. Bolts used with lapped seam type (2 flange) liner plates shall be not less than $\frac{5}{8}$ -in. diameter. Bolts shall conform to ASTM A449 Quenched and Tempered Steel Bolts and Studs for plate thickness equal to or greater than 0.209-in. and to ASTM A307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength for plate thickness less than 0.209-in. Nuts shall conform to ASTM A307.

Bolts and nuts used with the four-flanged type shall be not less than $\frac{1}{2}$ -in. for 7-gauge plates and lighter and not less than $\frac{5}{8}$ -in. diameter for plates heavier than 7-gauge. The bolts and nuts shall be quick acting coarse thread and shall conform to ASTM A307, Grade A.

501.13.4. Fabrication. The plates shall be new and unused prior to fabrication. All plates shall be punched for bolting on both longitudinal and circumferential seams or joints and shall be so fabricated as to permit complete erection from the inside of the tunnel. All plates shall be of uniform fabrication and those intended for one size tunnel shall be interchangeable.

501.13.5. Grout Holes. One-half of the total number of the top plates shall be equipped with 2-in. diameter grout holes to facilitate grouting above and around the tunnel liner conduit. All grout holes shall be equipped with screw type galvanized plugs for final watertight closure of the grout holes.

501.13.6. Galvanizing. After the plates are formed to shape and after all holes are punched, the plates shall be galvanized on all surfaces by the hot-dip process. A coating of prime western spelter or equal shall be applied in accordance with ASTM A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. Spelter coating shall be of first-class commercial quality free from injurious defects such as blisters, flux and uncoated spots. All nuts shall be galvanized to conform to ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

501.13.7. Bituminous Coating. The plates shall be given a bituminous coating meeting the current American Railway Engineering & Maintenance of Way Association specification or ASTM A849 Post-Applied

Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe. Bituminous protected corrugated metal pipe or plates may be spray-coated in the field with a minimum dry film thickness of 0.05-in. prior to installation.

501.13.8. Section Properties. Section properties shall conform to those specified in AASHTO Standard Design Specifications for Highway Bridges, Section 16, Steel Tunnel Liner Plates.

501.13.9. Rejection. Structures on which the spelter coating has been bruised or broken either in the shop or in shipping or which shows defective workmanship shall be rejected. The requirement applies not only to the individual plates but also to the shipment on any contract as a whole. Among others, the following defects are specified as constituting poor workmanship, and the presence of any or all of them in any individual liner plate or in general in any shipment shall constitute sufficient cause for rejection:

- (1) uneven laps,
- (2) elliptical shaping,
- (3) variation from a straight centerline,
- (4) ragged edges,
- (5) unevenly lined or spaced bolt holes,
- (6) illegible brands,
- (7) bruised, scaled or broken spelter coating, or
- (8) dents or bends in the metal itself.

501.14. POLYVINYL CHLORIDE (PVC) WATER PIPE

501.14.1. General. Unplasticized polyvinyl chloride (PVC) water pipe shall meet the requirements of AWWA C900, sizes 4-in. to 60-in. diameter. In accordance with C900, Section III.A, purchaser options and alternatives shall be provided by the specifier, including working, occasional, and recurring surge pressures, pressure class, or dimension ratio (DR). Purchaser options and alternatives shall be specified in the supplemental conditions, plans, or technical specifications. Laying lengths shall be 20-ft ±1-in.

501.14.2. Approvals. PVC water pipe shall be approved by the Underwriters' Laboratories and shall be accepted by the State Fire Insurance Commission for use in water distribution systems in cities and towns of Texas. PVC water pipe shall also bear the seal of approval (or "NSF" mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe.

501.14.3. Dimension Ratio. PVC water pipe shall meet the dimension ratios (DR's) and physical dimensions as shown in AWWA C900. The pressure classification refers to the maximum hydrostatic pressure to which the pipe shall be subjected in normal operations.

501.14.4. Joints. PVC water pipe shall be furnished with gasketed joints. Lubricant used for pipe and fittings assembly shall be nontoxic and in conformance to NSF61. The lubricant shall have no detrimental effect to either gasket or pipe.

501.14.5. Fittings. Fittings for PVC water pipe shall conform to one of the standards Table 501.14.5.(a) PVC Water Pipe Fittings unless otherwise specified. Fittings joints shall be push-on, integrally restrained, or mechanical. Bolts and nuts for mechanical and integrally restrained fittings joints shall be of a high-strength, corrosion-resistant, low-alloy steel and shall conform to ASTM A325 High Strength Bolts for Standard Steel Joints (Type 3) or shall be stainless steel in accordance with ASTM A304.

Table 501.14.5.(a) PVC Water Pipe Fittings Standards

Standard	Topic
AWWA C110 (ANSI A21.10)	Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. for Water
AWWA C153	ANSI Standard for Ductile-Iron Compact Fittings for Water Service
AWWA C907	Polyvinyl Chloride (PVC) Pressure Fittings for Water—4 in. Through 8 in.
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in. Through 12 in. or Water Distribution

501.15. POLYVINYL CHLORIDE (PVC) PRESSURE-RATED PIPE (SDR SERIES)

501.15.1. General. PVC pressure-rated pipe shall conform to the current ASTM D2241, Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

501.15.2. Material. The pipe shall be made of PVC plastic having cell classifications of 12454 or 13343 in accordance with ASTM D1784.

501.15.3. Joints. Joint tightness shall be tested in accordance with ASTM D3139, Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

501.15.4. Testing. All pipe shall meet ASTM requirements for sustained pressure test, accelerated regression test, burst pressure, flattening and impact resistance.

501.16. MOLECULARLY ORIENTED POLYVINYL CHLORIDE (PVCO) WATER PIPE

501.16.1. General. Unplasticized (PVCO) Water pipe shall meet the requirements of AWWA Standard C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. – 24 In., for Water Distribution. Laying length shall be 20ft ± 1 inch.

501.16.2. Material. PVCO water pipe starting stock shall be made from ASTM D1784 cell class 12454 material, having an Hydrostatic Design Basis (HDB) of 4000-psi. When orientation is achieved, PVCO pipe will have an HDB of 7100-psi. The pressure classifications refer to the maximum hydrostatic pressure to which the pipe shall be subject in normal operations.

501.16.3. Dimensions. Dimensions shall conform to the requirements in AWWA C909.

501.16.4. Joints. PVCO water pipe shall be furnished with gasketed joints, meeting ASTM D3139 Joints for Plastic Pressure Pipes using Elastomeric Seals. Lubricant used for pipe and fittings assembly shall be nontoxic and shall have no detrimental effect to either gasket or pipe. Solvent cement shall not be used with PVCO pipe.

501.16.5. Fittings. Fittings for PVCO water pipe shall conform to American National Standard for Gray-Iron and Ductile-Iron Fittings, 3 In. through 48 In., For Water and Other Liquids, AWWA Standard C110 (ANSI A21.10) or AWWA C907 for Polyvinyl Chloride (PVC) Pressure Fittings for Water, 4 In. through 12 In., or AWWA C153 ANSI Standard for Ductile-Iron Compact Fittings for Water Service unless otherwise specified. Fittings joints shall be push-on or mechanical joints. Bolts and nuts for mechanical joints shall be of a high-strength, corrosion-resistant, low-alloy steel and shall conform to High Strength Bolts for Standard Steel Joints, ASTM A325 (Type 3) or stainless steel in accordance with ASTM A304.

501.17. POLYVINYL CHLORIDE (PVC) WASTEWATER PIPE & FITTINGS WITH DIMENSION CONTROL

501.17.1. General. PVC Wastewater Pipe and Fittings shall conform to ASTM D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings for 4 in. through 15 in. diameter and ASTM F679 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings for greater than 15 in. diameter.

501.17.2. Material. The pipe shall be made of PVC plastic having cell classification of 12454, or 12364, and fittings shall be made of PVC plastic having cell classifications of 12454, or 13343 as defined in ASTM D1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds. Pipe type shall be determined by size as shown in Table 501.17.2.(a) PVC Wastewater Pipe Type.

501.17.2.(a) PVC Wastewater Pipe Type

Pipe Size (diameter)	Type	Standard
4-in. through 15-in., inclusive	Pipe stiffness of 46, 115 and 153	ASTM D3034
greater than 15-in.	Pipe stiffness of 46, 75 and 115	ASTM F679

501.17.3. Dimensions. Dimensions shall conform to requirements of ASTM D3034 or F679.

501.17.4. Testing. All pipe shall meet ASTM requirements for flattening, impact resistance, stiffness, joint tightness and extrusion quality as specified in ASTM D3034 or F679.

501.18. POLYVINYL CHLORIDE (PVC) PROFILE GRAVITY WASTEWATER PIPE AND FITTINGS – FOR DIRECT BURY AND SLIPLINING APPLICATIONS

501.18.1. General. This specification designates requirements for PVC plastic gravity wastewater pipe for the conveyance of domestic wastewater with various modified wall profiles and performance requirements.

501.18.2. Stiffness. Minimum pipe stiffness at five percent deflection shall be 46-psi for wastewater conduit as specified for all sizes when calculated in accordance with ASTM D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

501.18.3. Pipe Classification. Pipe as indicated on the plans shall conform to one of the standards in Table 501.18.3. PVC Profile Gravity Pipe Standards.

501.19. PVC COMPOSITE PIPE FOR WASTEWATER CONDUITS

501.19.1. General. PVC composite pipe shall conform to ASTM D2680 Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping for 8 in. through 15 in diameter. Acrylonitrile-Butadiene-Styrene (ABS) shall not be allowed.

501.19.2. Joints, Couplings and Fittings. Wyes or tees with saddle shall be provided as indicated on the plans. Adapters to other types of pipe shall be supplied as indicated on the plans.

501.19.2.1. Chemically Welded Joints. If the pipe is plane ended with couplings, the pipe shall be delivered prebelled. Sufficient primer and solvent cement shall be provided. The solvent cement shall conform to ASTM D2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

501.19.2.2. O-Ring Joints. If the pipe is prebelled with an enlarged coupling, an O-Ring shall be provided for each joint. The physical properties of the gasket shall be at least equal to the requirements of ASTM C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

501.19.3. Tests. The pipe stiffness at five-percent vertical deflection shall be at best equal to or exceed 200-lb./in. of deflection for each diameter as determined by ASTM D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading. The physical test may be the 3-Edge Bearing Method under applicable ASTM Designation if preferred.

501.20. SECTION HELD FOR FUTURE USE.**501.21. SOLID WALL POLYETHYLENE PLASTIC PIPE FOR WATER, WASTEWATER, AND PIPE REHABILITATION**

501.21.1. General. Pipe and fittings shall conform to the material and physical properties as described in ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter, unless otherwise specified herein or in the special specifications. Standard Lengths shall be 40-ft or 50-ft for straight pipe. Coiled pipe may be obtained in reels of 500-ft, 1000-ft or 1500-ft depending on outside diameter and Dimension Ratio (DR) requested.

Solid wall high density polyethylene pipe (HDPE) for pressure water pipe shall meet the requirements of AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ in. Through 3 In., for Water Service or AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 63 In., for Water Distribution.

501.21.2. Material. Pipe and fittings shall be made of high density, high molecular weight polyethylene pipe PE3408 material, polyethylene resin which conforms to Polyethylene Plastics Molding and Extrusion Materials, meeting the requirements of Type III, Grade P33, as defined in ASTM D3350 Polyethylene Plastics Pipe and Fittings Materials. The polyethylene plastic shall meet the Cell Classification requirements of 345464C or 345464E as defined in ASTM D3350. Pipe for non-pressure applications shall have a light colored interior for video inspection, unless otherwise specified in the plans, contract documents or purchase request.

501.21.3. Dimensions. The polyethylene (PE) pipe shall meet the dimension ratios and outside diameter, wall thickness and tolerances as provided in the reference specifications of manufacture as listed in Table 501.21.3.(a) Solid Wall PE Pipe Dimension Standards. Diameters and wall thickness other than those shown in the standards may be used if specifically called for in the plans, contract documents or purchase request, and if they are mutually agreed upon by the manufacturer and OWNER.

Table 501.21.3.(a) Solid Wall PE Pipe Dimension Standards.

Standard	Topic
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, ½ in Through 3 in for Water Service
AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4in through 63in for Water Distribution and Transmission
ASTM D2239	Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D2737	Polyethylene (PE) Plastic Tubing
ASTM D3035	Polyethylene (PE) Plastic Pipe Based on Controlled Outside Diameter
ASTM F714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

501.21.4. Joints. Dependent upon installation requirements, site location, weather conditions, and the presence of water, joining shall be performed within or outside the excavation.

Sections of polyethylene pipe and fittings shall be joined by the butt fusion process, unless an alternate method is approved by the OWNER. The butt (heat) fusion method shall be performed in accordance with the pipe manufacturer's recommendations. Electrofusion fittings shall be used. Extrusion welding or hot gas welding of PE shall not be used for pressure pipe application or fabrications where shear or structural strength is important.

501.21.5. Tests and Requirements. Tests for compliance with this specification shall be made as specified herein and according to the applicable ASTM or AWWA Standard(s). All polyethylene pipe shall be tested for brittleness, joint separation, quality, and ring stiffness as specified in the applicable ASTM or AWWA Standard(s). A certification of compliance with this specification shall be furnished by the manufacturer for all material furnished under this specification. In addition, the OWNER may, at its own expense, witness inspection and test of the materials.

501.21.5.1. Tensile Properties. The tensile strength, yield strength, elongation and elastic modulus of the material shall be determined in accordance with Tensile Properties for Plastics, ASTM D638 (D 638M).

501.21.5.2. Hydrostatic Properties. The long term hydrostatic strength rating shall be listed in the name of the pipe and fittings manufacturer in PPI (Plastic Pipe Institute) TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings compounds, with a standard grade HDB rating of 1600-psi at 73°F.

501.21.5.3. Melt Index. The melt index of the polyethylene plastic, as determined in accordance with ASTM D1238 Flow Rates of Thermoplastics by Extrusion Plastometer, shall meet the requirements as specified in ASTM D3350 Cell Classification of 4.

501.21.5.4. Density. The density of the polyethylene plastic, as determined in accordance with ASTM D1505 Density of Plastics by the Density - Gradient Technique shall have specific base resin densities meeting the requirements as specified in ASTM D3350 Cell Classification 3.

501.21.5.5. Environmental Stress Cracking Resistance. The environmental stress cracking resistance (ESCR) of the material shall meet the requirements as specified in ASTM D3350 Cell Classification of 6 using ASTM F1473 (PENT) or meet a Cell Classification of 4 according to ASTM D1693.

501.21.5.6. Wastewater Pipe Stiffness. Minimum pipe stiffness at five-percent deflection shall be 46-psi for all sizes of gravity and pressure wastewater conduits as specified in Section XI "Deflection Control In Unpressurized Polyethylene Piping Systems," Table X1.1 "Pipe Stiffness Ranges for Specified Materials" and DR's of ASTM F714.

501.22. POLYETHYLENE (PE) LARGE DIAMETER WASTEWATER PIPE WITH MODIFIED WALL PROFILES AND PERFORMANCE STANDARDS

501.22.1. General. High Density Polyethylene gravity wastewater pipe and fittings in nominal sizes 18-in. through 120-in. with integral bell joints shall conform to current ASTM F894 Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

501.22.2. Materials. The pipe and fittings shall be made of high density, high molecular weight polyethylene pipe material meeting the requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D3350 Polyethylene Plastics Pipe and Fittings Materials with a minimum cell classification of 345444C.

501.22.3. Stiffness. Minimum pipe stiffness at five-percent deflection shall be 10-psi for wastewater as specified for all sizes when calculated according to Appendix XI, "Relation of RSC To Pipe Properties and Pipe Stiffness" of ASTM F894.

501.22.4. Joints. Joint tightness shall be tested in accordance with ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

501.22.5. Testing. Pipe shall be tested for flattening, quality and ring stiffness as specified in the applicable ASTM Designations.

501.23. THERMOPLASTIC CORRUGATED DRAINAGE TUBING AND CORRUGATED SMOOTH LINED STORM WATER PIPE AND FITTINGS

501.23.1. General. High Density Corrugated and Corrugated Smooth Lined Thermoplastic storm water tube/pipe and fittings shall conform to Table 501.23.1.(a) Thermoplastic Storm Water Pipe and Fittings.

Table 501.23.1.(a) Thermoplastic Storm Water Pipe and Fittings.

Pipe Material	Topic	Standard
Polyvinyl Chloride (PVC)	PVC Corrugated Storm Water Pipe With A Smooth Interior	ASTM F949 (4"-36")
Polyethylene (PE)	PE Corrugated Pipe With A Smooth Interior	AASHTO M294 (12"-60") AASHTO M252 (3"-10")
Polypropylene (PP)	PP Corrugated Pipe With A Smooth Interior	ASTM F2736 (6"-30")

501.23.2. Materials.

501.23.2.1. PVC. The storm water conduit/drainpipe shall be of PVC compound having a minimum cell classification of 12454 in accordance with ASTM D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds. The fittings shall be made of PVC compound having a cell classification of 12454 or 13343 as defined in ASTM D1784.

501.23.2.2. PE. The tube/pipe and fittings shall be made of virgin polyethylene which conforms with the requirements of cell class 335400C as defined and described in ASTM D3350 Polyethylene Plastics Pipe and Fittings Materials.

501.23.2.3. PP. Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2736, Section 4 for the respective diameters. Minimum pipe stiffnesses at 5% deflection shall meet or exceed ASTM F2736, Section 6.2.6 Pipe Stiffness.

501.23.3. Stiffness.

501.23.3.1. PVC. Constant minimum pipe stiffness at five-percent deflection shall be 46-psi for storm conduit as specified for all sizes when calculated in accordance with ASTM D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

501.23.3.2. PE. Minimum tube/pipe stiffness at 5-percent deflection shall be 50-psi for 3-in. through 10-in. diameters and as outlined in Section 7.4 of AASHTO M-294 for other diameters.

501.23.3.3. PP. Minimum pipe stiffnesses at 5% deflection shall meet or exceed ASTM F2736, Section 6.2.6 Pipe Stiffness.

501.23.4. Joints.

501.23.4.1. PVC. Joints shall be an integral bell-gasketed joint. When the joint is assembled, it shall prevent misalignment of adjacent pipes and form either a soil tight joint (2-psi hydrostatic test per AASHTO Standard Specification for Highway Bridges, Section 26.4.2.4) or a watertight joint (10.8-psi

test per ASTM D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals) as required.

501.23.4.2. PE. Joint integrity shall be tested in accordance with ASTM F667 Large Diameter Corrugated Polyethylene Pipe and Fittings, Section 9.6 for PE corrugated pipe up to 24" or AASHTO M-294 and M-252 for smooth-lined corrugated pipe. Profile wall HDPE pipe joints shall be made and tested in accordance with ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

501.23.4.3. PP. Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2736 for the respected diameters (12"-30"), and shall be watertight according to the requirements of ASTM D3212. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. 12"-30" diameters shall have a reinforced bell with a polymer composite band installed by the manufacturer.

501.23.5. Testing.

501.23.5.1. PVC. Pipe shall be tested for flattening, impact resistance and extrusion quality as specified in the applicable ASTM Designations.

501.23.5.2. PE. All polyethylene tubing/piping shall be tested for elongation, brittleness, joint separation, quality and ring stiffness as specified in the applicable AASHTO M-294, AASHTO M-252 or ASTM F2648, as applicable.

501.23.5.3. PP. All polypropylene piping shall be tested as per ASTM F2736, Section 8 as applicable.

501.24. FIBERGLASS (GLASS-FIBER-REINFORCED THERMOSETTING-RESIN) WASTEWATER PIPE

501.24.1. General. This specification designates requirements for fiberglass glass-fiber reinforced thermosetting-resin pipe (RTRP) sizes from 8-in. to 144-in. for the conveyance of wastewater. Pipe for gravity application shall conform to ASTM D3262 for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe. Pipe for force main applications shall conform to or ASTM D3754 for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe. If ASTM D3754 pipe is selected, its actual outside diameter shall be in accordance with AWWA C950 Fiberglass Pressure Pipe.

501.24.2. Stiffness. Minimum pipe stiffness at 5-percent deflection shall be 46-psi for gravity and pressure wastewater conduit and 36-psi for gravity sliplining applications as specified for all sizes when calculated in accordance with ASTM D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

501.24.3. Joints. Joint tightness shall be tested in accordance with ASTM D4161 for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

501.24.4. Fittings. Fittings shall conform to ASTM D5685 Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe Fittings or D3840 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications.

501.24.5. Testing. Pipe shall be tested for inside and outside diameter, wall thickness, squareness of pipe ends, chemical requirements, stiffness, beam strength as specified in the respective ASTM D3681 Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition, ASTM D2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading, and ASTM D3262 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.

501.25. FIBERGLASS (GLASS-FIBER-REINFORCED THERMOSETTING-RESIN) FOR WATER PIPE

501.25.1. General. This specification designates requirements for glass-fiber reinforced thermosetting resin pipe in sizes 8-in. to 156-in. intended for water conveyance in pressurized systems of less than 450 psi. Pipe manufactured for these applications shall conform to ASTM D3517 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe.

501.25.2. Joints. Joints shall either be bell & spigot with elastomeric gasket, flanged, lay-up lamination or mechanical coupling. Gaskets shall comply with ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe. Lay-up laminations shall be of manufacturer approved materials and

applied by, or under, the supervision of a pipe manufacturer's representative. Mechanical coupling shall be of a type approved for use on the pipe by the manufacturer.

501.25.3. Fittings. Fittings shall conform to ASTM D5685 Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe Fittings. Only fittings approved for use by the pipe manufacturer shall be permitted.

501.25.4. Markings. All pipe shall have be clearly marked by the manufacturer designating nominal size, pressure class, stiffness, manufacturer's name or trademark, and ASTM D3517 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe.

501.25.5. Testing. All pipe and fittings, once in place complete with compacted backfilled shall be hydrostatically tested at 120-percent of design pressure in accordance with [Section 506.5](#). Hydrostatic Test.

ITEM 502. APPURTENANCES

502.1. MANHOLES

502.1.1. Manhole Materials. Manholes shall be fabricated in different configurations to meet the specific needs required in the water or wastewater or storm water system.

502.1.1.1. Precast Reinforced Concrete Manhole Sections. These specifications cover precast reinforced concrete manhole sections, which shall conform to ASTM C478 Precast Reinforced Concrete Manhole Sections, with the following additions:

- (1) Aggregates for the concrete shall comply with requirements of ASTM C33 Concrete Aggregates.
- (2) Resilient connectors between reinforced concrete manhole structures and pipes shall meet the requirements of ASTM C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

502.1.1.1.1. Joints. Joints shall conform to the joint specification ASTM C443 Joints for Concrete Pipe & Manholes, Using Rubber Gaskets. All joints shall have rubber gaskets. Rubber gaskets shall meet the requirements of [Item 501.5.4.1. Rubber Gaskets](#).

502.1.1.1.2. Coatings and Linings. Coatings and linings called for in the specifications or shown on the plans shall meet the requirements as specified by the OWNER and shall be installed or applied by the manufacturer. Add mixtures may be required as per OWNER specification.

502.1.1.1.3. Lifting Devices. Manhole sections and cones may be furnished with lift lugs or lift holes. If lift lugs are provided, they shall be 180° apart. Cast-in-place nuts must have clean threads capable of inserting lug bolts. OWNER shall approve the lift lug design. If lift holes are provided, they shall be plugged with a nonmetallic nonshrink grout approved by the OWNER. Field repairs shall not be allowed without OWNER approval.

502.1.1.1.4. Rejection. Manhole sections shall be subject to rejection on account of failure to conform to any of the requirements specified herein or having defects as follows:

- (1) Variations in any dimensions exceeding the permissible variation prescribed.
- (2) A piece broken out of the bell, spigot, tongue or groove in such size that the watertightness of the joint could be impaired.
- (3) Any shattering or flaking of concrete or other conditions indicating an improper concrete mix.
- (4) Lack of uniformity in placement steel which might preclude all joints being typical of those tested.
- (5) Cracks sufficient to impair the strength, durability, or serviceability of the pipe.
- (6) Joint sections with spalls, cracks, fractures, or other imperfections that could adversely affect the performance of the joint.

502.1.1.2. Fiberglass Manholes. Fiberglass manholes shall conform to all ASTM standards governing plastic laminations and ASTM D3753, Glass-Fiber-Reinforced Polyester Manholes and Wetwells, with supplementary details or additions as set forth in these specifications. See Standard Drawing 5040.

502.1.1.2.1. Manufacturing. The barrel and cone shall each be produced in a continuous manufacturing process that insures continuous reinforcement and uniform strength and composition. The cone section, if produced separately, shall be affixed to the barrel section at the factory with a reinforced glass resin joint resulting in a one-piece unit. Field made joints shall not be acceptable.

502.1.1.2.2. Manhole Configuration. The manhole shall be a circular cylinder with a minimum internal diameter of 4-ft. The cone of the manhole shall have a bearing surface wide enough to facilitate the placement of adjustment rings. The ring and cover shall not be placed directly on the manhole. The manway reducer shall be concentric with respect to the manhole cylinder. Eccentric manway reducers shall not be permitted. Manhole gaskets shall be used to ensure a watertight assembly.

502.1.1.2.3. Testing. All tests included in Glass Fiber-Reinforced Polyester Manholes, ASTM D3753, shall be required. Manufacturer shall provide OWNER a product certification if requested. This certification shall confirm the fiberglass manhole provided is in compliance with the testing requirements outlined in the ASTM standard.

502.1.1.2.4. Rejection. Any fiberglass manhole shall be subject to rejection for failure to conform to any of the requirements of these specifications. Any manhole found to be defective or damaged resulting from improper handling or installation shall be removed and replaced at no additional expense to the OWNER. Patching shall not be acceptable.

502.1.2. Grade Adjustment Risers. Casting shall be raised to final grade adjustment of access covers and frame assemblies made using adjustment risers. Risers may be concrete, polyethylene, metal, or rubber meeting requirements below or other materials as approved by the OWNER. OWNER shall specify material. Adjustment risers shall be tested to assure compliance with impact and loading requirements of the AASHTO Standard Specification for Highway Bridges. To determine the suitability of a specific ring or frame and to insure a proper fit, the dimensions of the existing frames, grates and covers must be verified by the CONTRACTOR and provided to the supplier prior to fabrication of the adjustment rings and frames.

Installed grade adjustment risers and riser assemblies shall fit within the existing casting without interference, cause no binding to the manhole lid, be immobile and watertight. Manhole lids shall have bearing on all of the surface of inner ring(s).

502.1.2.1. Precast Concrete Adjustment Riser. Concrete adjustment risers shall be precast, reinforced concrete meeting requirements of ASTM C478 Precast Reinforced Concrete Manhole Sections. Preformed flexible gaskets shall be used below each riser.

502.1.2.2. HDPE Adjustment Riser. The HDPE adjustment risers shall be manufactured from high density polyethylene plastic as identified in ASTM D1248 Polyethylene Plastic Molding and Extrusion Materials. They may be molded from 100% recycled HDPE material or have other recycled HDPE material content. Material properties shall be tested and qualified for usage according to the test methods in ASTM D1248. HDPE risers shall be manufactured using the injection molding process as defined by the Society of Plastic Engineers.

502.1.2.3. Metal Adjustment Riser.

502.1.2.3.1. Steel. Inner riser rings shall consist of $\frac{3}{4}$ " thick domestic steel meeting the requirements of ASTM A36 Carbon Structural Steel. Intermediate and outer rings shall be one of the combinations indicated in Table 502.1.2.3.1.(a) Steel Adjustment Risers, as specified by the OWNER.

Table 502.1.2.3.1.(a) Steel Adjustment Risers

Intermediate ring	Outer ring	Type
none	ASTM A36 steel $\frac{1}{2}$ " thick	solid
ASTM A36 12-gauge steel	$\frac{1}{2}$ " x $\frac{1}{2}$ " surrounding intermediate ring at finished elevation	solid
none	ASTM A36 steel $\frac{1}{2}$ " thick	Adjustable ¹
ASTM A36 steel $\frac{1}{8}$ " thick	$\frac{1}{2}$ " x $\frac{1}{2}$ " surrounding intermediate ring at finished elevation	Adjustable ¹

1. Adjustment devices for adjustable steel risers shall be fabricated from stainless steel, have a positive lock, and be in line with the lower bearing bar. It shall be capable of adjustment $\pm\frac{3}{8}$ " from nominal.

Rings shall be fabricated to $\pm\frac{1}{16}$ " concentricity. The outer riser ring shall have an inside diameter no greater than $\frac{3}{16}$ " larger than the outside diameter of the manhole lid. All materials shall be coated as specified by OWNER.

Certified welders shall securely weld rings in accordance with American Welding Society D1.5 Bridge Code to prevent differential movement between rings under traffic loads.

502.1.2.3.2. Iron. Gray iron adjustment risers shall be manufactured from iron conforming to ASTM A48 Gray Iron Castings, Class 35B, in accordance with AASHTO M306. Ductile iron adjustment risers shall be manufactured from iron conforming to ASTM A536 Ductile Iron Castings, Grade 70-50-05.

502.1.2.4. Rubber Adjustment Riser. The adjustment risers shall be manufactured from a mixture of rubber and appropriate additives to create a flexible product that will not rot, chip or break, and is resistant to moisture, oil and other common automotive chemicals. Product shall be stable under a wide range of temperatures and resistant to temperature fluctuations. Rubber adjustment risers may be

produced with recycled rubber content. Results of the tests listed in Table 502.1.2.4.(a) Rubber Adjustment Riser Tests shall be provided to the OWNER.

Table 502.1.2.4.(a) Rubber Adjustment Riser Tests

Property	ASTM Test Method	Topic
Density	C642	Test Method for Density, Absorption, and Voids in Hardened Concrete
Durometer hardness, molded and interior surfaces	D2240	Rubber Property-Durometer Hardness
Tensile strength	D412	Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
Compression deformation, initial and final	D575	Rubber Properties in Compression
Compression set	D395	Rubber Property-Compression Set
Freeze and thaw when exposed to deicing chemicals	C672	Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
Coefficient of thermal expansion	C531	Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
Weathering (70 hours at 70 C)	D573	Rubber-Deterioration in an Air Oven

502.1.3. Frame and Cover. Frame (Ring) and cover shall meet the requirements of [Item 806.4.1.2](#). Iron Castings.

502.1.4. Manhole Construction. TCEQ regulations shall take precedence in the case of conflict between these specifications and TCEQ regulations.

Manholes shall be of sufficient inside diameters to allow personnel to work within them and to allow proper joining of the pipes in the manhole wall. Unless otherwise specified, manholes shall have an inside diameter of at least 48-inches.

Manholes constructed in advance of paving projects shall be constructed with the top of the concrete portion of the manhole 23-inches below the final finished grade. The ring and cover shall be placed on a built-up section of approved grade rings and approved sealers between rings and between rings and other materials. Manholes shall be watertight. The type and size, if greater than 4-feet inside diameter, shall be shown on the plans for each location. The CONTRACTOR shall furnish all appropriate equipment and access required for inspection.

Backfilling of manholes shall comply with [Section 504.4](#).

502.1.4.1. Manhole Types and Requirements. Manholes in water lines shall be Cast-In-Place or Precast as described below and as shown in Division 5000 Standard Drawings. Manholes in wastewater service lines may be any of those described below, also shown in Division 5000 Standard Drawings. Manholes in storm sewers shall be Cast-In-Place, Precast, or constructed according to Standard Drawing 6010A-B. Storm sewer junction boxes shall be constructed according to Standard Drawing 6010A-B or constructed according to engineered plans. Manholes may be standard or shallow, as specified by the OWNER.

502.1.4.1.1. Cast-In-Place. The base, wall and cone shall be Class F or Class PF concrete as specified by the OWNER, in conformance with [Item 702](#). Concrete Structures, poured and vibrated to assure a monolithic structure free from infiltration. Typical requirements are shown in Standard Drawing 5030. Manufacturer shall submit shop drawings for OWNER approval. Construction joints with waterstops must be approved by the OWNER.

502.1.4.1.2. Precast. Precast manholes shall conform to the requirements of [Item 502.1.1.1](#). Precast Reinforced Concrete Manhole Sections. Typical requirements are shown in Standard Drawing 5020. The base shall be Class F or Class PF concrete as specified by the OWNER, in

conformance with [Item 702](#), Concrete Structures. The precast sections shall be of the bell-and-spigot design incorporating trapped O-ring gaskets in conjunction with premolded joint sealing compound, or tongue-and-groove with a premolded joint sealing compound (water or storm water). Wastewater precast sections shall be sealed using trapped O-rings gaskets in conjunction with premolded joint sealing compound. Premolded joint sealing compound may be used for water line manholes only when approved by the OWNER. Prior to placing each section of manhole riser or cone, the bells and spigots to be joined shall be thoroughly cleaned, the gasket properly placed, lubricated and the joint pushed home. Combination of joints shall be selected to minimize the number of individual segments. Long joints shall be used in the bottom and shorter segments utilized for top adjustments. Lift holes may be used but must be filled with a nonshrink grout after the section is in place. Precast manholes used in floodplains shall require sealed anchor design.

502.1.4.1.3. Fiberglass. Fiberglass manholes shall conform to the requirements of [Item 502.1.1.2](#), Fiberglass Manholes. The fiberglass portion of the manhole shall be delivered in one piece. Field jointing shall not be permitted. Fiberglass manholes shall be installed in accordance with the manufacturer's recommendation and with supplementary details, additions or exceptions as directed by the OWNER and/or as shown on the plans. Typical requirements are shown in Standard Drawing 5040. The base shall be Class F or Class PF reinforced concrete as required per [Item 702](#), Concrete Structures as specified by the OWNER. A minimum of 8 holes $\frac{5}{8}$ -in. in diameter shall be drilled equidistantly around the periphery of the manholes at a distance 4-in. from the bottom for use in inserting #4 reinforcing bars to be keyed into the concrete base to prevent the manhole from floating. All holes shall be sealed around the reinforcing steel to prevent leakage.

502.1.4.1.4. Drop. Drop manholes shall be constructed in accordance with details on the plans. Typical requirements are shown in Standard Drawings 5070 and 5080. The basic construction for drop manholes shall be identical to that described for standard manholes preceding with special provisions incorporated to provide drop piping and appurtenances as detailed.

502.1.4.1.5. Pressure Type. Pressure type manholes (sealed manholes) shall be constructed in accordance with Standard Drawing 5050 unless otherwise shown on the plans.

502.1.4.1.6. Standard Manhole. Standard manholes shall be constructed to the proper elevation as required and to a depth of at least 6-ft. above the invert of the main(s) or lateral(s) in the system.

502.1.4.1.7. Shallow Manhole. Shallow manholes shall be constructed for specific locations in a storm sewer system for depth less than 6-ft. when specifically designated on the project plans, or when so directed by the OWNER.

502.1.4.2. Vents. When specified, vents shall be constructed as shown in Standard Drawing 5060 unless the OWNER provides details for vent construction.

502.1.4.3. Invert. The invert of manholes shall be formed in a typical pattern regardless of the wall construction.

502.1.4.3.1. Flow Channel. When specified in the special provisions or in the plans, the pipe shall be laid through the manhole stations where possible, prior to concreting, so that the full depth of the pipe is embedded in concrete to form the flow channel.

502.1.4.3.2. Flow Channel Alternate. Where pipe cannot be used through the manhole due to intersecting flow channels, flow channels equivalent to the top of pipe shall be formed with concrete, then troweled to a smooth, even finish with a steel trowel.

502.1.4.3.3. Manhole Bench. The manhole bench from wall line to flow channels shall be sloped and troweled smooth on a grade of 1-in.-per-foot with a liberal radius applied at flow channel intercepts.

502.1.4.4. First Full Joint. The first full joint of pipe extending from the manhole shall be cradled in concrete to the pipe joint in the same pour as that for the manhole base slab as shown on the plans.

502.1.4.5. Grade Adjustment Risers. Installation of risers shall be shown on the plans. Grade risers and sealers shall be approved by the OWNER. Risers may be of concrete, polyethylene, metal, rubber or other materials meeting the requirements of [Item 502.1.2](#), Grade Adjustment Risers. The minimum

number of risers required of the type approved shall be used. The manhole and grade adjustment shall form a watertight assembly. Tapered adjustment risers shall be used to match road grade. The annular space between risers and cone basin, between risers and cover frame, and between multiple risers shall be sealed using an approved sealant. Butyl sealant shall be used for HDPE.

502.1.4.6. Covers. Manhole covers shall be detailed on the plans. Manhole covers of nominal 30-inch or larger diameter are required for all manholes where personnel entry is anticipated. Manholes located within the floodplain shall have gasketed, pressure-type lids and bolted covers, or have another means of preventing inflow.

Installation of covers shall be shown on the plans. For all manhole installations, the manhole covers shall be provided with pick slots or bars in lieu of pick holes. (Pickholes are allowed for stormdrain manholes.) If the rim elevation above surrounding ground is prohibited by land use or other reasons, a cover with a pick slot or bar as described for use in street locations shall be used.

502.1.4.7. Concrete Pad. A 5-ft. by 5-ft. square concrete pad shall be constructed as shown on the plans for manhole installation outside of paved areas.

502.1.4.8. Wastewater Manhole Frame Seals. All newly constructed Wastewater Manholes shall include an Internal Frame Seal as approved by OWNER. All costs for furnishing and installing the seal and extensions shall be included in the applicable Unit Price bid for Wastewater Manholes.

502.1.5. Manhole Testing. Manholes shall be tested by hydrostatic exfiltration or vacuum testing, or other method as approved by TCEQ and determined by the OWNER. Manholes shall be tested after installation with all connections (existing and/or proposed) in place. Drop-connections and gas sealing connections shall be installed prior to testing.

502.1.5.1. Exfiltration Testing Manholes. The rate of exfiltration for manhole testing shall not exceed 0.025-gallons per foot diameter per foot of manhole depth per hour. Alternative test methods shall ensure compliance with the above allowable leakage. Hydrostatic exfiltration testing shall be performed as follows: All wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water, and maintained full for at least 1-hour. For concrete manholes a wetting period of 24-hours may be used prior to testing in order to allow saturation of the concrete. If the manhole fails the hydrostatic test, the manhole shall be repaired and retested until it passes the test.

502.1.5.2. Vacuum Testing Manholes. Vacuum testing of manholes shall be performed by the CONTRACTOR in compliance with these specifications. All lift holes and exterior joints shall be plugged with a non-shrink grout. No grout shall be placed in horizontal joints prior to testing. All pipes entering the manhole shall be plugged. Stubouts, manhole boots, and pipe plugs shall be secured to prevent movement while the vacuum is drawn. A minimum 60-in./lb. torque wrench shall be used to tighten the external clamps that secure the test cover to the top of the manhole. The test head shall be placed at the inside of the top of the cone section, and the seal inflated in accordance with the manufacturer's recommendations. A vacuum of 10-inches-of-mercury (34-kPa) shall be drawn, and the vacuum pump shut off. With all valves closed, the time for the vacuum to drop to 9-inches-of-mercury (30-kPa) shall not be less than the time indicated in Table 502.1.5.2.(a) Vacuum Drop Minimum Time.

Table 502.1.5.2.(a) Vacuum Drop Minimum Time

Depth of MH (feet)	Manhole Diameter		
	48"	60"	72"
	Minimum Time Required for a Vacuum Drop of 1" Hg (min:sec)		
0 – 20	0:40	0:50	1:00
22	0:44	0:55	1:06
24	0:48	1:00	1:12
26	0:52	1:05	1:18
28	0:56	1:10	1:24
30	1:00	1:15	1:30
See note 1.	0:04	0:05	0:06

1. Additional 2-ft. depths, add indicated time for each 2-ft.

Manholes shall be accepted with relation to vacuum test requirements if they meet the criteria above. Any manhole that fails the initial test must be repaired with a non-shrink grout or other suitable material based on the material from which the manhole is constructed. The manhole shall be retested as described above until a successful test is made. After a successful test, the temporary plugs shall be removed.

502.1.6. Measurement and Payment of Manholes. Measurement and payment for manholes shall be on a per each basis and shall cover all costs for the structure complete in place as designed. Included shall be all excavation, castings, reinforcing steel, concrete, backfill, and other materials, and all appurtenances for a complete and functional unit.

Payment for grade adjustment for existing manholes shall be measured and paid per each manhole.

The payment for extra depth in excess of the basic manhole depth shall be made under a separate item of bid as defined herein. If a separate bid item is not established in the contract, there shall not be any payment for extra depth, and the manhole shall be paid for as per each regardless of the depth. Unless specified otherwise, only one bid item shall provide payment for extra depth of manhole structures in excess of the basic depth for all types of manholes under consideration. Such extra depth shall be allocated on the total depth of all manholes, excluding shallow manholes, specified for the project. Payment for extra depth of the various types of manholes shall be at a unit price bid per linear foot of additional depth, measured to the nearest $\frac{1}{10}$ ft. over the basic depth stipulated for the type manholes under bid. A standard manhole is 6-ft. deep measured from the top of the manhole cover to the flow line of the invert. A shallow manhole is less than 6-ft. deep as measured above.

The contract price shall be the total compensation for the furnishing of all labor, materials, tools, equipment and incidentals necessary to complete the work, including earth excavation, disposal of surplus materials and backfill, all in accordance with the plans and these specifications.

502.2. WASTEWATER MAIN CLEANOUTS AND ACCESS CHAMBERS

Cleanouts shall be constructed in accordance with the plans and these specifications for materials and construction.

502.2.1. Typical Cleanout. Typical cleanout requirements are shown in Standard Drawing 5110.

502.2.2. Access (Sampling) Chambers. An access chamber may be specified in a wastewater or storm drainage situation that requires access for maintenance and inspection equipment without human entry. Chamber may be used in lieu of cleanouts, dead-end manholes or sampling ports.

The chamber body shall be a one-piece, rotational molded polyethylene unit that is corrosion resistant, lightweight, and designed for use in traffic and non-traffic locations where sewer pipe is 6", 8", 10" or 12" in diameter. The chamber shall be adaptable to clay, cast iron, ductile iron, PVC, and/or concrete pipe through use of an eccentric coupling. Such coupling shall be provided with the chamber or recommended by the chamber manufacturer and readily obtainable.

502.2.2.1. Composition and Characteristics. The wastewater access chamber shall be rotational molded of 100% virgin, hexane-based, Linear Low Density Polyethylene meeting the minimum standards in Table 502.2.2.1.(a) Access Chamber Requirements.

Table 502.2.2.1.(a) Access Chamber Requirements

Characteristic	Test Method	Value
Density	ASTM D1505	0.936-grams/cm ³
Tensile Strength @ Yield	ASTM D638	2490-psi
Flexural Modulus	ASTM D790	87,000-psi
Heat Distortion @ 66psi Load	ASTM D648	151°F
Low Temp. Impact @ 125 mils Thick	ARM Std. (B)	45-ft.-lbs.
Environmental Stress Corrosion Cracking (ESCR), 100% Igepal	ASTM D1693	> 1000-Hours
Wall thickness	-	minimum 0.375"

Additionally, at minimum, size and dimensions shall be sufficient to accommodate insertion of 36" long, standard tractor type closed-circuit TV cameras and manufactured within a 0.50-inch tolerance of required dimensions. Chamber shall be manufactured with no seams or welds. Chamber interior shall be white or cream color for visibility. Bottom of chamber shall form a channel (invert) with minimal flow disruption. Top of chamber shall have capability of accepting 18" sewer pipe and gasket. Outlets and inlets shall be male (spigot) type extensions connecting to existing or new piping systems with eccentric reducing couplings. Spigot sizes of chamber shall be in accordance with ASTM D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings, SDR 35 Sewer Pipe sizing.

502.2.2.2. Access Chamber Installation. Installation shall conform to manufacturer recommendations, with supplemental requirements contained herein. Chamber assembly including lid shall be watertight. Appropriate flexible couplings shall be used between chamber coupling and pipe. Couplings shall be attached and sized prior to lowering chamber into trench. All gaskets including those included with lid shall be properly seated, and CONTRACTOR shall insure that gaskets are not rolled or twisted. Embedment (bedding and backfill) material as provided for surrounding pipe shall be provided for chamber compacted to a minimum 80% Proctor Density, unless the OWNER specifies otherwise. Embedment material shall be prevented from entering chamber.

Two 3" minimum thickness grade rings shall be included in the access chamber assembly. If standard manhole ring and cover is to be used, it shall be set on grade rings according to normal specified standards to meet local codes. If chamber is to be installed in backyard or easement location where it may be undesirable to have a manhole cover visible, the polyethylene, sealed lid of the chamber may be fitted with a non-ferrous metal disk. Once the disk is epoxy bonded to lid and covered with earth or other ground cover, the metal will allow the chamber to be located with a typical metal locator if access is required.

502.2.2.2.1. Installation on Existing Pipe. The OWNER may specify special conditions in addition to those listed above.

502.2.2.2.2. Installation in New Construction. In addition, installation in new construction shall also meet these provisions. Excavation shall be performed in accordance with [Item 201](#), Site Protection or [Item 701.2](#), Structural Removal, Excavation, and Backfill, as determined by the OWNER. The excavation shall provide a minimum of 6 in. outside the widest dimension of the chamber allowing enough space for installation workers to function. Normally, the trench width for the chamber will be no wider than the trench excavated for the pipe being laid. The chamber shall be lowered into trench and connected to pipe as the pipe is laid. Enough crushed stone shall be placed around the lower portion of the chamber to support it and prevent it from leaning.

502.2.3. Measurement and Payment of Cleanouts. Measurement and payment for cleanout structures shall be on a per each basis and shall cover all costs for the structure complete in place as designed.

Included shall be all excavation, castings, reinforcing steel, concrete, backfill, and other materials, and all appurtenances for a complete and functional unit.

Cleanouts shall not be measured and paid for according to depth.

The contract price shall be the total compensation for the furnishing of all labor, materials, tools, equipment and incidentals necessary to complete the work, including earth excavation, disposal of surplus materials and backfill, all in accordance with the plans and these specifications.

502.3. FIRE HYDRANTS

502.3.1. Materials. Fire hydrants which are to be installed as shown on the plans or to be furnished for general installation shall be dry-barrel traffic model that conform to AWWA C502 Standard for Dry-Barrel Fire Hydrants, except for changes and/or additions specified as follows or as shown on the plans or in the contract specifications. All hydrant components covered by NSF-61 must comply with NSF-61 requirements.

502.3.1.1. Supplementary Details Specified. The type of shut-off may be either of the following:

- (1) Compression type with the flow.
- (2) Compression type against the flow.

The valve action shall provide positive shut-off at minimum closing torque. Wedge action closing gates shall not be permitted, and the scissors type main valves shall not be permitted unless approved by the OWNER.

Inlet connection shall be mechanical joint unless otherwise specified and shall be for a 6-in. cast iron pipe with minimum net valve opening of 5¼-in. unless otherwise specified.

Delivery classification: number and size of pumper and hose nozzles shall be as shown on the plans and contract specifications.

Bury length: ground to bottom of connecting pipe shall be 4-feet or as specified by the OWNER.

Diameter outlet connections: hose and pumper nozzle threads shall be of the size and type shown on the plans.

Gaskets shall be furnished on all nozzle caps and shall be long life, black rubber meeting ASTM D2000, Classification System for Rubber Products in Automotive Applications, or equal.

Unless otherwise specified in the special provisions or in the plans, the operating and nozzle cap nuts shall be tapered pentagon nuts with faces not less than 1-in. high.

Drain valve and outlet: hydrants shall be equipped with a minimum of two drainholes and provided with an automatic and positively operating noncorrodible drain or dip valve so as to drain the hydrant completely when the main valve is shut.

Direction to open is to be specified in the contract specifications. Number of turns to open shall be in accordance with AWWA Standard C502.

The outside of the hydrant shall be thoroughly cleaned and thereafter painted in the shop with one coat of primer. After shop priming, a finish coat of colored paint as specified by OWNER shall be applied to the exterior above ground surfaces.

502.3.1.2. Breakable Type Hydrants. Breakable or Sleeve Type Couplings. The barrel of the hydrant between the base and the nozzle section must be made in two parts connected by a swivel flange or breakable flange which shall permit facing of the nozzles in any desired direction in increments of 45° or less. The complete hydrant shall be of such design that when the hydrant barrel is broken through traffic collision or otherwise, it may be replaced without disturbing the base of the hydrant.

The materials used for gaskets between the upper and lower barrels and the base and nozzle section shall be compounded to conform to ASTM D2000 or an equal material that shall have OWNER approval prior to substitution unless otherwise specified in the plans.

Provision shall be made in the design of the stem to disconnect the stem from the hydrant parts above the standpipe break point in the event of traffic accidents. Design of the coupling shall be such that when the coupling is broken, no parts shall come loose and fall into the hydrant barrel, and the break shall not occur through the pins or bolts holding the coupling to the stem.

502.3.1.3. Main Valve Seats. Main valve seats shall be of such design that incorrect positioning is impossible.

502.3.1.4. Nozzle Cap Chains. When required by the OWNER, the nozzle cap chains shall be in accordance with AWWA C502 Dry-Barrel Fire Hydrants.

502.3.1.5. Flanges. All flanges other than barrel flanges shall be equipped with mechanical joints. Gland bolts shall be high-strength, low-alloy, corrosion-resistant steel conforming to ASTM A325 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength, Type 3.

502.3.1.6. Operating Stems. The spindle of the operating stem and the stem nuts for hydrants having the operating threads located in the barrel or waterway shall be manganese bronze, Everdur or other high-quality noncorrodible metal. Barrel bolts and nuts shall meet the requirements of ASTM A307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

All working parts in the waterway, except for sliding stem support mechanisms, shall be bronze-to-bronze or bronze-to-iron unless otherwise specified in the special provisions or in the plans.

502.3.1.7. O-Ring. Hydrant stem packing boxes, where needed, shall be provided with O-ring grooves and sealed with O-rings. O-rings shall be furnished in lieu of stem packing. They shall be of the double O-ring type designed so that the rubber rings shall move against a bronze, stainless steel or other noncorrodible metal surface. O-ring shall be in accordance with ASTM D2000, Classification System for Rubber Products in Automotive Applications.

502.3.1.8. Extensions. Fire hydrants shall be designed to accept a 6 in., 12 in. or 18 in. extension and no more than one extension and maximum of 18 in.

502.3.1.9. Hydrant Heads. The hydrant shall be constructed so that the nozzles may be faced in any desired direction.

502.3.1.10. Drawings. Proposals shall be accompanied by catalogue cuts, photographs or drawings in duplicate showing complete detailed dimensions of the hydrants when requested by the OWNER.

502.3.1.11. Upperstem Thread Lubrication. Upperstem thread lubrication may be accomplished with oil or grease. When oil is used, it shall be in conjunction with a functional oil reservoir and an oil filler port. The hydrant shall be factory filled with a USP white mineral oil such as Lubriplate No. 3-V (SAE 20), Mobile Whiterex 425 or equal. Means for field check of oil lubrication level shall be provided. When grease is used, the hydrant shall be factory lubricated with a food grade grease such as Lubriplate No. 630-AA (medium soft), or equal. Means for field lubrication without disassembly shall be provided.

502.3.1.12. Tests and Affidavit of Compliance. Manufacturers shall be required to furnish the OWNER certificate of compliance with AWWA C502 and this specification.

Technical manufacturing drawings or certificate of tests relating to fire hydrants for contract installation must be supplied by the CONTRACTOR to OWNER not later than two weeks after beginning construction when identical hydrants have previously been approved by the OWNER, or prior to installation when identical hydrants have not previously been approved by the OWNER. Technical manufacturing drawings or certificate of tests must be supplied for all hydrants purchased by the OWNER. Technical drawings or certificates shall have the OWNER'S approval before final payment shall be made.

502.3.1.13. Sample Hydrant. The OWNER may purchase one sample hydrant for verification of compliance with these and manufacturer's specifications. The OWNER may test this sample; and, if it fails to meet any of the specifications, the hydrant shall be returned to CONTRACTOR at CONTRACTOR'S expense. CONTRACTOR shall refund to the OWNER the full purchase price of the hydrant.

502.3.1.14. Rejection. Fire hydrants or materials specified in this section may be rejected for failure to meet any of the provisions of this specification or for any defects causing them to be unsuitable for their intended use.

502.3.2. Installation. Fire hydrants shall be installed as shown in Standard Drawing 4120, on the appurtenance sheets or as directed by the OWNER.

Set fire hydrant on the lot line extended when possible. The horizontal center of the hydrant shall be placed not less than 3-feet and not more than 8-feet from the back of the nearest curb or edge of pavement no closer than 18-inches to existing or proposed sidewalks, and located at least 1-foot outside of the area

between the Points of Curvature of the corner turning radii at intersections unless otherwise indicated on the plans.

The hydrant shall set truly vertical and be securely braced and blocked on well-compacted or undisturbed soil surrounded by a minimum of 7-CF clean gravel or stone to permit free draining of the hydrant, with the large pumper nozzle facing the nearest curb.

Fire hydrants shall be braced and blocked on a Class B or Class PB concrete per [Item 702](#). Concrete Structures, or as specified by the OWNER. Concrete slab shall not be less than 4-in thick and not less than 3-ft. by 3-ft. square buried to a depth between 6- and 12-inches below finished grade. A splash pad that extends to the sidewalk, or to curb in the absence of a sidewalk, shall be installed if directed by the OWNER. Hydrant shall be set perpendicular with the pumper nozzle facing the nearest curb, and to a depth such that the center of the nozzle is between 18- and 28-inches from the top of finished grade.

Any adjustment needed after installation shall be made by the CONTRACTOR without extra compensation.

502.3.3. Measurement and Payment. Fire hydrants shall be paid for at the contract unit price per each, complete in place, as provided in the proposal and contract. The contract price shall be the total compensation for the furnishing of all labor, material, tools, equipment, hydrant extensions, concrete, gravel drains, paint or protective coating and incidentals necessary to complete the work.

The hydrant lead shall be paid for at the unit price bid for installing pipe. The gate valve and box installed in leads shall be paid for at the unit price bid for installing gate valves and boxes, or as specified by OWNER.

Fire hydrant extensions shall be paid for at the unit price bid per foot if a separate pay item is established in the contract.

Refer to Standard Drawing 4120.

502.4. THRUST RESTRAINT

Each change in direction of a pressure conduit, fittings, and plugs in pressure conduits shall be restrained in such a manner as shall substantially brace the same against undisturbed trench walls. Type of thrust restraint shall be as specified on the plans.

502.4.1. Concrete Blocking. Standard thrust blocking shall conform to appropriate details and tables of Standard Drawings 4010A through 4040. Special blocking shall be accomplished with Class B or Class PB concrete per [Item 702](#). Concrete Structures, or as specified by the OWNER and as detailed on the appurtenance sheet or as detailed on the plans.

502.4.2. Mechanical Joint Restraint. Mechanical joint restraint may be used on ductile iron or PVC pipe. Installation shall follow manufacturer's recommendations.

Restraining mechanisms for PVC pipe and fittings shall be tested and pressure rated in accordance with ASTM F1674 Standard Test Method for Joint Restraint Products for Use with PVC Pipe.

502.4.2.1. Ring and Wedging. Ring and wedging mechanical joint restraint shall be incorporated into the design of the follower gland. The restraint shall be sized and selected for material compatibility according to manufacturer's instructions. The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be of grade 60-42-10 ductile iron conforming to ASTM A536 Ductile Iron Castings. The wedges shall be ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell conforming to AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings and AWWA C153 Ductile-Iron Compact Fittings for Water Service. Torque limiting twist-off nuts shall be used to insure proper actuation of the restraining wedges. Necessary spacers, gaskets and bolts shall be supplied by the manufacturer of ring and wedging restraint. Ring and wedging shall be coated as specified for pipe and fittings.

Restraint for nominal pipe sizes greater than 48-inches shall be engineered.

502.4.2.2. Integrally Restrained Mechanical Joints. In addition to specifications for Ductile Iron fittings in [Item 501.7](#). Ductile-Iron Pressure Pipe and Fittings or [Item 501.14](#). Polyvinyl Chloride (PVC)

Water Pipe, integrally restrained mechanical joints shall conform to the applicable provisions of the standards listed in Table 502.4.2.2.(a) Integrally Restrained Mechanical Joint Standards.

Table 502.4.2.2.(a) Integrally Restrained Mechanical Joint Standards

Standard	Topic
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
ASTM D3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

502.4.3. Welding. Reinforced Concrete Cylinder Pipe (RCCP) may be internally or externally welded, as specified by the OWNER, according to manufacturer criteria in conformance with appropriate AWWA Standards.

502.4.4. Measurement and Payment. No separate payment shall be made for restraint, unless specified otherwise by the OWNER.

502.5. FITTINGS

502.5.1. Brass Stops, Cocks, and Fittings for Waterworks Service.

502.5.1.1. General. Stops, cocks, and other fittings furnished under these specifications shall be in accordance with AWWA C800 Standards for Underground Service Line Valves and Fittings of the size and type specified, except cast solder-joint fittings shall conform to alloy 83-4-6-7, ASTM B584 Practice for Copper Alloy Sand Castings for General Applications. All stops, cocks and fittings shall be full size throughout the size specified.

502.5.1.2. Physicals. Any pipe, fitting, solder or flux used in the installation or repair of any public water system shall be lead-free. For the purpose of these Specifications, the term 'lead free' means (1) Not containing more than 0.2 percent lead when used with respect to solder and flux; and (2) Not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.

The weighted average lead content of a pipe, pipe fitting, plumbing fitting, or fixture shall be calculated by using the following formula: For each wetted component, the percentage of lead in the component shall be multiplied by the ratio of the wetted surface area of that component to the total wetted surface area of the entire product to arrive at the weighted percentage of lead of the component. The weighted percentage of lead of each wetted component shall be added together, and the sum of these weighted percentages shall constitute the weighted average lead content of the product. The lead content of the material used to produce wetted components shall be used to determine compliance. For lead content of materials that are provided as a range, the maximum content of the range shall be used.

Brass used shall have a tensile strength (as determined from test bars) of not less than 30,000-psi when tested as prescribed by ASTM B208 Practice for Preparing Tension Test Specimens for Copper-Base Alloys for Sand, Permanent Mold, Centrifugal, and Continuous Castings (Fig. 5).

Fittings shall be designed for 200-psi working pressure and, when subjected to hydrostatic test pressures $1\frac{1}{2}$ times working pressure or when subjected to a minimum of 85-psi air pressure while submerged in water, shall not leak or show signs of structural failure.

Stops and cocks containing brass parts shall be shipped prelubricated with a light fluid lubricant between key and body. Lubricant shall remain fluid indefinitely, either in storage or in service.

502.5.1.3. Design Features of Stops and Cocks. Seating surfaces of the ground key type shall be tapered and shall be accurately fitted together by turning the key and reaming the body. Seating surfaces shall be lapped together using suitable abrasives to insure accurate fit. The large end to the tapered surface of the key shall be reduced in diameter for a distance that shall bring the largest end of the seating surface of the key into the largest diameter of the seating surface of the body, and the taper

seat in the body shall be relieved on the small end, so that the small end of the key may extend through to prevent wearing of a shoulder and to facilitate proper seating of the key. The stem end of the key, key nut and washer shall be so designed that if the key nut is tightened to failure point, the stem of the key shall not fracture. The nut and the stem shall withstand a torque on the nut of at least three-times the necessary effort to properly seat the key without failure in any manner.

The ball stop shall have a full-size round-way opening with straight-through flow, teflon coated bronze ball with a minimum of 0.5-mil thickness coating. The stop must be so constructed that it may be disassembled and the ball removed without special tools.

Plug type stop shall have full size round way opening with straight-through flow. Seating surfaces shall be brass (or teflon coated brass) to rubber O-rings, providing positive pressure seal without mechanical means. The stop must be so constructed that the plug may be removed without special tools. Rubber O-rings should conform to requirements of ASTM D2000 Classification System for Rubber Products in Automotive Applications and test method shall conform to ASTM D1414 for Test Methods for Rubber O-Rings.

Inlet and outlet threads, of the types specified, shall conform to the applicable tables of AWWA Standard C300 Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, and inlet threads shall be protected in shipment by a plastic coating or other equally satisfactory means. If used, coupling nuts shall have a bearing skirt machined to fit the outside diameter of the pipe for a length at least equal to the outside of the pipe.

Corporation stops shall be so designed as to rotate about the axis of the flow passageway within a circle of rotation small enough to properly clear the inside of any standard tapping machine of appropriate size.

The outlet side of ¾-in. brass curb stops shall be female iron pipe with flared copper pipe, compression or female iron pipe thread on the inlet, as specified. The outlet side of 1-in., 1½-in. and 2-in. brass curb stops shall be female iron pipe with compression, streamline or female iron pipe thread on the inlet, as specified.

The outlet side of ¾-in. and 1-in. corporation stops shall be flared copper pipe or compression with male AWWA “tapered” thread or male iron pipe thread on inlet side, as specified. The outlet side of 1½-in. and 2-in. corporation stops shall be compression or streamline with male AWWA “tapered” thread or male iron pipe thread on inlet side, as specified.

502.5.1.4. Design Features of Fittings. All castings shall be smooth, free from burrs, scales, sand holes and defects of every nature which would make them unfit for the use for which they are intended.

Nuts shall be smooth cast and shall have symmetrical hexagonal wrench flats.

Flare-joint fittings shall be smooth cast. Seating surfaces for metal-to-metal seal shall be machined to proper taper or curve, free from any pits or protrusions.

Solder-joint fittings shall be smooth cast. Inside surfaces of solder-joint ends shall be machined smooth to proper inside diameter.

All thread fittings, of all types, shall have N.P.T. threads, and male threaded ends shall be protected in shipment by a plastic coating or other equally satisfactory means.

Compression tube fittings shall have a Buna-N beveled gasket or equal. Compression nut shall have:

- (1) for plastic or copper pipe and tubing, an approved restraining device.
- (2) for iron pipe, a stainless steel set screw to bite in and lock on the pipe.

502.5.1.5. Tests. All brass stops, cocks and fittings included in this section shall be tested in accordance with the applicable provisions of the specifications relating thereto.

502.5.1.6. Rejection. Brass stops, cocks, and fittings may be rejected for failure to meet any of the requirements of this specification.

502.5.2. All Other Fittings. All other fittings shall conform to respective provisions of [Item 501](#), Underground Conduit Materials, listed according to conduit type. In water pipe, Ductile Iron or Ductile Iron Compact fittings shall consist of standard crosses, tees, bends, reducers, sleeves, plugs, blind flanges, etc. Fittings for reinforced concrete pressure pipe, steel cylinder type, shall consist of special crosses, tees, bends, reducers, dished plugs, closure sections, flanged outlets, blind flanges, bored flanges, etc.

502.5.3. Measurement and Payment. Payment for fittings shall be made only if a separate bid item is established in the Contract. If a separate bid item is not established, the fittings shall be included in the price of the pipe bid item.

Ductile Iron and Ductile Iron Compact Fittings shall be measured for payment per ton if a separate bid item is established in the Contract. Special fittings for reinforced concrete pressure pipe, steel cylinder type, shall be measured for payment per each, grouped as to size and kind. Fittings that are an integral part of a special item, such as a bored flange in an air valve installation, shall not be measured for payment per each, but shall be included in the contract unit price for that special item.

502.6. VALVES

502.6.1. Metal Seated Gate Valves for Ordinary Waterworks Service.

502.6.1.1. General Description. All gate valves 3-in. through 48-in. shall conform to AWWA Standards C500 Metal-Seated Gate Valves for Water Supply Service, except for changes or specified alternatives as detailed in this specification or as shown on the plans and contract documents. Materials must comply with NSF Standard 61 – Drinking Water System Components – Health Effects. Tests and design data may be as designated on the plans and contract specifications.

Valves over 16-in. in diameter shall be installed in a special vault, as indicated in appropriate Division 4000 Standard Drawings, or the gear box shall be enclosed in a manhole and supported on a concrete pad. Smaller valves shall be supported with concrete, all as detailed in appurtenance sheets attached to the plans.

Gate valves larger than 48-in. shall be a special consideration. The OWNER shall hydrostatically test all gate valves larger than 48-in. for a reasonable period after receipt of a specified test pressure.

All gate valves shall be iron body, bronze mounted, double disc, parallel seat, nonrising stem, internal wedging type. Valves must embody the best workmanship and finish. Valve design shall provide minimum torque designs effectively reducing friction and drag through thrust collar design and tracks for gates.

502.6.1.2. Bonnet Bolting. Body bolts, studs and nuts shall be 304 stainless steel.

502.6.1.3. Ends. Valves shall have flanged, push-on, or mechanical-joint ends, or any combination of these as may be specified.

Mechanical-joint ends shall conform to AWWA C111 (ANSI A21.11) American National Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings. Push-on joint ends shall conform to AWWA C111 (ANSI A21.11). Flanged ends shall conform to AWWA C110 (ANSI A21.10) American National Standard for Gray-Iron and Ductile-Iron Fittings, 3 In. through 48 In. for Water and Other Liquids, Class 125-lb. Bolts and nuts for mechanical joints shall be of a high-strength, low-alloy corrosion-resistant steel conforming to ASTM A325 (A325M) High-Strength Bolts for Structural Steel Joints (Type 3). All mechanical-joint glands shall be ductile iron.

502.6.1.4. Gates and Rings. Gates and rings shall conform to AWWA Standards C500 except as follows: All gates above 4-in. shall be cast iron with bronze-gate rings, and 4-in. gates may be solid bronze. Gates 3-in. and smaller shall be solid bronze.

502.6.1.5. Wedging Device. Wedging devices shall conform to the requirements of AWWA C500, except as follows: Gate valves 4-in. and smaller shall have solid bronze wedges. Wedges for valves above 4-in. may be solid bronze or cast-iron with an integral bronze nut. Wedging surfaces may be bronze, monel, or stainless steel cast integral with the wedge. Stem nuts or wedging surfaces that are attached with fasteners are not acceptable. Wedging surfaces on valves up to 16-in. shall be bronze-, monel-, or stainless-steel-to-iron. Wedging surfaces on valves 16-in. and larger shall be bronze-to-bronze, monel-to-monel, or stainless-to-stainless. Other moving surfaces integral to the wedging action shall be bronze to iron.

502.6.1.6. Rollers and Tracks and Scrapers for Horizontal Valves. Rollers and tracks and scrapers for horizontal valves shall conform to AWWA Standards C500, with the following exception: Babbitt tracks shall not be acceptable.

502.6.1.7. Valve Stems and Nuts. Stem and nuts shall be in accordance with AWWA Standards C500, except as follows: Stem nuts shall be of a nongalling, high-grade brass or bronze and shall have threads of sufficient length to develop the full strength of the stem. Stems as received shall meet the minimum strengths as specified. Upset stems on valves larger than 16-in. shall not be permitted under these specifications. Upset stems shall conform to the requirements of AWWA C500.

502.6.1.8. Stuffing Boxes. Stuffing boxes shall conform to the requirements of AWWA Standards C500 with the following exceptions: All valves 2-in. through 16-in. shall be equipped with double O-rings, provided arrangement is made for replacement under pressure of the upper O-ring when the valve is fully open. All geared valves shall be equipped with double O-rings in the main stuffing box. All horizontal valves shall have attached stuffing boxes as per the above AWWA Standards. Stuffing box bolts and nuts shall be 304 stainless steel.

502.6.1.9. Follower Glands and Gland Bolts and Nuts. Glands, gland bolts and nuts shall conform to the requirements of AWWA Standards C500 with the following exceptions: Gland flanges or followers that are a separate part may be cast iron or bronze. Glands for valves over 12-in. in diameter shall be solid bronze or cast-iron bronze bushed. Gland bolts and nuts shall be either bronze or Type 302 stainless steel. For either choice both bolts and nuts shall be of the same material.

502.6.1.10. Hand Wheels and Operating Nuts. All valves 2-in. in diameter and above shall be nut operated unless otherwise ordered. All operating nuts shall be ductile iron or cast iron. Handwheels shall be furnished only when called for on plans or in the contract specifications. All valves shall open by turning counterclockwise or as specified by OWNER.

502.6.1.11. Gearing. Gearing shall be in accordance with AWWA C500. Spur or bevel gearing as called for on the plans or as applicable shall be provided on all valves 18-in. in diameter and larger.

502.6.1.12. Gear Cases. Gear cases shall be furnished on all geared valves. All geared valves shall be equipped with extended type gear cases, with cast iron side plates. Stuffing boxes shall be located on top of the bonnet and shall be outside the gear case. Gear cases shall be lubricated and enclosed with oil seal or O-ring at all shaft openings to prevent the entrance of water which may be in the manhole or vault. Valves equipped with ball or roller type thrust bearings inside the grease case shall have all shaft openings sealed with double O-rings. Gear cases shall be cast iron.

502.6.1.13. Bypass Valves. Bypass valves shall conform to the requirements of AWWA C500 with the following exceptions: Bypass valves are required on all 18-in. valves and larger AWWA C500 valves. Properties, construction and design requirements herein specified are applicable to bypass valves, except stems on bypass valves over 4-in. shall have the same physical qualities as for 30-in. and larger.

502.6.1.14. Cast Iron. All gray cast iron shall conform to the requirements of ASTM A126 Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B or ductile iron shall conform to ASTM A536 Ductile Iron Castings.

502.6.1.15. Horizontal Valves. All valves over 16-in. in diameter shall be designated for horizontal installation in a horizontal pipeline unless shown otherwise on the plans. All other valves shall be vertical.

502.6.1.16. Valves for Installation in Vertical Pipeline. Valves 14-in. and larger AWWA C500 valves ordered for installation in vertical pipeline shall be equipped with disc face tracks and wedge springs to prevent pre-wedging. Valves 4-in. through 12-in. shall be double disc, square-bottom valves.

502.6.1.17. Tapping Valves. Tapping valves shall conform to the requirements of AWWA C500, and the other requirements of this section with the following exceptions: Tapping valves shall have oversize seat rings to permit entry of standard tapping machine cutters. In the open position, valve gates shall be clear of the ports so that the cutter shall pass through without making contact with the gates. Valves shall have an inlet flange conforming to AWWA C110 (ANSI A21.10) Class 125, with a machined projection to mate with tapping sleeve outlet flange recess to assure correct alignment. This alignment ring shall comply with MSS Standard SP-60 Connecting Flange Joint Between Tapping Sleeves and Tapping Valves. Valves shall have standard mechanical joint outlet and shall fit any standard tapping machine.

502.6.1.18. Tests and Inspection. All valves shall be tested by the manufacturer in accordance with AWWA C500. Any leaking at the test pressure through any casting or between the bronze ring and the cast iron body shall cause the said casting to be rejected. No plugging or patching to stop any leakage shall be allowed.

When requested at any time, notarized certificates of material and test compliance for these valves shall be provided. Such reports furnished shall be identified by purchase order or contract. The material shall also be identified as to location within the valve and specification or composition.

502.6.2. Resilient-Seated Gate Valves for Ordinary Waterworks Service.

502.6.2.1. General Description. All gate valves 3-in. through 36-in. shall conform to AWWA Standards C515 for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service, or C509 for Resilient-Seated Gate Valves for Water-Supply Service, except for changes or specified alternatives as detailed in this specification or as shown on the plans and contract documents. Materials must comply with NSF Standard 61 – Drinking Water System Components – Health Effects. Tests and design data may be as designated on the plans and contract specifications.

Gate valves larger than 36-in. shall be a special consideration. The OWNER shall hydrostatically test all gate valves larger than 36-in. for a reasonable period after receipt.

All gate valves shall be iron body, resilient seated, nonrising bronze stem and bronze stem nut. Valves must have the resilient seat bonded and vulcanized to the wedge and employ the best workmanship and finish. Valve design shall provide minimum torque designs effectively reducing friction and drag through thrust collar design and guide tracks for the gate.

502.6.2.2. Bonnet Bolting. Bonnet Bolting shall conform to [Item 502.6.1.2](#). Bonnet Bolting.

502.6.2.3. Ends. Ends shall conform to [Item 502.6.1.3](#). Ends.

502.6.2.4. Gate. Gate shall be encapsulated with an elastomer that meets all requirements of AWWA C515 or C509. The bonding of the rubber to the gate shall meet the requirements of ASTM D429, Test Method A or Method B. Gates 3-in. and smaller shall be rubber encapsulated bronze.

502.6.2.5. Valve Stems and Nuts. Stem and nuts shall be in accordance with AWWA Standards C515 or C509 except as follows: Stem nuts shall be of a nongalling, high-grade brass or bronze and shall have threads of sufficient length to develop the full strength of the stem. Stems as received shall meet the minimum strengths as specified. Upset stems on valves larger than 16-in. shall not be permitted under these specifications.

502.6.2.6. Stuffing Boxes. Stuffing boxes shall conform to the requirements of AWWA Standards C515 or C509 with the following exceptions: Arrangement is made for replacement under pressure of the upper O-ring when the valve is fully open. All geared valves shall be equipped with double o-rings in the main stuffing box. All horizontal valves shall have attached stuffing boxes as per the above AWWA Standards.

502.6.2.7. Follower Glands and Gland Bolts and Nuts. Glands, gland bolts and nuts shall conform to the requirements of AWWA Standards C515 or C509 with the following exceptions: Gland flanges or followers, if used, that are a separate part may be cast iron or bronze. Glands for valves over 12-in. in diameter shall be solid bronze or cast-iron bronze bushed. Gland bolts and nuts shall be either bronze or Type 302 stainless steel. For either choice both bolts and nuts shall be of the same material.

502.6.2.8. Hand Wheels and Operating Nuts. Hand wheels and operating nuts shall conform to [Item 502.6.1.10](#).

502.6.2.9. Gearing. Gearing shall be in accordance with AWWA Standards C515 or C509. Spur or bevel gearing as called for on the plans or as applicable shall be provided on all valves 18-in. in diameter and larger.

502.6.2.10. Gear Cases. Gear cases shall be furnished on all geared valves. Gear cases shall be lubricated and enclosed with oil seal or O-ring at all shaft openings to prevent the entrance of water which may be in the manhole or vault. Valves equipped with ball or roller type thrust bearings inside the grease case shall have all shaft openings sealed with double O-rings. Gear cases shall be gray iron or ductile iron.

502.6.2.11. Bypass Valves. Bypass valves are not required on resilient seated gate valves.

502.6.2.12. Cast Iron. Cast iron shall conform to [Item 502.6.1.14.](#)

502.6.2.13. Horizontal Valves. Valves for horizontal installation shall be equipped with wedge guide caps or inserts to guide and support the wedge during travel. All valves over 16-in. in diameter shall be designated for horizontal installation in a horizontal pipeline unless shown otherwise on the plans. All other valves shall be vertical.

502.6.2.14. Valves for Installation in Vertical Pipeline. All resilient seated gate valves shall be suitable for horizontal mounting in a vertical pipeline without special modifications.

502.6.2.15. Tapping Valves. Tapping valves shall conform to the requirements of AWWA Standards C515 or C509 and the other requirements of this section with the following exceptions: Tapping valves shall have a port opening to permit entry of standard tapping machine cutters. In the open position, valve gates shall be clear of the ports so that the cutter shall pass through without making contact with the gate. Valves shall have an inlet flange conforming to AWWA C110 (ANSI A21.10) Class 125, with a machined projection to mate with tapping sleeve outlet flange to assure correct alignment. This alignment ring shall comply with MSS Standard SP-60 Connecting Flange Joint Between Tapping Sleeves and Tapping Valves. Valves shall have standard mechanical joint outlet and shall fit any standard tapping machine.

502.6.2.16. Tests and Inspection. All valves shall be tested by the manufacturer in accordance with AWWA Standards C515 or C509. Any leaking at the test pressure through any casting shall cause the said casting to be rejected. No plugging or patching to stop any leakage shall be allowed.

When requested at any time, notarized certificates of material and test compliance for these valves shall be provided. Such reports furnished shall be identified by purchase order or contract. The material shall also be identified as to location within the valve and specification or composition.

502.6.3. Air Valves.

502.6.3.1. General. Unless otherwise indicated in the plans or contract specifications, air valves shall meet the requirements of AWWA C512 Air Release, Air/Vacuum and Combination Air Valves for Water Works Service with exceptions specified herein. Only wastewater air valves shall be used for wastewater applications.

502.6.3.2. Description. Air valves shall be of two types as follows:

- (1) An air valve called for on the plans shall mean an air and vacuum valve of the ball type designed to permit the escape of air from a pipeline when the line is being filled and to permit air to enter the pipeline when the line is being emptied.
- (2) A combination air valve called for on the plans shall mean a combination air and vacuum and air release valve designed to fulfill the functions of air and vacuum valve and also designed to permit the escape of air accumulated in the line at the high point when the line is under pressure while in operation. Air valves 3-in. and smaller shall be self-contained in one unit. Air valves larger than 3-in. may be a combination of two valves.

502.6.3.3. Material. The valves shall be stainless steel or iron body, stainless steel, brass or bronze fulcrum levers and links, stainless steel ball floats and pins, steel flange bolts and nuts, Buna-N synthetic rubber seats or equal against bronze or stainless steel, and brass for other parts.

502.6.3.4. Inlets and Outlets. Inlets shall be threaded for 2-in. and smaller and flanged for 3-in. and larger. Outlets shall be threaded through 4-in.

502.6.3.5. Operating Pressure and Testing. The valves shall be designed to operate under an operating pressure of 200-psi and shall be tested to 1½ times that pressure.

502.6.4. Brass Wheel Valves.

502.6.4.1. General. Valves furnished under this specification shall be wedge disc, non-rising stem gate valves with threaded ends. They shall be equipped with bronze hand wheels and nuts and shall have bronze packing gland followers. They shall be of all brass and/or bronze construction.

502.6.4.2. Pressure Rating. Valves shall be rated for 125-psi saturated steam working pressure and 200-psi for liquids and gases up to 150°F.

502.6.4.3. Tests. Each valve furnished under these specifications shall be tested at a hydrostatic pressure of 250-psi with the valve open. Under this test the valve shall not show any indication of leakage at the packing or anywhere on the body. Each valve shall also be tested at hydrostatic pressure of 250-psi applied to one end only with the valve closed. There shall be no indication of leakage by the gate or through the packing under this test.

502.6.4.4. Direction to Open. Valve shall open by turning the handwheel counterclockwise.

502.6.4.5. Material Specifications. The materials used in the manufacture of these valves shall equal or exceed the specifications shown in Table 502.6.4.5.(a) Brass Wheel Valve Materials.

Table 502.6.4.5.(a) Brass Wheel Valve Materials

Part	Material	Designation/Specification
Packing	Teflon impregnated asbestos or approved equal	
Body	Bronze	ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings
Bonnet	Bronze	ASTM B62
Gates	Bronze	ASTM B62
Handwheel	Bronze	ASTM B62
Handwheel Nut	Bronze	ASTM B62
Gland & Packing Nut	Lead-free Brass	ASTM B16/B16M Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
Stem	Bronze	ASTM B62, 50,000-psi minimum tensile strength

502.6.4.6. Stem. Stem shall be completely free of visible flaw, and matching shall be smooth and free of defect. A back seating surface shall be provided on the wedge or on the lifting nut to seat tightly against the bonnet when the valve is open to seal the packing gland against line pressure so that the valve may be repacked against line pressure.

502.6.4.7. Threaded Ends. Valve ends shall be threaded internally with American National Taper pipe threads. Thread shall be clean, smooth, true to form and concentric with the axis of the valve. Variations in alignment of thread shall not exceed $\frac{1}{16}$ -in.-per-foot. Thread shall be chamfered approximately to the major diameter of the thread at the face of the valve at an angle approximately 45° with the axis of the thread for the purpose of easy entrance in making a joint and for protection of the thread.

502.6.4.8. Valve Body. The body of the valve shall offer sufficient support to the gate while it is moving to keep the gate wedge in place and to accurately align the gate on the body seat. The waterway opening shall be equal to or greater than the nominal pipe size.

502.6.4.9. Gate. The gate shall be of wedge design and may be furnished either solid or two-piece. Two-piece or “split” disc gates shall be equipped with lifting nut. Gate faces shall be accurately machined and fitted into the valve body in such a manner that the center of the gate circle is very slightly above the center of the seat circle when the valve is tightly closed.

502.6.4.10. Workmanship. All valve parts shall be true to form, free from injurious defects and shall be seated and finished in a workmanlike manner. Casting shall be free from blow holes, porosity, hard spots, excessive shrinkage, cracks or other injurious defects. They shall be smooth and well cleaned both inside and outside, and all fins and similar roughness shall be removed. Castings shall not be repaired, plugged, brazed or burned in.

502.6.4.11. Packaging. Valve shall be closed for shipment and wrapped or packaged in accordance with best commercial practice as necessary for mechanical protection and ease in handling.

502.6.5. Butterfly Valves.

502.6.5.1. General. Butterfly valves and actuators shall conform to AWWA C504 Rubber-Seated Butterfly Valves and to these specifications:

- (1) Type of body shall be short body, flanged.
- (2) Body material shall be cast iron or ductile iron.
- (3) Class shall be as specified on the plans or contract specifications.
- (4) Shafts shall be Type 304 or 316 stainless steel.
- (5) Flange holes shall be drilled full size.
- (6) Valve seats shall be natural rubber or Buna-N and polished stainless steel, Type 304 or 316, 90° seating angle only, with a 360° uninterrupted seating surface.
- (7) Shaft seals shall be standard split-V packing or double O-ring seal cartridges.
- (8) Discs shall be ductile iron, cast iron, or fabricated steel.
- (9) Operating nuts shall be ductile iron.

502.6.5.2. Submittals. The following shall be furnished to the OWNER. Incomplete data shall be cause for rejection of bid.

- (1) Weights and drawings in accordance with AWWA C504.
- (2) Guaranteed delivery time after receipt of purchase order.
- (3) Number of turns of handwheel required to close valve.
- (4) The required actuator torque (To) in foot-pounds for each butterfly valve based on the specified operating conditions of pressure and flows.
- (5) Seating-unseating torque (To) in foot-pounds required for each butterfly valve.
- (6) Rated torque capability of each butterfly valve actuator.

The following data shall be furnished if not previously available to the OWNER:

- (7) Experience: evidence of at least five years satisfactory experience building butterfly valves to AWWA Standards.
- (8) Torque tests in accordance with rubber seated butterfly valves AWWA C504.
- (9) Proof of design tests in accordance with AWWA C504.

502.6.5.3. Ends. Valves shall have flanged ends. Flanged ends shall conform to AWWA C110 (ANSI A 21.10), Class 250-lb.

502.6.5.4. Actuators.**502.6.5.4.1. Manual Actuators.**

Location. All actuators shall be located at the right end of a horizontal shaft with the input shaft vertical and upward looking in the direction of flow, unless otherwise noted.

Closure. The valve shall close by turning the input shaft clockwise. All handwheels shall turn clockwise to close the valve. All operators shall be equipped with a disc position indicator with each valve. The indicator shall be highly visible, clearly showing the legends "Open" and "Closed" at the ends of a 90° arc, with a pointer to show the disc position (Closed — 0° and Open — 90°). The arc shall be graduated in degrees.

Type. All manual actuators shall be totally enclosed worm gear type and traveling-nut type. All manual worm gear type actuators shall be Limitorque, Type HBC or approved equal.

Sizing. Each valve actuator shall be sized for the maximum valve torque requirements based on the operating pressures and flow rates as specified.

502.6.5.4.2. Electric Motor Actuator. Each electric actuator shall conform to AWWA C504 and shall be of sufficient size to open and close the valve against maximum differential pressure and maximum required torque conditions when voltage at motor terminals is 90-percent of nominal voltage and shall have totally enclosed worm gear reducer with spur gear attached. Limit switches shall be of the four train gear with switches adjustable to operate at any point in the opening or closing cycle of the valve.

Limit switches and torque switches shall be located in a special compartment that is an integral part of the actuator and shall be readily accessible. Each limit switch shall have two normal closed contacts. Limit switch gearing shall be in step at all times whether in power or manual operation.

Limit switch gearing shall be stainless steel or high-grade bronze. Two torque switches shall be furnished, one for opening direction and one for closing direction. The torque switches shall be connected in series so that they will operate regardless of the phasing of the power.

Torque and thrust loads in both closing and opening directions shall be limited by torque switches. Each torque switch shall be provided with a micrometer adjustment and reference setting indicator. The adjustment shall permit a variation of approximately 40-percent in torque setting. Switches shall have a rating of not less than 6-amperes at 120-volts-a.c. and 2.2-amperes at 115-d.c. The torque switches shall be in series with the opening and closing coils of the starter.

The torque switches shall be factory adjusted by the manufacture for this application.

A handwheel for manual operation shall be provided. Motor shall not rotate when handwheel is in use. A fused motor shall not interfere with manual operation. For valve control, furnish for each valve a reversing starter in watertight enclosure that is integral with the actuator housing. Furnish a push-button station NEMA-4 with red and green indicating lights separate from the valve actuator. Space heaters shall be provided to protect the motor, reversing starter and limit switch compartments from moisture condensation. Valve control wiring diagrams shall be furnished with submittal data.

Valve actuators shall conform to latest revision of AWWA C504 and shall be designed to hold the valve in any intermediate position between fully opened and fully closed without creeping and fluttering.

502.6.5.4.3. Other Actuators. Other types of actuators shall conform to AWWA C504.

502.6.5.5. Shipment and Storage Requirements. Electric motor actuated valves shall be shipped to bonded covered warehouse storage to be designated by the OWNER. Valves shall be stored indoors and shall have space heaters energized. Full face flange protectors of waterproof plywood shall be at least one-inch thick.

502.6.5.6. Tests. All butterfly valves shall be tested by the manufacturer in accordance with AWWA C504. Test results shall be furnished to the OWNER.

502.6.6. Line Valve Installation. At locations shown on the plans, CONTRACTOR shall furnish and install valves of the type and size indicated. Valve vaults shall be furnished as provided in the special contract documents and constructed in accordance with [Item 702.5.8.8](#). Vaults and applicable Division 4000 Standard Drawings.

502.6.6.1. Gate Valves. Valves shall be carefully handled and lowered into position in such a manner as to prevent damage to any part of the valve. The valve shall be placed in the proper position and held securely until all connections have been made. Where valves are to be placed in a concrete structure, the floor shall be completed before installing the valve. The valve shall be securely blocked so that its weight is carried by the floor rather than being supported by connected piping. See also Standard Drawing 4050.

502.6.6.2. Air Release Valves. The term "air release valve" as used in this section shall apply to the installation of both air release valve and combination air and vacuum release valves. Vaults shall be furnished as an integral part of either air release valve or combination air and vacuum release valve installation.

Air valves shall be installed in the manner shown in Standard Drawings 4090 – 4100B and on the appurtenance sheet unless otherwise indicated on the plans. The proper valve and fitting sizes shall be installed on mains in accordance with the schedule in Table 502.6.6.2.(a) Minimum Air Release Valve Sizing unless otherwise specified by the OWNER.

Table 502.6.6.2.(a) Minimum Air Release Valve Sizing¹

I.D. of Main (in.)	Size of Valve and Fitting (in.)
16 and smaller	1
18 through 36	2
42 and larger	3

1. This table is for use if no sizing is indicated on the plans.

Matching taps shall be provided for and made in accordance with [Item 502.10](#). Connections to Conduit for Service. Fittings required for mounting air valves shall be as specified in [Item 502.5](#). Fittings. All fittings shall be tight, leak free and plumbed true to the required position.

502.6.7. Rejection. Any valve may be rejected for failure to meet its respective requirements of this specification or referenced specifications.

502.6.8. Measurement and Payment. Where valves are furnished by the OWNER, the valves shall be measured for payment for handling, placing, installing, jointing, testing and all incidentals per each, grouped by size. Where the valves are to be furnished by the CONTRACTOR, the valves shall be measured for payment for furnishing, hauling, handling, placing, installing, jointing, testing and all incidentals per each, grouped by size. The price bid for valves shall include vault, roadway box, cover, extension pipe and pad supports since separate pay items shall not be set up for these items. Manholes or vaults for valve gear boxes shall be paid for at the contract unit price per each, grouped by sizes, complete in place, if provided in the proposal and contract. The contract unit price shall be the total compensation for labor, materials, tools, equipment and incidentals necessary to install valves complete in place in strict accordance with drawings, specifications, and/or instructions of the OWNER.

502.7. PREFORMED FLEXIBLE CONDUIT JOINT SEALANT

502.7.1. General. This specification covers a cold-applied preformed flexible butyl rubber or plastic sealing compound for sealing interior and/or exterior space on concrete sewer pipe and manhole sections, where infiltration or exfiltration is a factor in the design.

502.7.2. Applicable Standards. Except as modified or supplemented herein, all preformed flexible joint sealants shall conform to the applicable requirements of the standard specifications listed in Table 502.7.2.(a) Conduit Joint Sealant Standards.

Table 502.7.2.(a) Conduit Joint Sealant Standards

Publisher	Standard
Federal Specification	SS - S - 210A(1) Sealing Compound, Preformed Plastic, For Expansion Joints
American Association for State Highway and Transportation Officials (AASHTO)	M198

502.7.3. Basis of Acceptance. The acceptability of the preformed flexible joint sealant shall be determined by the results of physical tests, by inspection and by approval of its experience record.

502.7.4. Material. The joint sealer shall be supplied in either extruded rope form of suitable cross-sectional area or flat tape form and shall be sized as recommended by the manufacturer and approved by the Engineer. The joint sealer shall be protected by a suitable removable wrapper. The joint sealer shall not in any way depend on oxidation, evaporation, or any other chemical action for either its adhesive properties or cohesive strength. The joint sealer shall remain totally flexible without shrinking, hardening, or oxidizing regardless of the length of time it is exposed to the elements.

The manufacturer shall furnish an affidavit attesting to the successful use of the product as a preformed flexible joint sealant on concrete pipe and manhole sections for a period of at least 5-years.

If requested by the OWNER, the CONTRACTOR shall provide results of above specified tests to insure product compliance with these specifications or shall supply an affidavit of compliance from the manufacturer insuring compliance with these specifications.

502.7.5. Installation of Joint Sealant. All surfaces to be in contact with the joint sealant shall be thoroughly cleaned of dirt, sand, mud or other foreign matter. A primer shall be applied to all surfaces prior to installing the joint sealant in accordance with recommendations by the manufacturer. The protective paper wrapper shall remain on the joint sealant until immediately prior to placement of the pipe in the trench. After removal of the protective paper wrapper, the joint sealant shall be kept clean.

Backfilling of pipe laid with this joint sealer may proceed after the joint has been inspected by the OWNER.

502.7.6. Rejection. The preformed flexible joint sealant may be rejected for failure to meet any of the requirements of this specification.

502.7.7. Measurement and Payment. Joint sealant shall not be paid for separately, but shall be considered subsidiary to furnishing and installing conduit.

502.8. POLYETHYLENE WRAP FOR METAL PIPE AND FITTINGS

These specifications cover polyethylene film used as a wrap to protect cast iron and other metals in a corrosive soil environment.

502.8.1. Material. Unless otherwise specified, encasement material, sizing, and marking shall conform to AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe Systems.

502.8.2. Installation. Unless otherwise specified, encasement installation shall conform to AWWA C105. Polyethylene wrapping of pipe, fittings or hydrants shall precede blocking or restraint.

Fittings such as bends and reducers shall be wrapped similarly to pipe. Specials such as but not limited to valves, hydrants, and crosses shall be wrapped by splitting, tucking and overlapping the polyethylene tube, then closing the field-made splices with the required tape. All seams shall be folded twice prior to taping in accordance with AWWA C105.

Material to cover valves may be acquired from the overlapping excess polyethylene tub on the adjacent pipe lengths. The tubing shall be drawn over the bell of pipe on either side and insulated with field-made seams as described above.

Hydrants shall be encased with the polyethylene tubing slipped over the hydrant and extended to a point 2-in. to 3-in. above the ground line. The wrap shall be excluded from the drain region to allow normal drain function of the hydrant.

502.8.3. Rejection. Failure to meet any of the specifications contained in this section shall be cause for rejection of the materials.

502.8.4. Measurement and Payment. No separate payment shall be made for polyethylene wrap. It shall be considered subsidiary to the bid items on which the polyethylene wrapping is required.

502.9. CORROSION-RESISTANT COATINGS AND LINERS FOR WASTEWATER CONDUIT AND APPURTENANCES

502.9.1. General. Coatings and liners are used as a protective barrier attached to the interior walls of concrete, ductile iron, or steel pipe or manhole sections, special concrete appurtenances for protection against the corrosive chemical elements which may occur in certain domestic wastewater environments and for protection against certain corrosive wastes from industry.

All work for and in connection with the installation of the coatings and linings, including interlocking liner plates and epoxy lining in concrete pipe and the field sealing and welding of joints, shall be done in strict conformity with all applicable specifications, instructions and recommendations of the manufacturer.

502.9.2. Basis of Acceptance. The acceptability of the protective material and its attachment to the pipe or appurtenance shall be determined by the results of tests, by inspection and by approval of its experience record. The tests are designed to prove, demonstrate and insure:

- (1) whether or not the protective material is the same as used in the tests,
- (2) surface continuity and lack of holidays and voids,
- (3) adhesion,
- (4) resistance to temperature changes,
- (5) resistance to abrasion,
- (6) resistance to fire, and
- (7) chemical resistance.

The inspection at the manufacturing plant or in the field is to determine:

- (1) whether or not the protective material is the same as used in the tests,
- (2) that it is attached in the same manner, and as uniformly, as it is attached to the concrete in the tests,
- (3) that the joint areas are adequately protected.

The experience record of the protective material attached to the pipe or appurtenances must be acceptable.

To qualify the material and the attachment of the material to the pipe or appurtenances for acceptance, all tests must be met or certified for the specific protection intended, all conditions to be evaluated by inspection must be met, and the experience record must be submitted and approved.

502.9.3. Testing Requirements. Unless otherwise specified, the manufacturer of the protective material is responsible for meeting the testing, inspection standards and experience records as described herein, except in the case of a pipe manufacture electing to procure the protective material and applying the material as the pipe is manufactured. In such a case the pipe manufacturer would be responsible.

The test results shall be certified by a recognized testing laboratory acceptable to the OWNER and do not necessarily have to be made on each project.

The inspection results shall be attested to in writing by a licensed Professional Engineer or witnessed by the Engineer representing the OWNER. The experience record shall be documented with dates, locations, actual number of feet of protected conduit in the ground, length of time in the ground, the nature of the environment against which the conduit is being protected and the names and addresses of responsible references who shall verify the facts in the experience record.

502.9.4. Physical Requirements.

502.9.4.1. Chemical Resistance. The OWNER may designate which of the solutions mentioned may be used or may designate others.

The chemical resistance test shall be made as follows:

- (1) The specimens, approximately 5-in. long, 2¼-in. wide and 1-in. thick, shall be cut from the pipe. The protective material shall be attached to these test specimens in the same manner as it would be attached to the pipe. The protective material shall be to manufacturer's specified minimum thickness. If curing is required, the protective material shall be cured to the manufacturer's recommendations.

- (2) The protective material on the prepared test specimens shall be tested for indentation hardness in accordance with the requirements of ASTM D2240 Test Method for Rubber Property—Durometer Hardness and the hardness recorded.

- (3) The prepared test specimens shall then be placed in wide mouth glass containers half submerged in the following solutions:

5%	sulphuric acid
5%	hydrochloric acid
3%	salt (NaCl) water
1%	phenol
5%	alum
5%	phosphoric acid
10%	biodegradable detergent
100%	motor oil

- (4) The containers shall be closed and held at 100°F for six-months.

- (5) After six months the specimens shall be taken from the containers and tested again for indentation hardness in accordance with the requirements of ASTM D2240. The test durometer hardness shall be made in both the area exposed to the liquid and in the area exposed to the vapor above the liquid. There shall be no loss of indentation hardness either in the area below the liquid or in the area above the liquid.

502.9.4.2. Surface Continuity, Holidays, and Voids. Voids and holidays shall be cause for rejection. The surface continuity and holiday test shall be made as follows:

- (1) An electrical holiday detector, capable of producing and maintaining a voltage equal to 800 times the square root of the specified minimum protective thickness expressed in mils, shall be used to determine the complete continuity of the protective surface.
- (2) The electrical holiday detector shall be used on a full size piece the protective material taken from a production run.

502.9.4.3. Adhesion to the Pipe or Appurtenances.

502.9.4.3.1. Adhesion to Concrete. Where the protective material adheres directly to the concrete, adhesion test shall be made as follows:

- (1) Make a test specimen by drilling a core hole through the protective material and the pile to produce a core sample 1-in. in diameter by $\frac{3}{4}$ -in. or more in depth. (This hole may be repaired and the pipe from which the sample was taken may be used.)
- (2) Check the protective material for thickness.
- (3) Cement the test specimens onto a solid wooden block at least 2-in. x 2-in. x 1-in. in thickness so that the protective material is cemented onto the wooden block.
- (4) Allow sufficient time for the cement to set.
- (5) Support the wooden block so that the test specimen is on its underside and hang a 40-pound weight on the test specimen. This can be done using an ordinary wooden clamp.
- (6) This test should be made at an ambient temperature of between 60°F and 90°F.
- (7) The protective material shall adhere to the material for a minimum of two-hours.

502.9.4.3.2. Anchored to Concrete. Where the protective material is anchored to the concrete by fins embedded or dovetailed into the concrete adhesion test shall be made as follows:

- (1) Using a large enough square footage of the protective material to be a representative sample, the fins shall not be capable of being pulled out of the material, usually concrete, nor the protective material torn away from the embedded fins using less than a pull equal to 50-psi.
- (2) For the adhesion test, either [Item 502.9.4.3.](#) Adhesion to the Pipe or Appurtenances or paragraph (1) above shall be used, but not both.

502.9.4.4. Resistance to Temperature Changes. The test for resistance to temperature changes for those materials that adhere directly to the concrete shall be made in accordance with the latest ASTM Method when required by the OWNER.

502.9.4.5. Resistance to Abrasion. The test for resistance to abrasion shall be made as follows:

- (1) A 1-foot length of pipe which has been lined with the protective material shall be suitably capped and arranged on rollers so that it can be revolved at high speeds. A door shall be left in one end so that access can be had to the interiors of the test section.
- (2) A slurry shall be made composed of six-pounds of gravel and three-pounds of water, and it shall be placed inside the test section and the test section shall be rotated so that the protective material has peripheral speed of four-feet-per-second. After 1,500,000 revolutions, the protective material shall not show visible signs of wear or abrasion.

502.9.4.6. Resistance to Fire. The protective material, if plastic, shall be tested for resistance to fire by meeting the requirements of ASTM D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position. The material shall be self-extinguishing or nonburning according to ASTM D635.

502.9.5. Appurtenance Protection. Adequate protection shall be provided at the ends of joints.

All special shapes such as tees and wyes, branches, slants and curves shall be protected with the protective material, and they shall be given the same degree of protection provided to the production run of pipe. Lift holes, if called for on the plans or in the specifications, shall be sealed with epoxy or sealant recommended by the coating or liner manufacturer that shall pass the tests as set out in this [Item 502.9.](#) Corrosion-Resistant Coatings and Liners for Wastewater Conduit and Appurtenances.

502.9.6. Inspection. The tests required under the physical test requirements section of this specification need only be made once on any one project. Each length of pipe or special may be subject to visual

inspection during manufacture, transportation or laying by the OWNER in order to cull and reject pipe as specified in [Item 502.9.8](#). Rejection.

502.9.7. Repair of Coatings and Liners. Where the protective material is damaged or where the adhesion of the protective material to the concrete is damaged, repairs may be made at the discretion of the OWNER.

502.9.8. Rejection. The protective material shall be rejected if:

- (1) any the tests described under physical test requirements are not met,
- (2) the manufacturing method of applying, adhering and curing the protective material differs from that used on the test samples,
- (3) the protective material thickness as used on the test samples exceeds the minimum specified in the manufacturer's specification by more than five-percent, or
- (4) it cannot be adequately repaired in the field.

502.9.9. Measurement and Payment. No separate payment shall be made for coating or lining unless otherwise specified by the OWNER. It shall be considered subsidiary to the bid items on which the coating or lining is required.

502.10. CONNECTIONS TO CONDUIT FOR SERVICE

502.10.1. Definitions. "Service" shall be defined as a service line to an individual customer. "Bullheads" shall be defined as an individual service line with branches at the end to serve two or more customers.

502.10.2. Materials.

502.10.2.1. Service Clamps. Service clamps shall be designed for tapping water pipe under normal service pressure. The clamp shall consist of a contoured saddle fastened to the pipe by one U-bolt for the single strap clamp for pipes less than 4-in. I.D., and by two U-bolts for double strapped clamps or shall consist of two sections or halves that shall be fastened together with a minimum of two bolts and nuts for pipes 4-in. I.D. and larger. The saddle shall be sealed against the pipe with a rubber gasket and shall have a heavy hub tapped with a corporation stop thread. The clamp shall be designed for 150-psi water working pressure.

502.10.2.1.1. Service Saddles. The service saddles shall be shaped so as to provide approximately 180° coverage around the pipe. Service saddle shall be material conforming to ASTM B62 Composition Bronze or Ounce Metal Castings or as otherwise specified by OWNER. Casting shall conform to AWWA C800.

Service Saddle Hubs. The service saddle hub for single and double strap clamps shall have a wall thickness of not less than ½-in. including threads. The hub shall be tapped with a corporation stop thread of the size specified.

The thread shall have a taper and pitch in accordance with AWWA Standard C800 for Threads for Underground Service Line Fittings. The hub shall be reinforced so that threads shall not be distorted by bending movements.

Open slots for bolts shall not be allowed.

Clamps. Double strapped clamps 4-in. through 12-in. shall have not less than the thickness from the point of the built-up hub segment to the segment immediately adjoining the holes for the service saddle straps specified in Table 502.10.2.1.1.(a) Clamp Minimum Thickness.

Table 502.10.2.1.1.(a) Clamp Minimum Thickness

Clamp Size (in.)	Minimum Thickness (in.)
4	0.190
6	0.195
8	0.195
10	0.195
12	0.215

Markings. Service saddles shall be distinctly marked with cast letters showing manufacturer's name, type pipe saddle as designed for (cast iron, ductile, etc.) and minimum/maximum o.d. ranges.

502.10.2.1.2. Straps. Straps shall be of materials conforming to ASTM B124 Copper and Copper Alloy Forging Rod, Bar, and Shapes, or ASTM B98 Copper-Silicon Alloy Rod, Bar, and Shapes, or A276 Stainless Steel Bars and Shapes. Straps shall be formed flat on one side to fit uniformly against the wall of the pipe. Rod diameter shall be not less than $\frac{5}{8}$ -in. flattened to $\frac{3}{4}$ -in. on one side.

Straps shall be threaded $\frac{5}{8}$ -in. 11-NC-2A for a distance such that $\frac{1}{2}$ -in. remains after clamp is fully tightened on pipe.

502.10.2.1.3. Gaskets. Gaskets shall be of neoprene rubber. Shore hardness shall be 65 ± 5 . Gasket shall be of O-ring type, $\frac{3}{16}$ in. thick and securely fastened to the service saddle to facilitate installation.

502.10.2.1.4. Nuts. Nuts shall be of the same material as service saddles or straps. Nuts are to be semi-finished heavy hexagon tapped $\frac{5}{8}$ -in. 11-NC-2B.

502.10.2.1.5. Hydrostatic Test. All products not previously approved for use shall be subject to hydrostatic test. Service clamps shall not leak or show any structural deformation under a hydrostatic test pressure of 300-psi for 30-days.

502.10.2.1.6. Rejection. All service clamps furnished under these specifications shall be subject to inspection by the OWNER. If any products are found not to conform to the specifications, the lot or any portion thereof may be rejected.

502.10.2.1.7. Water Tubing. See [Item 501.10.](#) for conduit requirements.

502.10.2.2. Tapping Valves. Tapping valves shall conform to the requirements of [Item 502.6.1.17.](#) Tapping Valves.

502.10.2.3. Tapping Sleeves. The material for tapping sleeve bodies shall be cast iron or ductile iron in accordance with AWWA C110 (ANSI 21.10) or ASTM A285 Pressure Vessel Plates, Carbon Steel, Low-and Intermediate-Tensile Strength, Grade C carbon steel, in two sections or halves to be bolted together with high-strength, corrosion-resistant, low-alloy steel bolts conforming to AWWA C111 (ANSI A21.11). Branch outlet of tapping sleeves shall be flanged with a machined projection or recess to mate with tapping valve inlet flange to assure correct alignment.

Cast-iron and ductile-iron tapping sleeves shall be mechanical joint, or as specified, with dimensions to secure proper fit on the type and class of pipe on which they are to be used. Bolts, nuts and glands for mechanical-joint ends shall conform to the requirements of [Item 502.6.1.3.](#) Ends.

Steel sleeves shall be restricted to use on pipe sizes 12-in. and larger and subject to the following additional specifications:

- (1) Flange shall conform to AWWA Standard C207 for Steel Pipe Flanges for Waterworks Service — Sizes 4 In. through 144 in. Class D, ANSI 150 lb. (68.0 kg) drilling. Gasket shall be affixed around the recess of the tap opening in such a manner as to preclude rolling or binding during installation.
- (2) All steel sleeves shall be fusion bonded epoxy coated to an average of 12-mil thickness. Finished epoxy coat shall be free of laminations and blisters, shall not peel and shall remain pliable and resistant to impact.
- (3) Steel sleeves shall be provided with a $\frac{3}{4}$ -in. NPT test opening so that test can be made prior to tapping. Opening shall be provided with a $\frac{3}{4}$ -in. bronze plug.

502.10.2.4. Meter Boxes. The meter box shall be constructed for impact strength and corrosion resistance. The meter box may not be constructed of a material known to degrade in wet, acidic or alkaline soil. Materials specified by the OWNER may include, but are not limited to, cast or ductile iron, precast polymer concrete, corrugated galvanized sheet metal, and plastics such as HDPE, LDPE and LMDPE.

Cast iron shall meet ASTM A48 Gray Iron Castings, Class 30B. Ductile iron shall meet ASTM A536 Ductile Iron Castings. Corrugated galvanized sheet metal (minimum thickness of .036 inches) made with G-90 galvanized coating shall be minimum 20 gauge and galvanized according to requirements of [Item 804.3.](#) Galvanizing. Plastics may be black or white and shall be UV stabilized.

All meter box rings and covers shall be solid, made of gray cast iron conforming to ASTM A48 Class 30B or ductile iron conforming to ASTM A536 and shall bear the MFG ID, casting product number, and Country of Origin.

Where traffic is anticipated, the meter box, with cover installed, shall be able to bear a minimum of 16,000-lb load in a wheel load (H-20) style test.

Box dimensions shall be specified by OWNER. The OWNER may specify boxes compatible with remote meter reading. Meter boxes shall be clearly marked with manufacturers ID and model number.

502.10.3. Water Conduit Connections. This section and [Item 506.6](#). Connections to Existing Water Conduits shall govern for the construction of connections to water conduits.

502.10.3.1. Taps and Tap Assemblies in Water Conduit. Taps and/or tap assemblies of the specified size shall be installed in locations as detailed and indicated on the plans or as specified.

502.10.3.1.1. Taps. Taps for transmission of water or air from the main into system service accessories can be either of two types as follows:

- (1) Standard internal pipe threaded holes in wall of water mains. These taps may be either manufactured into the pipe or installed in the field.
- (2) Tap installations that are made by clamping a service saddle equipped with a sealed threaded port on the periphery of the main and then drilling through the pipe wall to complete each service port. Taps may be made either on an uncharged system or into a main under pressure.

502.10.3.1.2. Tap Assemblies. The tap assembly shall consist of a corporation stop and an iron to copper connection attached to a hard copper (Type K) tubing terminating approximately 1-ft. below ground surface with a brass gate valve as shown and detailed on the plans to serve as additional air release.

When tap assemblies are an integral part of an air valve installation, measurement and payment shall be in accordance with [Item 502.6](#). Valves.

Tap assemblies may be required by the project plans and specifications adjacent to gate valve installations. Tap assemblies so required shall be installed in the water main on either side of the valve. Payment for the tap assemblies shall be included in the unit price bid for furnishing and installing the gate valve complete in place.

When taps are required for flushing, chlorination and/or testing, the CONTRACTOR shall locate the taps in accordance with Standard Drawing 4110 or other detail drawings, plans or in locations directed by the OWNER. No separate payment shall be made for taps required for testing, flushing, and/or chlorination.

Upon completion of the testing and purification, the CONTRACTOR shall return to the job site, remove the blow-off down to the corporation stop, backfill leaving the corporation stop in place, and replace all pavement. The CONTRACTOR'S removal of the blow-off shall include all labor, materials, tools, equipment and incidentals necessary to complete the work, including excavation, backfill and disposal of surplus materials without additional compensation.

502.10.3.1.3. Tapping Sleeves. Steel sleeves shall not be used for taps greater than 75-percent of the pipe diameter. Use of steel sleeves for "size-on-size" taps is prohibited unless sleeve is full-bodied stainless steel, as approved by OWNER.

All steel sleeves shall be crated in wooden crates that shall provide protection from damage to epoxy coating during transport and storage.

502.10.3.1.4. Tapping Ductile Iron Pipe. Service taps, unless otherwise specified, shall be made in cast iron pipe by direct tapping of the pipe wall (without use of tap saddles) for tap sizes relative to pipe diameters as shown in Table 502.10.3.1.4.(a) Tapping Ductile Iron Pipe.

Table 502.10.3.1.4.(a) Tapping Ductile Iron Pipe

Tap Diameter	Pipe Diameter
¾-in. and 1-in.	4-in. through less than 12-in.
1½-in. and 2-in.	12-in. and larger

When direct tapping of cast iron pipe cannot be made within the limits as provided above, taps shall be made as set forth in this specification, utilizing service saddles.

502.10.3.1.5. Tapping Concrete Pipe. Tap location shall be provided to the pipe manufacturer, when available, and taps shall be made by the manufacturer during the fabrication phase of the pipe when locations are so furnished. Taps fabricated during manufacture with a diameter less than or equal to 2-in. shall be provided with brass or bronze insert bushings. Taps greater than 2-in. shall be provided as flanged outlets with flange to thread insulator adapter kits. When taps are required to be made in the field, the taps shall be made in accordance with the pipe manufacturer's recommended procedures and to the satisfaction of the OWNER.

502.10.3.1.6. Tapping Asbestos Cement (AC) Pipe.

If a tap to existing asbestos cement pipe is necessary, use **EXTREME CAUTION** to avoid the airborne release of asbestos fibers.

Taps to asbestos cement pipe can be made with bronze double strap tapping saddles, tapping tees, or pre-tapped couplings with brass insert bushings. A tapping tee shall be paid for as a fitting. If pre-tapped couplings are called for in the contract and proposal, a separate pay item shall be provided for each, classified as to size.

502.10.3.1.7. Tapping PVC Pipe. Service taps in AWWA C900 PVC pressure pipe shall be made with a shell cutter assembly and the coupon removed for tap sizes relative to pipe class and diameter as shown in Table 502.10.3.1.7.(a) Tapping PVC Pipe.

Table 502.10.3.1.7.(a) Tapping PVC Pipe

Tap Diameter	Pipe Diameter	Pressure Class
¾-in. and 1-in.	6-in. to 12-in.	150 and 200

When direct tapping of PVC pipe cannot be made within the limits as hereinbefore provided, taps shall be made as set forth in this specification, utilizing service saddles.

502.10.3.1.8. Measurement and Payment. Measurement shall be for individual taps made by size, and payment shall be absorbed under [Item 506](#). Water Conduit Installation or [Item 502.6](#). Valves unless otherwise specified.

502.10.3.2. Services and Bullheads. The details on installation and materials required are shown in applicable Division 4000 Standard Drawings or on the appurtenance sheets attached to the plans.

The end of each water service connection shall be marked with heavy gauge polyethylene tape, 6-inches in width with a thickness of 0.004-inches. The tape should be blue in color on which has been printed "Caution Buried Water Line Below" in continuous print. The tape should have a minimum tensile strength of 1700-psi lengthwise and 1200-psi crosswise.

Meter boxes shall be buried to protect the meter from unauthorized access, damage and freezing.

502.10.3.2.1. Procedures for Transferring Service. The CONTRACTOR will inform the customer that the service is being transferred. Splices in service lines shall conform to Standard Details 4130 and 4140, unless otherwise approved by OWNER.

Short Service. A water service shall be classified as a "Short Service" if the existing service line to the water meter is on the same side of the street as the new main and requires the existing service line to be replaced to complete the installation as indicated on the plans and specified herein. A curb stop will be installed on the end of the service line.

Long Service. A water service shall be classified as a "Long Service" if the existing service line to the meter is on the opposite side of the street as the new main and requires a new service line to be installed under the street to complete the installation as indicated on the plans and specified herein.

All new services will be flushed according to [Item 506.7](#). Purging and Disinfection of Water Conduits. The main will then be hydrostatically tested and disinfected. After a good sample is received, the CONTRACTOR will then begin transferring the services.

The water serving the customer through the existing water service will be stopped by closing a corp or curb stop on the existing water service. The existing customer line and new service line will then be cut at the property line and connected. Galvanized customer lines will not be threaded for connection, but will be cut and connected with a coupling.

Any meter box located within a driveway or sidewalk shall be relocated and placed in the parkway or behind the sidewalk as directed by the OWNER. Reuse of the existing water meter box shall be as determined by the OWNER. The connection of the new service water lines to the meter shall be considered subsidiary to the service installation.

502.10.3.2.2. Measurement and Payment. Where water services have to be transferred from a line to be replaced, killed or salvaged to a line being constructed, they shall be paid for per each, as set out in the proposal and contract.

Bullheads or water services shall be measured and paid for at the contract price per each, in accordance with size and location, complete in place, as provided in the proposal and contract. The tapping saddle shall be measured and paid for as part of the service. There shall be no extra pay for extra depth in the installation of service leads (deadheads).

Meter boxes shall be paid for per meter box.

The contract price shall be the total compensation for the furnishing of all labor, materials, tools, equipment and incidentals necessary to complete the work.

502.10.4. Wastewater Conduit Connections. This section shall govern for the construction of connections to wastewater conduits. Connections of wastewater pipe to existing wastewater conduits or wastewater appurtenances shall be as shown on the plans or as directed by the Engineer. Details of construction shall be shown on the plans.

The end of each wastewater service connection shall be marked with heavy gauge polyethylene tape, 6-inches in width with a thickness of 0.004-inches unless a cleanout is present. The tape should be green in color on which has been printed "Caution Buried Wastewater Line Below" in continuous print. The tape should have a minimum tensile strength of 1700-psi lengthwise and 1200-psi crosswise.

502.10.4.1. Service Connection. Service pipe shall be of the same pipe material as the main wastewater conduit unless otherwise specified on the plans or in the contract or approved by the OWNER. Connections shall be made to prevent the occurrence of bi-metallic corrosion or any other corrosion that can result by joining incompatible materials.

Wastewater service connections shall be defined as a service line connecting the customer's wastewater system at the property line or utility easement to the main wastewater conduit and shall consist of the service combination tee wye, the necessary Class B or Class PB (as specified by the OWNER) concrete cradle or crushed stone for the tee wye, the service pipe necessary to extend the line from the main wastewater conduit to the customer's property line and a plug placed in the end of the service line.

Services for single-family residence shall normally be 4-inches in diameter. Standard 4-inch laterals shall consist of a standard wye and bend and the necessary pipe and cleanout as shown on the plans or directed by the OWNER. Larger laterals in non-residential uses shall consist of a manhole and the necessary minimum 6-inch pipe as shown on the plans or directed by the OWNER. If the CONTRACTOR is required to connect or reconnect the service line to the customer's wastewater system, the connection shall be as shown on the plans. If the CONTRACTOR is not required to connect to the customer's wastewater system, the service line shall be plugged and sealed.

Extra depth service connections shall be installed when the wastewater main is at a depth greater than that necessary to serve the abutting property. The service is identical to a standard connection except that pipe risers will be installed at a maximum 45-degree angle into the trench walls to connect the combination tee wye and 45-degree bend to the service pipe. Where possible, a minimum slope of 1/4-in.-per-foot (equivalent to a 2% slope) will be maintained. Where the wastewater main is located in the street and the abutting property slopes to the street, the wastewater service shall normally have a minimum depth of 5-feet below the top of the curb at the point where it passes beneath the curb. Where

abutting property slopes away from the wastewater main, service connections shall be placed at a depth adequate to serve the normally expected use of the property.

Where water and wastewater service connections cross, they shall be treated in accordance with TCEQ regulations.

502.10.4.2. Cleanouts. Service line cleanouts shall conform to Standard Drawing 5120. If service line cleanouts are required, double cleanouts shall be installed at the property line, or as specified by OWNER. When specified in the special provisions or in the plans, a test tee shall be installed at the end of the service line (located in the parkway), with the branch in a vertical position.

502.10.4.3. Measurement and Payment. Wastewater conduit connections shall be measured at the contract unit price per each, complete in place. The contract unit price shall be total compensation for the furnishing of all labor, materials, tools, equipment and incidentals necessary to complete the work, including excavation, concrete encasement, if required, disposal of excess material, backfill, embedment, concrete blocking, paving and sod, all in accordance with the plans and specifications.

502.11. MISCELLANEOUS CONDUIT CONNECTIONS

502.11.1. Pitot Outlets. Pitot outlets shall be of the type indicated on the plans or appurtenance sheet. Pitot outlets shall be measured for payment for each. Pitot outlets shall be paid for at the contract unit price per each.

502.11.2. Facilities for Dewatering of Water Lines. There shall be constructed, at the location shown and detailed in the plans, permanent standard blow-offs and drains and special dewatering facilities to permit the blowing off and/or the dewatering of lines or sections of line.

Permanent blow-offs and drains shall be measured as complete units. Payment shall be made for permanent blow-off and drain at the unit price bid which shall be full compensation for the complete installation. Payment for permanent blow-offs with dewatering sump manhole shall be made on a lump sum basis at the unit price bid, which shall be full compensation for complete installation, including excavation and backfill from blow-off fitting to manhole, furnishing and installing sump manhole and other items needed for complete installation exclusive of items for which there are bid items in the proposal.

502.11.3. Wastewater Connections. Connection of wastewater mains to existing manholes and to other wastewater mains where constructing a manhole is not feasible or not required shall be watertight. The use of pipe hammers or jackhammers is prohibited.

502.12. STRUCTURES.

502.12.1. Description. This section shall govern for the construction of all miscellaneous structures such as junctions, transitions, and utility supports, and for the construction of appurtenances such as deep-cut connections, wyes, stoppers and bulkheads, and such other miscellaneous structures or appurtenances which may be shown on the plans. Construction shall conform with any applicable provisions of Division 700. Structures.

Unless otherwise specified on the plans, all storm sewer structures such as junctions, transitions, manholes, cleanouts, wyes, elbows, tees, stoppers and such other miscellaneous structures or appurtenances which may be shown on the plans shall be made of the same base metal and coating (metallic or otherwise) as the pipe on which it is connected. All such structures or appurtenances field fabricated or otherwise will be repaired in accordance with [Item 502.9.7. Repair of Coatings and Liners](#) or [Item 804.3.5. Repair of Damaged Zinc Coating](#), as applicable.

In general there shall not be a pay item for pipe support when a temporary part of conduit installation, but the contract prices for the new or re-laid pipe, shall be the total compensation for the furnishing of all labor, tools, materials, equipment and incidentals necessary to complete the work including excavation, installation and removal of the temporary piping, construction of piers, stripping of forms, disposal of surplus materials, in accordance with the plans and specifications. Where a pay item is included, the contract price shall be the additional compensation for all excavation, labor, tools, and materials over and above the bid price for furnishing and installing the conduit.

502.12.2. Permanent Concrete Structures. The construction of reinforced concrete structures, including junctions, transitions, vaults, piers and beam supports, and such other similar structures as may be covered

by this specification, shall be performed in accordance with the requirements of [Item 702](#). Concrete Structures, applicable Division 1000-5000 Standard Drawings, and the following additional requirements. Unless otherwise specified, all concrete shall have an average compressive strength at 28-days equal or greater than 3000-psi. Excavation shall be made to the required depth and of sufficient width to construct the work to grade, form and dimensions. All soft and yielding materials shall be removed and replaced with acceptable materials. The subgrade shall be moistened to a minimum depth of 2-in. before placing concrete. All formed surfaces of the concrete exposed to public view shall be given a textured finish as shown on the plans. All other formed surfaces shall be given the "Type 1 Finish," as described in [Item 702.5.13](#). Finishing Exposed Surfaces. Corrosion protection shall be applied as may be called for on the plans or the proposal and shall be measured for payment and paid for at the contract price as detailed in [Item 502.9](#). Corrosion-Resistant Coatings and Liners for Wastewater Conduit and Appurtenances.

Permanent concrete structures shall be measured and paid for in accordance with [Item 702](#). Concrete Structures, as provided for in the contract documents. No measurement or payment shall be made for reinforcing steel.

502.12.3. Miscellaneous Pipe Structures. Riprap and miscellaneous pipe structures that may be necessary shall be designed in detail on the plans.

The structures shall be measured for payment per each or in linear feet between the limits set out on the plans as provided for in the proposal and contract. Miscellaneous concrete shall be measured for payment paid for at the contract unit price as provided in the proposal and contract, typically in cubic yards. The contract price shall be the total compensation for the furnishing of all labor, materials, tools, equipment and incidentals necessary to complete the work, including all excavation, disposal of surplus materials and backfill, in accordance with the plans and these specifications.

502.12.4. Connections to Existing Structures. The bottom of the existing structure shall be mortared or concreted, if necessary, to eliminate any drainage pockets by the new connection in general accord with details for the new structure as shown on the plans. Where conduit is connected into old structures that are to remain in service, any damage to the structure resulting from the work of making the connection shall be restored by the CONTRACTOR to the satisfaction of the Engineer.

502.12.5. Waterstops. Waterstops shall be of the type and kind and of materials designated on the plans. Care shall be taken that the waterstop is properly located and held in position during placement of concrete. For particular material, the following shall apply:

- (1) PVC Material. Splices of waterstop shall be performed by fusing the material, using a heat device thermostatically controlled in accordance with the manufacturer's recommendations.
- (2) Copper Material. Any copper sheets which are damaged under construction operations shall be repaired or replaced. Splices shall be made by lapping and soldering or other approved method.

No separate payment shall be made for waterstop material or for installation of this item. The costs shall be included in the price bid for the completed structure into which the materials are incorporated.

502.12.6. Water Migration Barrier. Water migration barrier prevents water flow along an embedded conduit. A 3-ft. $\pm$ 1-ft. long clay barrier (30< P.I. <40) shall be placed at 200-ft. intervals or as directed by OWNER along all water and wastewater mains. This clay barrier shall be for the full width and depth of the trench, replacing all bedding, embedment and backfill materials, and shall be placed at the mid-point of a length of pipe being placed, but not at a location where a lateral or service connects with the water and wastewater main.

ITEM 503. TRENCHLESS INSTALLATION

503.1. CONDUIT MATERIALS

Conduit materials shall be indicated on the plans and shall conform to the specifications of [Item 501](#). Underground Conduit Materials.

503.2. TUNNEL/CASING PIPE SPACERS

503.2.1. General. This specification covers the materials and requirements for pipe restraining system for pipe installation in tunnels or casing pipe under railroads, highways, streets or other trenchless situations. Restraining systems shall prevent pipe joint separation during and after installation and shall provide dielectric insulation between the carrier pipe and the tunnel liner/casing pipe and shall be resistant to corrosion.

503.2.2. Types.

503.2.2.1. Steel Rib and Wood Lagging System. Steel ribs shall conform to ASTM A36 Carbon Structural Steel. The ribs shall be of the size shown on the plans, special provisions or approved from a design load submittal. The ribs shall be bent by cold pressing in dies.

Wood lagging shall have a minimum thickness of 2.75-in. and a minimum average ultimate stress capacity of 5,000-psi. The ultimate stress capacity to be determined according to ASTM D198 Static Tests of Lumber in Structural Sizes, flexure test on five randomly selected timbers from each shipment of lagging. The maximum load carried by each timber disregarding the highest and lowest one of the five timbers tested shall be averaged to determine the ultimate stress capacity of that shipment.

Nuts shall conform to ASTM A307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength. The bolts shall conform to ASTM A449 Quenched and Tempered Steel Bolts and Studs for rib thickness equal to or greater than 0.209-in. and to ASTM A307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength for rib thickness less than 0.209-in.

503.2.2.2. PVC Restrained Casing Spacer System. PVC Restrained Casing Spacers shall be provided at all pipe bell joints and not more than 10-feet apart to support pipe and its contents.

Casing spacer runners shall be an ultra-high molecular weight polymer with a minimum tensile impact of 600-ft-lbs/sq.in. Restrainer body and runner supports shall conform to ASTM A536 High Strength Ductile Iron Grade 65-45-12. Connecting rods and nuts shall conform to high strength, low alloy steel as designated in ANSI/AWWA Standard C-111/A21.11

503.2.2.3. HDPE Casing Spacers. Spacers shall provide full circumferential support in case the carrier pipe twists as it is pushed through the casing. Casing spacers shall have a minimum projection height necessary to clear the bell of the carrier pipe or as otherwise indicated on the plans. Casing spacers shall fasten tightly onto the carrier pipe to prevent spacer movement during installation. The span between spacers should result in conservative long-term load safety factors with carrier pipe full of fluid. Manufacturer shall provide the load carrying capacity of the spacer assembly and maximum spacing shall conform to manufacturer's recommendations.

503.2.2.4. Alternate Casing Spacers. When approved by the OWNER, Nylon, Stainless Steel, Ductile Iron, or Carbon Steel Casing Spacers may be used. Such alternate systems shall conform to all requirements as stated in the plans.

503.2.3. Tests. Tests for compliance with this specification shall be as specified herein. A certification of compliance with this specification along with a report of each test shall be furnished to the OWNER.

503.2.4. Rejection. Tunnel/casing spacers and related materials may be rejected for failure to meet any of the requirements of this specification.

503.3. METHODS OF JACKING, BORING OR TUNNELING

503.3.1. Description. This specification shall govern for the provision of the required opening for the installation of conduits by the methods of jacking, boring or tunneling as shown on the plans and in conformity with this specification.

503.3.2. Materials. The encasement and carrier pipe shall be of the type and strength as indicated on the plans. All necessary materials shall conform to the applicable sections of these specifications or as specified by the OWNER(S) or Engineer.

503.3.3. Construction Methods.

503.3.3.1. General. The CONTRACTOR may request to perform the work by jacking, boring, or tunneling in lieu of open cut.

Where encasement with carrier pipe is required to be installed under railroad embankments or under highways, streets or other facilities by jacking, boring or tunneling methods, construction shall be made in a manner that shall not interfere with the operation of the railroad, highway or other facility and shall not weaken or damage any embankment or structure. The CONTRACTOR shall notify all railroad companies or TxDOT at least 48-hours prior to construction. The CONTRACTOR shall provide insurance as required by the governing authority.

During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained around the excavation, equipment, and materials as required in [Item 107.20](#), Protection of Work and of Persons and Property, until such time as the backfill has been completed and then shall be removed from the site. All excavations shall be safely secured at all times to prevent unauthorized access to the excavation site.

The CONTRACTOR shall take the proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation needed to install the conduit. All damages caused by excavating or blasting, either to surface or subsurface structures, shall be repaired or replaced by the CONTRACTOR at the CONTRACTOR'S own cost and expense. The CONTRACTOR shall dispose of all surplus materials at its own expense.

The drilling of pilot holes for the alignment of pipe prior to its installation by jacking, boring, or tunneling shall not be a requirement but may be necessary to maintain grade.

503.3.3.2. Construction by Jacking. If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. This excavation shall not be carried to a greater depth than is required for placing of the guide and jacking timbers and a horizontal distance no nearer the roadbed than the minimum distance shown on the plans.

At the other end of the pipe, an approach trench shall be excavated accurately to grade. All open trenches and pits shall be braced and shored or their walls sloped in such a manner as shall adequately prevent caving or sliding of the walls into the open trench or pit and be in accordance with the requirements of [Item 107.20](#), Protection of Work and of Persons and Property.

Heavy-duty jacks suitable for forcing the pipe through the embankment shall be provided by the CONTRACTOR. In operating jacks, even pressure shall be applied to all jacks used. Suitable bracing between jacks and the jacking head shall be provided so that pressure shall be applied to the pipe uniformly around the ring of the pipe. The jacking head shall be of such weight and dimensions that it shall not bend or deflect when full pressure is applied at the jack. The jacking head shall be provided with an opening for the removal of excavated material as the jacking proceeds. A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides which are straight and securely braced together in such manner as to support the section of pipe and to direct it in the proper line and grade. All timber and other materials used in the construction of the jacking assembly shall be of such quality and dimensions that they shall withstand all stresses to which they are subjected in such a manner as to insure even pressures on the pipe during jacking operations. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe.

As the jacking proceeds, the embankment material shall be excavated slightly in advance of the pipe in such a manner as to avoid making the excavation larger than the outside diameter of the pipe, with the excavated material being removed through the pipe. The excavation for the underside of the pipe, for at least $\frac{1}{3}$ of the circumference of the pipe, shall conform to the contour and grade of the pipe. The excavation for the top half of the pipe shall conform closely to the outside diameter of the pipe and a clearance greater than 2-in. shall not be permitted. All voids between the pipe and the earth shall be

filled with grout per ASTM C476 Grout for Masonry. Grout holes may be provided in the pipe, or grouting may be made through drill holes from the ground surface if practicable. The grouting shall follow immediately upon completion of the jacking operation. Grout shall have a maximum compressive strength of 100-psi at 28-days.

All carrier pipe installed by jacking shall be supported by a quarter point cradle of Class B or Class PB concrete as specified by the OWNER across the jacking pit and to the first joint in the ditch section on each end.

The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall generally not exceed 2-ft. The pipe preferably shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the OWNER shall be permitted only to the extent of 1-in. per 10-ft., provided that such variation shall be regular and only in one direction and that the final grade of the flow line shall be in the direction indicated on the plans.

Once jacking of pipe is begun, the operation shall be carried on without interruption, insofar as practicable to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be repaired if approved by the OWNER or removed and replaced by the CONTRACTOR at the CONTRACTOR'S entire expense.

The pits or trenches excavated to facilitate jacking operations shall be filled as soon as practicable or as directed by the OWNER. The pits or trenches shall then be backfilled in accordance with the location and conditions as are covered elsewhere in these specifications.

If a carrier pipe is laid through an encasement pipe, the bedding of crushed rock, concrete, grout or granular material, if any, shall be considered a part of the unit price of the jacking operation.

503.3.3.3. Construction by Boring. The hole shall be bored mechanically with a suitable boring assembly designed to produce a smooth, straight shaft and so operated that the completed shaft shall be at the established line and grade. The size of the bored hole shall be of such diameter to provide ample clearance for bells or other joints. The holes are to be bored mechanically. The boring shall be done by using either a pilot hole or a dry bore method.

A pilot hole boring shall be constructed by the following method: An approximate 2-in. pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. The pilot hole shall serve as the centerline of the larger diameter hole to be bored.

The dry bore shall be constructed as follows: The casing pipe shall be advanced as the soil is removed by augers. Bentonite may only be used as a lubricant. Casing shall be new or used steel conduit approved by the OWNER, with a minimum inside diameter sufficiently larger than the outside diameter of the carrier pipe or ducts to accommodate placement or removal.

All carrier pipe installed by boring shall be supported by a quarter point cradle of Class B or Class PB concrete as specified by the OWNER across the boring pit and to the first joint in the ditch section on each end. All pits should have crushed rock and sump areas to remove water. Where groundwater is found, pits shall be lined with filter fabric.

All voids shall be grouted per ASTM C476 Grout for Masonry and shall be considered a part of the unit price of the boring operation.

In addition to the requirements stated above, the applicable provisions of [Item 503.3.3.2. Construction by Jacking](#) in regard to the construction of trench, tolerance in line and cradle, method of operations, backfilling, etc. shall govern for construction by boring.

503.3.3.4. Construction by Guided Boring or Directional Drilling. Guided boring or directional drilling shall be accomplished according to the standards in *Trenchless Technology Guidelines* published by the International Society for Trenchless Technology.

503.3.3.5. Construction by Tunneling. The tunnel shall be excavated in such a manner and to such dimensions so as to permit placing of the proper supports necessary to protect the excavation. The CONTRACTOR shall take the proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation shown on the plans. All damages caused by excavating and blasting,

either to surface or subsurface structures, shall be repaired or replaced by the CONTRACTOR at its own cost and expense. Adequate provisions shall be made for safety and health of the workers. All equipment operated in the tunnel shall be powered by either air or electricity. No equipment shall be permitted in the tunnel that uses a petroleum product such as fuel.

Electric lights shall be used for illumination of completed portions of the tunnel used for passage and wherever lighting is needed for inspection of the work. A sufficient number of lamps shall be used to properly illuminate the work, and all wiring for electric power and lights shall be installed and maintained in a safe and secure manner in accordance with the current applicable electrical specifications of the OWNER. CONTRACTOR shall maintain the tunnel air in a condition suitable for the health of the workers and sufficiently clear for surveying operations. A sufficient supply of fresh air shall be provided and maintained at all times in all underground places. Provisions shall be made for the quick and complete removal of gases and dust resulting from blasting or other tunnel operations. Except when unnecessary due to natural ventilation, artificial ventilation shall be maintained in the tunnel by ventilating plants of ample capacity operated when needed to meet the preceding requirements.

If required by the plans or if required for safety, suitable steel or timber sheeting, shoring and bracing in accordance with [Item 107.20.3](#), Trench Safety shall be used to support the sides and roof of the excavation. When the installation is completed, and if approved by the OWNER, supports may be left in place, provided that they clear the encasement or carrier pipe. No separate payment shall be made for supports left in place. Nothing contained herein shall prevent the CONTRACTOR from placing such temporary or permanent supports as it shall deem necessary, nor shall anything contained herein be construed as relieving the CONTRACTOR from its full responsibility for the safety of workers and for all damages to personal property caused by its operations.

If the tunnel is to be lined with concrete as a monolithic structure, then the overbreak, if any, or voids shall be poured with Class A or Class PA concrete as specified by the OWNER. The CONTRACTOR shall not be compensated for overbreaks.

No pipe shall be placed until the foundation is in a condition satisfactory to the OWNER. Tunnel dimensions shown on the plans are minimum dimensions. Any excess excavation and subsequent backfill, concrete or grout fill shall be at the expense of the CONTRACTOR. The pipe shall be laid in the tunnel true to line and grade. Tolerance in line and grade shall be as specified in [Item 503.3.3.2](#), Construction by Jacking.

If indicated or specified, the entire void between the outside of the pipe and the tunnel walls or the inside face of the tunnel lining shall be grouted per ASTM C476 Grout for Masonry unless the permanent sheeting, bottom, sides and roof of the tunnel are in a condition satisfactory to the OWNER. The minimum thickness of grout backfill where specified shall be maintained throughout. Grout required for backfill in excess of the minimum dimensions shown on the plans shall be at the entire expense of the CONTRACTOR.

All pipe damaged during construction operations shall be repaired, if approved by the OWNER, or removed and replaced by the CONTRACTOR at the CONTRACTOR'S entire expense.

503.3.3.6. Joints. If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting bands, whichever is feasible. When reinforced concrete pipe 24-in. and larger in diameter with tongue-and-groove joints is used for the encasement pipe, the interior joints for the full circumference shall be sealed, packed with mortar and finished smooth and even with the adjacent section of pipe.

503.4. MEASUREMENT AND PAYMENT.

Jacking, boring or tunneling shall be measured for payment in linear feet along the centerline of the pipe measured from face to face of the trench ends or pit walls between which the jacking, boring or tunneling traverses and shall not be classified for payment according to depth. The carrier pipe, when required, shall be measured for payment as provided in the contract documents. Jacking, boring or tunneling shall be paid for at the contract unit price per linear foot (m) complete in place, as provided in the proposal and contract. Open pits required for jacking, boring or tunneling shall be considered incidental and shall not be paid for separately. The contract unit price shall be the total compensation for furnishing and placing all materials including encasement

pipe, if required, and grout backfill; for all jacking, boring, tunneling, excavation and backfill; for all sheeting, shoring, bracing and drainage; for disposal of all surplus materials; and for all labor, tools, equipment and incidentals necessary to complete the work, all in accordance with the plans and these specifications. The carrier pipe, when required, shall be paid for as provided in the contract documents.

No additional compensation will be provided for jacking, boring, or tunneling in lieu of open cut approved by the OWNER. The removal of any obstruction that conflicts with the placing of the pipe will not be measured for payment or paid for as a separate contract pay item. The removal of any such obstruction will be included in such contract pay items as are provided in the proposal and contract. The drilling of pilot holes will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the proposal and contract. The CONTRACTOR shall only be paid for the limits as shown on the plans. Any overrun, except as approved by the OWNER, shall be at the CONTRACTOR'S expense.

ITEM 504. OPEN CUT – BACKFILL

504.1. GENERAL

This section addresses the process of open cut and backfill. Backfill shall mean embedment and final backfill. Embedment shall mean bedding and initial backfill. Bedding shall mean the material upon which a pipe rests. Initial backfill shall mean material that covers the storm sewer, wastewater collection system, and water lines. Final backfill shall mean the material required to fill the trench from the top of the initial backfill to ground elevation or subgrade of a street.

Work shall include:

- (1) Pollution Prevention shall be performed in accordance with [Item 202](#). Temporary Erosion, Sedimentation, and Water Pollution Prevention and Control;
- (2) Site preparation as part of open cut installation shall be performed in accordance with [Item 203](#). Site Preparation, except shall be considered as incidental work and the cost thereof shall be included in such contract pay item as provided in the proposal and contract;
- (3) Excavation shall be performed in accordance with [Item 203.2](#). Unclassified Channel Excavation.
- (4) Landscaping shall be performed in accordance with [Item 204](#). Landscaping;
- (5) Trench safety shall be performed in accordance with [Item 107.20](#). Protection of Work and of Persons and Property;
- (6) Restoration of disturbed areas shall be performed in accordance with [Item 107.27](#). Restoration of Property.

504.2. MATERIALS

504.2.1. Pipe Embedment Material for Special Applications. The pipe shall be embedded in accordance with details shown on the plans for the type of embedment indicated or specified. In general, if no particular type of embedment is shown on the plans nor specified, CONTRACTOR shall use material according to pipe manufacturer recommendation.

504.2.2. Pipe Embedment Material for Storm, Water and Wastewater Mains.

504.2.2.1. Crushed Stone Embedment. The aggregates shall consist of durable particles of crushed stone, free from frozen material or injurious amounts of salt, alkali, organic matter or other material either free or as adherent coating, and its quality shall be reasonably uniform throughout. It shall have a wear of not more than 40-percent when tested in accordance with TxDOT Test Method Tex-410-A Abrasion of Coarse Aggregate Using the Los Angeles Machine.

When tested by standard laboratory methods, crushed stone embedment for each gradation shall meet the requirements of Table 504.2.2.1.(a) Crushed Stone Embedment Gradations.

Table 504.2.2.1.(a) Crushed Stone Embedment Gradations

Passing or Retained on Sieve	Percent by Weight
Standard Crushed Stone — Aggregate Grade 4	
Retained on 1½-in. sieve	0%
Retained on 1-in. sieve	0 to 5%
Retained on ½-in. sieve	40 to 75%
Retained on No. 4 sieve	90 to 100%
Retained on No. 8 sieve	95 to 100%
Blended Crushed Stone — Aggregate Grade 48	
Retained on 1½-in. sieve	0%
Retained on 1-in. sieve	0 to 5%
Retained on ½-in. sieve	40 to 75%
Retained on No. 4 sieve	75 to 100%
Retained on No. 8 sieve	90 to 100%
Fine Crushed Stone — Aggregate Grade 8	
Retained on ½-in. sieve	0%
Retained on ¾-in. sieve	0 to 5%
Retained on No. 4 sieve	35 to 60%
Retained on No. 8 sieve	90 to 100%
Coarse Crushed Stone	
Passing 1½-in. sieve	100%
Retained on ¾-in. sieve	100%

504.2.2.2. Granular Material. Granular material shall be free flowing, such as sand or hydraulically graded crushed stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over two inches in diameter, clay and organic matter.

504.2.2.3. Select Material. Select material shall be gravel, fine stone cuttings, sand, sandy loam or loam free from excessive clay. Stone cuttings shall have no dimension greater than two-inches.

504.2.2.4. Crushed Stone for Foundation. Crushed stone for foundation shall meet the requirements for [Item 504.2.2.1](#). Crushed Stone Embedment except the gradation shall be according to Table 504.2.2.4.(a) Crushed Stone for Foundation Gradation.

Table 504.2.2.4.(a) Crushed Stone for Foundation Gradation

Passing or Retained on Sieve	Percent by Weight
Passing 5-in. sieve	100%
Retained on 2-in. sieve	100%

504.2.2.5. Natural Gravel. Natural gravel shall consist of uncrushed stones meeting the requirements for wear as outlined in [Item 504.2.2.1](#). Crushed Stone Embedment. The material shall be washed and screened and not have by weight more than one-percent organic matter, clays or loam and not more than five-percent by weight of any one of or combination of slate, shale, schist or soft particles of sandstone. The gradation shall be according to Table 504.2.2.5. (a) Natural Gravel Gradation.

504.2.2.6. Sand. Sand shall consist of clean, hard, durable, uncoated grains, free from lumps and organic material. All particles must pass a No. 8 sieve.

504.2.3. Final Backfill. The trench shall be backfilled in accordance with details shown on the plans for the type of backfill indicated or specified.

If filter fabric is required by OWNER, place filter fabric conforming to TxDOT Specification DMS-6200 between the native soil and the backfill.

504.2.3.1. Type “A” Backfill. Type “A” backfill shall meet the following requirements:

504.2.3.1.1. Tests. The liquid limit shall not exceed 35 when tested in accordance with ASTM D4318 Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. The plasticity index shall not exceed 10 when calculated in accordance with ASTM D4318. The linear shrinkage shall not exceed six-percent when Type “A” backfill is used for pavement base material.

504.2.3.1.2. Gradation. The material when tested by standard laboratory methods shall meet the gradation in Table 504.2.3.1.2.(a) Type “A” Gradation.

Table 504.2.3.1.2.(a) Final Backfill Type “A” Gradation

Passing or Retained on Sieve	Percent by Weight
Passing 2-in. sieve (50 mm)	100%
Passing ½-in. sieve (12.5 mm)	50 to 85%
Passing No. 4 sieve (4.75 mm)	20 to 65%
Passing No. 100 sieve (150 um)	0 to 5%

504.2.3.2. Alternate Allowable Type “A”. Field sand having the following requirements may be used in lieu of Type “A” backfill for filling trenches. The field sand material shall be obtained from approved sources; shall consist of durable particles; and shall be free of thin or elongated pieces, lumps of clay, soil, loam or vegetable matter. The material shall be required to meet the gradation in Table 504.2.3.2.(a) Alternate Allowable Type “A” Gradation when tested from source of supply test samples.

Table 504.2.3.2.(a) Alternate Allowable Type “A” Gradation

Passing or Retained on Sieve	Percent by Weight
Passing No. 4 sieve (4.75 mm)	100%
Passing No. 16 sieve (1.18 mm)	80 to 100%
Passing No. 50 sieve (300 um)	20 to 60%
Passing No. 100 sieve (150 um)	10 to 40%
Passing No. 200 sieve (75 um)	0 to 10%

504.2.3.3. Type “B” Backfill. Type “B” backfill is native or imported material. Type “B” backfill shall at minimum meet the following quality requirements.

504.2.3.3.1. Tests. The liquid limit shall not exceed 35 when tested in accordance with ASTM D4318. The plasticity index shall not exceed 12 when tested in accordance with ASTM D4318.

504.2.3.3.2. Gradation. Type “B” backfill shall meet the requirements in Table 504.2.3.3.2.(a) Final Backfill Type “B” Requirements.

Table 504.2.3.3.2.(a) Final Backfill Type “B” Requirements

Description	Limits
Stone. All stone must be reasonably uniform in distribution throughout the backfill material in order to be considered acceptable for use, regardless of the width of trench in which the material is to be used.	
Maximum amount of stone permitted, regardless of trench width, as a percent of final backfill volume	50%
Largest dimension of stone allowed in trenches 4-ft. or less in width	3-in.
Largest dimension stone to total final backfill volume, regardless of trench width	3%
Largest dimension of stone allowed in trenches greater than 4 ft. in width	6-in. Total volume not to exceed 1% of backfill
Lumps. All lumps must be reasonably uniform in distribution throughout the backfill material in order to be considered acceptable for use, regardless of the width of trench in which the material is to be used	
Maximum amount of clay or gumbo lumps permitted, regardless of trench width, as a percent of final backfill volume	25%
Largest dimension of clay or gumbo lumps in trenches 4-ft. or less in width	6-in.
Largest dimension of clay or gumbo lumps permitted in trench greater than 4-ft. in width.	10-in. Total volume not to exceed 1% of backfill

504.2.3.3.3. Additional Requirements. Additional requirements for Type “B” backfill when used in streets:

- (1) 35 percent or less shall pass the No. 200 sieve.
- (2) Material otherwise meeting specifications requirements and having a PI greater than 15 shall be considered as suitable for use only when compaction procedure includes mechanical compaction.
- (3) Material shall be of such characteristics that it shall stabilize without the use of lime or other similar additive and form an acceptable street subbase material.

504.2.3.4. Flowable or Stabilized Backfill. Flowable or stabilized backfill shall consist of a mixture of native soils or manufactured materials, cement and/or fly ash, and water which produces a material with unconfined compressive strength of between 250-psi and 450-psi after 28-days. Any materials used shall be primarily granular, with a plasticity index <12 and with 100% passing a ¾-in. sieve. The flowable mixture shall be mixed in a pug mill, concrete mixer, or transit mixer and shall have a minimum slump of 5-in. The flowable mixture must be allowed to set prior to the placement of any overlying material. Stabilized backfill as defined in [Item 504.6.2](#). Stabilized Backfill requires manual compaction.

504.2.3.5. Modified Flowable Backfill. Modified flowable backfill in areas of possible future excavation such as utility installations shall consist of a mixture of native soils or manufactured materials, cement and/or fly ash, air-entraining material, and water which produces a material with unconfined compressive strength of between 50-psi and 150-psi after 28-days. Modified flowable backfill in permanent areas such as abandoned pipe closures, abutments and embankments shall contain similar materials and shall have an unconfined compressive strength of greater than 150-psi after 28 days. Any materials used shall be primarily granular, with a plasticity index <12 and with 100% passing a ¾-in. sieve. The flowable mixture shall be mixed in a pug mill, concrete mixer, or transit mixer and shall have a minimum slump of 5-in. The flowable mixture must be allowed to set prior to the placement of any overlying material.

504.2.3.6. Fast Set Flowable Backfill. Fast Set Flowable Backfill shall be brought to site via volumetric concrete mixer and consist of an appropriate amount of cement (with other additives as necessary) mixed with mortar sand to flow and fill all voids in the excavation. This fill shall develop a compressive strength of 1120 pounds per square foot one hour after placement, and a 28-day compressive strength with the range of 25 to 100 psi. The material must be such that it can be capped in one and one-half to two hours.

504.2.4. Rejection. Materials that fail to meet the requirements of these specifications may be rejected by the OWNER. Such rejection shall incur no cost to the OWNER. Material sources, from which materials with properties not meeting these specifications are delivered, may be rejected as further supply sources to the project by the OWNER. Such rejection shall incur no cost to the OWNER.

504.3. EXCAVATION AND FOUNDATION

504.3.1. Excavation. Excavation shall be performed in accordance with [Item 203](#). Site Preparation.

504.3.2. Foundation. During the progress of the work, should the foundation for the conduits be in material unsuitable for the subgrade of the conduit, which is not the result of the CONTRACTOR'S negligence to make proper provisions for adequate drainage of the excavation, the CONTRACTOR shall remove such unsuitable subgrade material to the depth directed by the OWNER. The space thus created shall be filled with stone as described in [Item 504.2.2.4](#). Crushed Stone for Foundation, coarse crushed stone as described in [Item 504.2.2.1](#). Crushed Stone Embedment, or Class B or Class PB concrete (as specified by the OWNER) as described in [Item 702.3](#). Mix Design and Mixing Concrete for Structures. The type of material to be used for the foundation shall be determined by the OWNER. In lieu of removing the subgrade material or in conjunction with placement of the foundation material, the OWNER may require a geotextile material as described in the contract documents to be placed between the bedding and the subgrade or between the foundation material and the subgrade.

The entire foundation area in the bottom of all excavation shall be firm, stable and at uniform density as nearly as practicable. Unless necessary, materials shall not be disturbed. The final cleaning off and preparing of the foundation area shall be done immediately prior to the placing of the embedment materials or structures.

504.3.2.1. Foundation Measurement. Foundation material shall be measured for payment complete in place to the dimensions prescribed by the OWNER. Geotextile material, if used, shall be measured for payment complete in place to the dimensions prescribed by the OWNER.

504.3.2.2. Foundation Payment. Foundation material shall be paid for at the contract unit bid price in cubic yards as provided for in the contract. Geotextile material shall be paid for at the contract unit bid price per square yard as provided for in the contract. If a bid item is not established in the contract for foundation material and/or geotextile material, it shall be considered subsidiary to the contract (non-pay item).

In case of failure to make adequate pumping, draining and bailing provisions, resulting in unstable subgrade conditions, and which shall require any of the hereinbefore described foundations, such foundations shall be placed at the entire cost of the CONTRACTOR and shall not be measured or paid for as separate contract pay items.

The contract unit price shall be total compensation for furnishing all labor, tools, materials, equipment and incidentals necessary to complete the work, including all excavation and disposal of surplus material.

504.4. BACKFILL – GENERAL REQUIREMENTS

504.4.1. Description. This specification shall govern construction of all types of storm drain, wastewater collection systems, and water structures except where the requirements are revised by another governing specification. All structures shall be constructed in accordance with the design requirements, with the details shown on the plans, and with the requirements herein provided. Other applicable sections or parts of these specifications shall govern for such miscellaneous and incidental construction necessary to complete the work in accordance with the plans and specifications.

For specific applications, pipe materials, etc. refer to [Section 504.5.2](#). Embedment Classes.

504.4.2. Materials and Equipment. All materials used in the construction of work specified in this division shall conform to the applicable sections of these specifications and approved by the OWNER. Any materials placed before approval of the OWNER shall be removed, if directed by the OWNER, and replaced with approved materials.

All machinery and equipment necessary for the construction of the work specified herein shall be on the project and shall be maintained in good condition to insure the completion of the work without excessive delays for repairs and replacements. Equipment used for disposal of surplus materials beyond the limits of the work shall be such as to avoid spilling or wasting of materials along the line of haul. The CONTRACTOR shall immediately clean up all materials spilled or wasted along the line of haul. The OWNER reserves the right to approve the location and methods of disposal for surplus material.

504.4.2.1. Water for Construction. Unless otherwise specified in the contract, water required for construction and furnished from the OWNER's distribution system shall be paid and accounted for as prescribed by the OWNER. The CONTRACTOR shall make and bear the cost of all necessary arrangements and means for hauling the water. Water shall be furnished free of charge from the OWNER's main, if available, for filling newly constructed water mains for flushing, sterilizing and hydrostatic testing. Construction water, if delivered through a fire hydrant meter, shall be protected by a reduced pressure zone assembly provided at the CONTRACTOR's expense.

504.4.2.1.1. Use of Fire Hydrant and Valves. The CONTRACTOR shall not operate any fire hydrant or valve in the existing water system without the permission of the OWNER. If permission is granted, the CONTRACTOR shall use only approved fire hydrant and valve wrenches. The OWNER shall inspect all fire hydrants and/or valves operated by the CONTRACTOR prior to final acceptance of the project. All repairs or replacements required to restore satisfactory operation of fire hydrants and/or valves shall be at the expense of the CONTRACTOR.

504.4.2.2. Material and Equipment Storage. The CONTRACTOR shall confine equipment, storage of materials, and construction operations to the area shown on the Contract Drawings or as directed by OWNER. Storage shall not unreasonably encumber the site or public right-of-way with construction equipment or materials. Materials shall be stored in a manner to best protect and preserve the material to the satisfaction of the OWNER. Materials shall be sorted and stored neatly and accessibly. Materials not properly stored shall not be eligible for inclusion in partial pay estimates. Storage shall also comply with all requirements of [Item 106](#), Control of Material.

504.4.3. Sequence. The sequence of operations to be followed shall be prepared by the CONTRACTOR for approval by the OWNER. The sequence shall meet the job requirements for completion time, avoid interference with plant operations and conform to plan and specification requirements. The construction of all storm drain and wastewater collection systems shall begin at the outlet or lower end, unless otherwise directed by the OWNER. Tributary lines for storm drain and wastewater collection systems shall not be started until the main line has been built to their junction points.

504.4.4. Connections. The connections of conduits or appurtenances to conduits shall be made in accordance with the plans and as directed by the OWNER. This work shall be done in such a manner so as not to damage any of the structures involved. Any damage to the structures due to the connection shall be repaired at the CONTRACTOR's expense. No connecting conduit shall project beyond the inside surface of other conduits or appurtenances, except in case of pipe laid through a manhole.

504.5. EMBEDMENT

Embedment is the bedding and initial backfill. The type of embedment to be used for storm water collection systems, wastewater collection systems or water mains shall be specified in the contract documents or on the plans.

504.5.1. General**504.5.1.1. Terms.**

D — Inside diameter of the pipe.

OD — Outside diameter of the pipe.

B_c — Outside diameter of the pipe.

B_d — Trench width.

Stone cuttings are rock trench excavated material. The maximum allowable dimension of the stone to be used for embedment is 1-in.

Densities shall be shown as a percent of the maximum dry density at not less than 2% below optimum moisture of samples of the material as determined by the ASTM D698 Maximum Density Optimum Moisture Test.

504.5.1.2. Flexible Pipe. 16-in. or greater diameter flexible pipe may be strutted horizontally and vertically prior to backfilling. After backfilling, the struts shall be removed and the deflection checked to verify that excessive deflection as specified has not occurred. If excessive deflection has occurred, the pipe shall be removed and reinstalled.

504.5.1.3. Trench Dimensions. Trench dimensions shall be determined according to Table 504.5.1.3.(a) Trench Dimensions unless otherwise specified as greater.

Table 504.5.1.3.(a) Trench Dimensions

Pipe size	Trench Dimensions
Minimum Depth of Trench Below the Pipe	
27-in. and smaller	3-in.
30-in. to 60-in.	4-in.
66-in and larger	6-in.
Limiting Trench Width	
24-in. pipe and smaller	24-in. or O.D. of the pipe plus 16-in., whichever is greater
Greater than 24-in., to and including 72-in.	O.D. of the pipe installed plus 24-in.
Larger than 72-in.	O.D. times 1.25 plus 1-ft.

504.5.2. Embedment Classes.

504.5.2.1. Class “A” Embedment. See Standard Drawing 3010. The embedment consists of concrete bedding and initial backfill of granular material.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{4}B_c$, minimum of 6 in. measured from the outside of the pipe bell, the pipe shall be laid to grade on supporting brick or concrete block and jointed as specified. A compressible strip shall be placed between the pipe and the support. The pipe shall be restrained, if required, to prevent flotation. Class B or Class PB concrete as specified by the OWNER shall be poured on either side of the pipe to form the bedding under the pipe and up the sides of the pipe $\frac{1}{4}B_c$. The concrete placed under the pipe shall have a sufficient fluidity so it can flow under the haunches and be puddled to insure even support.

The initial backfill layer shall be granular material and shall be brought to a point 12-in. above the top of the pipe.

504.5.2.2. Class “A-1” Embedment. See Standard Drawing 3010. The embedment consists of crushed stone bedding and a cap of concrete as initial backfill.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{4}B_c$, minimum of 6 in. measured from the outside of the pipe bell, the bedding layer shall be brought to a point slightly above grade with compacted standard gradation crushed stone. Bell holes shall be formed, if required, a trough scooped out to grade, and the pipe laid and jointed as specified. The stone shall then be brought up in uniform layers on either side of the pipe $\frac{1}{2}B_c$.

Class B or Class PB concrete as specified by the OWNER, plain or reinforced as specified in the plans, shall be poured over the top of the pipe and bells to cover the pipe with a thickness of $\frac{1}{4}B_c$, 4-in. minimum to form the initial backfill layer.

504.5.2.3. Class “B” Embedment. See Standard Drawing 3020. The embedment consists of crushed stone bedding and initial backfill of select material or granular material.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{8}B_c$, minimum of 6 in. measured from the outside of the pipe bell, the bedding shall be brought up to a point slightly above the grade with stone cuttings or crushed stone, standard gradation. Bell holes shall be formed, a trough scooped out to grade and the pipe laid and joined as specified. The crushed stone or stone cuttings shall then be brought up the sides of the pipe in uniform layers $\frac{1}{2}B_c$.

The initial backfill shall consist of granular material. The material shall be placed on top of the crushed stone in uniform layers on either side of the pipe to a point 12 in. above the top of the pipe and compacted to at least 90-percent of maximum density as determined by ASTM D698.

504.5.2.4. Class “B+” Embedment. See Standard Drawing 3020. The embedment consists of fine crushed stone bedding and initial backfill of granular material.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{8}B_c$, minimum of 6 in. measured from the outside of the pipe bell, the bedding shall be brought up to a point slightly above grade with fine crushed stone. Bell holes shall be formed, a trough scooped out to grade and the pipe laid and jointed as specified. The stone shall then be brought up in uniform layers on either side of the pipe $\frac{1}{2}B_c$.

The initial backfill shall consist of granular material. The material shall be placed on top of the stone and shall be brought up in uniform layers on either side of the pipe to a point 12-in. above the top of the pipe. Density shall be at least 90-percent of maximum density as determined by ASTM D698.

504.5.2.5. Class “B-1” Embedment. See Standard Drawing 3020. The embedment consists of fine crushed stone bedding and initial backfill of select material or granular material.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{8}B_c$, minimum 6 in. for measured from the outside of the pipe bell, the bedding shall be brought up to a point slightly above grade with fine crushed stone. Bell holes shall be formed and the pipe laid and jointed as specified.

The stone shall then be brought up in uniform layers on either side of the pipe $\frac{3}{4}B_c$.

The initial backfill shall consist of compacted granular material brought up to a point 6 in. above the top of the pipe. Density shall be at least 90-percent of maximum density as determined by ASTM D698.

504.5.2.6. Class “B-2” Embedment. See Standard Drawing 3030. The embedment consists of fine crushed stone bedding and initial backfill of select material or granular material.

After the trench has been cut to a depth below the barrel of the pipe 6 in. measured from the outside of the pipe bell, the bedding layer shall be brought to a point slightly above grade with compacted fine crushed stone. Bell holes shall be formed, if required, a trough scooped out to grade, and the pipe laid and jointed as specified. The stone bedding layer shall then be brought up in uniform layers on either side of the pipe $\frac{3}{4}B_c$.

The initial backfill shall consist of compacted granular material and shall be brought to a point 12 in. above the top of the pipe. Density shall be at least 90-percent of maximum density as determined by ASTM D698.

504.5.2.7. Class “B-3” Embedment. See Standard Drawing 3030. The embedment consists of granular material.

After the trench has been cut to a depth below the barrel of the pipe a distance of minimum of 6 in. measured from the outside of the pipe bell, the bedding shall be brought to a point slightly above grade with compacted fine sand. Bell holes shall be formed, if required, a trough scooped out to grade, and the pipe laid and jointed as specified. The granular material shall then be brought up in uniform layers on either side of the pipe and over the pipe to a point 12 in. above the top of the pipe.

504.5.2.8. Class “B-4” Embedment. See Standard Drawing 3030. The embedment consists of cement-treated backfill.

After the trench has been cut to a depth below the barrel of the pipe a distance of minimum of 6 in. measured from the outside of the pipe bell, the bedding shall be brought to a point slightly above grade with cement-treated backfill. Bell holes shall be formed, if required, a trough scooped out to grade and the pipe laid and jointed as specified. The cement-treated backfill shall then be brought up to uniform layers on either side of the pipe and over the pipe to a point 6 in. above the top of the pipe.

504.5.2.9. Class “C” Embedment. See Standard Drawing 3040. The embedment is a bedding of crushed stone or stone cuttings and initial backfill of select material or granular material.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{8}B_c$, minimum of 6 in. measured from the outside of the pipe bell, the bedding shall be brought up to a point slightly above grade with stone cuttings or standard crushed stone. Bell holes shall be formed, a trough scooped out to grade, and the pipe laid and jointed as specified. The stone shall then be brought up in uniform compacted layers on either side of the pipe $\frac{1}{6}B_c$.

The initial backfill shall be granular material and shall be brought up in uniform compacted layers to a point 6 in. above the top of the pipe. Density shall be at least 90-percent of maximum density as determined by ASTM D698.

504.5.2.10. Class “C+” Embedment. See Standard Drawing 3040. The embedment consists of fine crushed stone bedding and initial backfill of granular material.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{8}B_c$, minimum of 6 in. measured from the outside of the pipe bell, the bedding layer shall be brought up to a point slightly above grade with fine crushed stone. Bell holes shall be formed, a trough scooped out to grade, and the pipe laid and jointed as specified. The stone shall then be brought up in uniform, compacted layers on either side of the pipe $\frac{1}{6}B_c$.

The initial backfill shall be granular material and shall be brought up in uniform, compacted layers to a point 6 in. above the top of the pipe. Density shall be at least 90-percent of maximum density as determined by ASTM D698.

504.5.2.11. Class “C-1” Embedment. See Standard Drawing 3040. The embedment shall consist of fine sand bedding and initial backfill of granular material.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{8}B_c$, minimum of 6 in. measured from the outside of the pipe bell, the bedding layer shall be brought up to a point slightly above grade with fine sand. Bell holes shall be formed, a trough scooped out to grade and the pipe laid and jointed as specified. The sand shall then be brought up in uniform compacted layers on either side of the pipe $\frac{1}{6}B_c$.

The embedment backfill shall be granular material and shall be brought up in uniform, compacted layers to a point 6-in. above the top of the pipe. Density shall be at least 90-percent of maximum density as determined by ASTM D698.

504.5.2.12. Class “D+” Embedment. See Standard Drawing 3050. The embedment consists of select material.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{8}B_c$, minimum of 6 in. measured from the outside of the pipe bell, the embedment shall be brought up to a point slightly above grade with select material. Bell holes shall be formed, a trough scooped out to grade and the pipe laid and jointed as specified. The material shall then be brought up in uniform compacted layers to a point 6 in. over the top of the pipe. Density shall be at least 90-percent of maximum density as determined by ASTM D698.

504.5.2.13. Class “G” Embedment. See Standard Drawing 3050. The embedment consists of Class B or Class PB concrete as specified by the OWNER.

After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{4}B_c$, 6 in. minimum measured from the outside of the pipe bell, the pipe shall be laid and jointed as specified. The pipe shall be supported by brick or concrete block. A compressible strip shall be placed between the pipe and support. The pipe shall be restrained, if required, to prevent flotation. Class B or Class PB

concrete as specified by the OWNER shall be poured on either side of the pipe to form the embedment under the pipe, up the sides and over the top of the pipe and bells with a minimum thickness of 6 in. The concrete placed under the bell shall have a sufficient fluidity so it can flow under the haunches and be puddled to insure even support.

504.5.2.14. Class “G-1” Embedment. See Standard Drawing 3060. The embedment consists of Class “G” embedment as specified above and a trench backfill of Class B or Class PB concrete as specified by the OWNER or stabilized backfill, whichever is specified in the plans, and a 6 in. thick Class B or Class PB (as specified by the OWNER) concrete cap as initial backfill.

504.5.2.15. Class “H” Embedment. See Standard Drawing 3060. The embedment consists of a completely encased pipe with standard Crushed Stone, Grade 4. After the trench has been cut to a depth below the barrel of the pipe a distance of $\frac{1}{2}B_c$, 6 in. minimum, the bedding layer shall be brought to a point slightly above grade with compacted crushed stone. Bell holes shall be formed, a trough scooped out to grade and the pipe laid and jointed as specified. The material shall then be brought up in uniform compacted layers of 6 in. to a point 6 in. over the top of the pipe.

504.5.2.16. Alternate Embedment for Concrete Pipe. The Engineer may design alternate embedment for concrete pipe. Such embedment shall be designed according to Design Data 40, Standard Installations and Bedding Factors for the Indirect Design Method written by the American Concrete Pipe Association. Such embedment shall be constructed as shown on the plans.

504.5.3. Initial Backfill.

504.5.3.1. General. Initial backfill is the material that covers the storm drain system, wastewater collection system, and water lines. Backfill procedure is that procedure required to return trenches or excavated areas to a condition satisfactory to the OWNER. Such backfilling occurs in two general areas. They are: (1) areas not subject to vehicular traffic; and (2) areas subjected directly to, or influenced by, vehicular traffic.

The methods of backfilling to be used shall vary with the width of trench, the character of the materials excavated, the method of excavation, the type of conduit and the degree of compaction required. The placing of backfill shall not begin until the pipe structure has been properly bedded and jointed and until approval has been given by the OWNER. The excavation shall be backfilled only with approved material.

504.5.3.2. Compaction. Compaction of all backfill material shall be performed in a manner that shall not crack, crush and/or cause the installed pipe to be moved from the established grade and/or alignment, as shown on the plans. Satisfactory density shall be obtained at various depths on all backfill material as indicated from random selected test points prior to the required exfiltration or pressure tests that are to be performed on lines being constructed. The required moisture content shall be at not less than 2% below nor more than 4% above the optimum moisture of the material or as specified by the OWNER. In-place density/moisture content shall be tested and verified as specified by the OWNER, or at a minimum frequency of once per 300-linear-feet per 1-foot of compacted depth.

504.5.3.2.1. Densities — Areas Subjected To or Influenced by Vehicular Traffic. The trench backfill shall be mechanically compacted to the top of the subgrade in 6-in. loose lifts to at least 95-percent of maximum density as determined by ASTM D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³). The embedment shall be compacted by a method approved by the OWNER to a density as specified under the description of the embedment as outlined in [Item 504.5. Embedment](#).

504.5.3.2.2. Densities — Areas Not Subjected To or Influenced by Vehicular Traffic. The trench backfill shall be placed in layers not more than 10-in. loose depth and shall be compacted by mechanical means, subject to the restrictions outlined in [Item 504.5.3.2.5. Compaction Methods](#) to at least 90-percent of maximum density as determined by ASTM D698. The embedment shall be compacted by a method approved by the OWNER to a density as specified under the description of the embedment required as outlined in [Item 504.5. Embedment](#).

504.5.3.2.3. Special Situations. In areas specifically designated in the plans and specifications, the entire backfill shall be backfilled and compacted to the density specified.

504.5.3.2.4. Limitations. Densities as specified shall be obtained as the project progresses. No more than 75-percent of the pipe installation on the project is to be completed until specified compaction and density requirements have been ascertained on backfill material for at least 25-percent of the pipe laid, or until an approval to proceed with pipe installation has been given by the OWNER.

504.5.3.2.5. Compaction Methods. The method of compaction shall be left to the discretion of the CONTRACTOR with the following exception, unless otherwise specified, provided the degree of compaction is obtained and provided that the pipe is not damaged in the process. If any potential damage to the pipe due to a method of compaction exists, in the opinion of the OWNER, that method of compaction shall not be allowed.

Compaction of any backfill material by flooding or jetting shall not be permitted.

Hand-operated mechanical tampers may be used with approval of the OWNER for compacting backfill.

504.5.3.3. Rejection. If the backfill does not meet the specified density and optimum moisture requirements throughout its depth, the OWNER shall require its removal and replacement to meet the above requirements at the CONTRACTOR'S expense.

504.6. FINAL BACKFILL

Final backfill material is the material required to fill the trench from the top of the initial backfill to ground elevation or subgrade of a street.

504.6.1. Excavated Material. Excavated material may be used in the trench backfill, provided (1) it meets the requirements of [Item 504.2.3.3](#), Type "B" backfill, and (2) the material is approved for backfill by the OWNER.

504.6.2. Stabilized Backfill. Stabilized backfill shall consist of a mixture of native soils including the trench excavation, approved for use by the OWNER, and two sacks of cement per cubic-yard. All material shall be mixed in a concrete mixer or transit mix unless approved otherwise by the OWNER. The stabilized backfill shall be compacted in a moist condition or water added to provide a free flowing mixture. If a free flowing mixture is used, the initial set must be permitted prior to placement of any material on the surface of the stabilized backfill.

504.6.3. Concrete Backfill. Concrete backfill shall consist of selected stone material or granular material mixed with a minimum of two sacks of cement per cubic-yard. All material shall be mixed in a concrete mixer or transit mixed unless approved otherwise by the OWNER.

504.6.4. Granular Material Backfill. Granular material backfill shall meet the requirements of [Item 504.2.2.2](#), Granular Material.

504.6.5. Sand Backfill. Sand backfill shall meet the requirements of [Item 504.2.2.6](#), Sand.

504.6.6. Flowable Backfill. Flowable backfill shall meet the requirements of [Item 504.2.3.4](#), Flowable Backfill.

504.6.7. Modified Flowable Backfill. Modified flowable backfill shall meet the requirements of [Item 504.2.3.5](#), Modified Flowable Backfill.

504.6.8. Fast Set Flowable Backfill. Fast Set Flowable Backfill shall meet the requirements of [Item 504.2.3.6](#), Fast Set Flowable Backfill.

504.7. MEASUREMENT AND PAYMENT OF BACKFILL

504.7.1. Measurement of Backfill Material. Measurement of backfill, which includes embedment and final backfill, shall be made per linear-foot of pipe only if a separate bid item is established in the Contract.

504.7.2. Payment of Backfill Material. Payment for backfill shall be made at the contract unit price per linear-foot of pipe only if a separate bid item is established in the Contract. This shall include furnishing and placing all materials and for all labor, tools, equipment and incidentals necessary to complete the work, all in accordance with the plans and specifications. No allowance for waste shall be made.

504.7.2.1. Special Embedment. If the OWNER orders an embedment material other than that specified in the Contract, it shall be paid for as an extra in price per linear foot of pipe, as compacted in place, except if another class embedment is ordered by the OWNER because the CONTRACTOR has over-excavated the trench width.

If the CONTRACTOR over-excavates the trench width and the OWNER orders another class of embedment to be used, the embedment shall be paid per linear-foot of pipe, compacted in place for the embedment originally specified if the original embedment was specified to be paid as a separate bid item. In lieu of another class of embedment, the CONTRACTOR may elect to use another class pipe if approved by the OWNER. The pipe shall be paid for as specified in relevant Items of Division 500 Underground Conduit Construction and Appurtenances at the unit price per linear-foot for the pipe originally specified if the original pipe was specified to be paid as a separate bid item.

If the CONTRACTOR elects to use another class embedment and the use of the embedment is approved by the OWNER, but not directed by the OWNER, the embedment shall be paid per linear-foot of pipe, compacted in place for the embedment originally specified if the original embedment was specified to be paid as a separate bid item.

504.7.2.2. Final Trench Backfill. If the CONTRACTOR elects to use a material other than the excavated material as trench backfill and the use of the material is approved by the OWNER, but not directed by the OWNER, the material shall be furnished and placed at no cost to the OWNER. The excavated material shall be disposed of at no cost to the OWNER.

If the OWNER orders the excavated material to be removed and disposed of and replaced with another material and a separate bid item is not established, the material shall be paid as an extra. The disposal of the rejected excavated material shall be at no cost to the OWNER.

If the OWNER orders the excavated material to be removed and disposed of and replaced with another material because of neglect of the CONTRACTOR to properly remove or store the material, or if the CONTRACTOR fails to compact the excavated material in the trench to the density requirements and the OWNER orders the material removed, the excavated material shall be replaced with a material approved by the OWNER at no cost to the OWNER. The disposal of the rejected material shall be at no cost to the OWNER.

504.7.2.3. Trench Safety. Payment for trench safety shall be according to the provisions of [Item 107.20](#). Protection of Work and of Persons and Property.

ITEM 505. OPEN CUT – GENERAL CONDUIT INSTALLATION

505.1. GENERAL

505.1.1. Conduit Location. The location of conduit to be installed will be determined by the Engineer using generally accepted design criteria, which includes the current guidelines of the TCEQ.

505.1.2. Location and Protection of Existing Utilities. Location and protection of existing utilities shall be carried out in accordance with [Item 107.24](#), Existing Structures, Facilities and Appurtenances.

505.1.3. Street Cut Permit. If required by the OWNER, the CONTRACTOR shall obtain a street cut permit prior to beginning the work. The CONTRACTOR shall have the executed permit available on the job site during the duration of the work.

505.1.4. Handling and Protection of Materials. All pipe, fittings and specials shall be handled in such a manner as not to damage the material. All dirt and trash shall be removed from the pipe prior to installation. All pipe and fittings handled with clamps or slings must meet with the approval of the OWNER; no hooks shall be permitted.

When it becomes necessary to deflect the pipe to avoid obstructions, the deflection of each joint must be within the limits provided by the manufacturer and be approved by the OWNER.

The pipe is to be kept clean during the laying operation and free of all dirt and trash. At the close of each operating day, the open end of the pipe is to be effectively sealed against the entrance of all objects and especially water.

505.1.5. Stringing of Pipe. Unless prior approval from the OWNER is granted to do otherwise, stringing of pipe in advance of the laying operation shall be restricted to one week's laying and shall be done in such a manner as to create no hazard to not interfere with traffic. Ready access shall be provided to all streets, alleys and driveways. The pipe shall be protected with barricades and warning signs at all times. Any damage to the pipe shall be corrected at the expense of the CONTRACTOR.

505.1.6. Laying Underground Conduit. Prior to being lowered into the trench, each pipe shall be carefully inspected; those not meeting specifications shall be rejected and either destroyed or removed from the job. All lumps or excrescences on the ends of conduit shall be removed before it is lowered into the trench. No pipe shall be laid except in the presence of the OWNER, unless otherwise specified, and the OWNER may order the removal of and re-laying of any pipe not so laid. The pipe and specials shall be so laid in the trench that after the project is completed the interior surface shall conform accurately to the grade and alignment indicated on the plans. Bell holes shall be excavated and all pipe shall be carefully adjusted to fit snugly in cradling or bedding so that the entire length bears on cradling or bedding material with no wedging or blocking to hold up the bell. All pipe shall be laid in the dry, regardless of the type of joint used.

Pipes shall be laid with the bell or groove end up grade unless otherwise approved by the OWNER and, in any event, shall be laid with the bell or collar away from the last section placed. Pipe must be swabbed clean before placement in the ditch.

Before laying the pipe, the interior of the joints shall be carefully bored smooth and clean and the annular space shall be kept free from dirt, stones or water. Pipe shall be installed and joints made up in complete conformance with the instructions and recommendations regarding proper installation and assembly furnished by the manufacturer. Proper facilities shall be provided for hoisting and lowering the section of the pipe into the trench without disturbing the prepared foundation and the sides of the trench. All pipe shall be so laid that the contact in the joint between two lengths of pipe shall be uniform throughout the circumference of the joint. Where curves in the alignment are indicated on the drawings, standard pipe (short sections of pipe or bevels) shall be used with the outside edge of the joint pulled away from the seat to make a smooth curve.

When work is suspended on the line for any reason, the end of the line shall be properly closed with an effective watertight seal or plug manufactured for this purpose.

505.1.7. Grades. The grade line shown on the profile is the elevation of the invert or flow line of the conduit. The OWNER shall establish benchmarks, base lines and other principal control points for use in construction. It shall be at the CONTRACTOR'S expense to establish all working or construction lines and grades as required and determined from the base measurements and control points set by the OWNER and shall be solely

responsible for the accuracy thereof. Wherever an offset needs to be over 10-ft., the CONTRACTOR shall be required to furnish a survey type tripod level or its equivalent in order to accurately transfer the grade to the trench or excavation. Where construction operations require the removal of the OWNER'S stakes, the CONTRACTOR shall reference such points in an approved manner. If they cannot be referenced, the CONTRACTOR must obtain authorization for their removal. In the case of their destruction or unauthorized removal, they shall be replaced by the OWNER at the CONTRACTOR'S expense.

The full responsibility for holding to alignment and grade shall rest upon the CONTRACTOR.

If a profile is not furnished for a water main, the main shall be constructed with a minimum cover as shown in Table 505.1.7.(a) Water Main Minimum Cover, unless directed otherwise by the OWNER.

Table 505.1.7.(a) Water Main Minimum Cover

Main Size	Minimum Cover (ft.) ¹	
	Unimproved Streets or Open Areas	Improved Streets (Curb, Gutter, and Subsurface Storm Drain)
Less than 12-in.	5-ft.	4-ft.
12-in. through 18-in.	6-ft.	5-ft.
20-in. and larger ²	7-ft.	6-ft.

1. The minimum cover requirement shall be measured from a point as designated on the plans.

2. May be greater if Air Relief and Vacuum Control Valves are on the main.

3. Unimproved streets are streets without curb and gutter and minimal surfacing.

505.2. GENERAL INSTALLATION REQUIREMENTS FOR PIPE TYPES

505.2.1. Section Held for Future Use

505.2.2. Concrete Pressure Pipe. When required in the project specifications, the pipe manufacturer shall furnish a factory-trained, job-experienced field representative who shall visit the project periodically during the course of installation. The project visiting schedule shall be approved by the OWNER. The field representative shall also be subject to call by the CONTRACTOR and/or OWNER to advise and assist with the solution of field problems. During visits, the representative shall observe all phases of the project including location and condition of pipe, stockpiled and installed pipe, trench width, if applicable, bedding and backfill, assembly of pipe joints and protection of steel. If, in the opinion of the representative, any phase of the installation is unsatisfactory to the extent of jeopardizing the performance of the pipe, representative shall so advise the CONTRACTOR'S superintendent and the OWNER.

After installation, flanged outlets shall be encased with mortar in a pipe diaper.

Test stations shall be provided at the appropriate locations as indicated on the plans to insure proper bonding and effectiveness of cathodic protection measures for concrete pressure pipe.

505.2.3. Concrete Gravity Pipe. Pipe shall be installed in accordance with ASTM C1479 Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.

505.2.4. Ductile Iron Pipe. Unless otherwise specified by the OWNER, ductile iron pipe shall be protected with a polyethylene encasement that conforms to [Item 502.8](#). Polyethylene Wrap for Metal Pipe and Fittings.

505.2.5. PVC Water Pipe. Pipe produced to the specifications of [Item 501.14](#). Polyvinyl Chloride (PVC) Water Pipe shall be installed in accordance with AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

505.2.6. PVC Pressure-Rated Pipe Installation. Pipe produced to the specifications of [Item 501.15](#). Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series) shall be installed in accordance with ASTM D2774 Practice for Underground Installation of Thermoplastic Pressure Piping. An engineering evaluation of specific installation requirements is recommended.

505.2.7. Molecularly Oriented Polyvinyl Chloride Installation and Special Conditions. Installation of pipe meeting specifications of [Item 501.16](#). Molecularly Oriented Polyvinyl Chloride (PVCO) Water Pipe shall be accomplished according to AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water with the following conditions/exceptions:

- (1) Solvent cement shall not be used with PVCO pipe.
- (2) PVCO pipe must be tapped through a saddle. Direct tapping the wall is not permitted.
- (3) The maximum recommended operating temperature is 130°F

505.2.8. PVC Wastewater Pipe Installation. Pipe produced to the specifications of [Item 501.17](#). Polyvinyl Chloride (PVC) Wastewater Pipe & Fittings With Dimension Control shall be installed in accordance with ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications. Engineering evaluations of specific installation requirements is recommended.

505.2.9. PVC Profile Gravity Pipe Installation. Pipe produced to the specifications of [Item 501.18](#). Polyvinyl Chloride (PVC) Profile Gravity Pipe and Fittings – for Direct Bury and Sliplining Applications shall be installed in accordance with ASTM D2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications. Engineering evaluations of specific installation requirements is recommended.

505.2.10. Section Held for Future Use

505.2.11. PVC Corrugated Pipe. Pipe produced to the plans and specifications shall be installed in accordance with ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications or AASHTO Section 30 for any drainage application. Engineering evaluations of specific installation requirements is recommended.

505.2.12. Solid Wall Polyethylene Pipe Installation. Engineering evaluations of specific installation requirements are recommended.

Water pipe produced to the specifications of [Item 501.21](#). Solid Wall Polyethylene Plastic Pipe for Water, Wastewater, and Pipe Rehabilitation shall be installed according to the standard practice of ASTM D2774 Underground Installation of Thermoplastic Pressure Piping, ASTM F1962 Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings, and/or to appropriate engineered pipe bursting techniques.

Wastewater pipe produced to the specifications of [Item 501.21](#). Solid Wall Polyethylene Plastic Pipe for Water, Wastewater, and Pipe Rehabilitation shall be installed according to the standard practice of ASTM D2321 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications, ASTM D2774, ASTM F1962, and/or to appropriate engineered pipe bursting techniques.

505.2.13. Thermoplastic Corrugated Drainage Tubing and Corrugated Smooth Lined Storm Water Pipe and Fittings. Engineering evaluations of specific installation requirements and pipe type selection are recommended. Installed per ASTM D2321, or AASHTO Section 30 except where installations are under proposed or existing paving; then, follow [Item 508.6.5.2](#). Backfilling to 1 ft. above the top of the pipe.

The internal diameter of the installed barrel of the tube/pipe must not be reduced by more than 5-percent of the actual inside diameter when measured not less than 30-days following completion of installment.

505.2.14. Fiberglass Pipe Installation. Installed pipe produced to the specifications of [Item 501.24](#). Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Wastewater Pipe shall be installed utilizing an envelope of standard crushed rock bedding materials, [Item 504.2.2](#). Pipe Embedment Material for Water And Wastewater Mains to a minimum of 6-in. above the crown of the pipe. Engineering evaluations of specific installation requirements are recommended. The internal diameter of the installed barrel of the pipe must not be reduced by more than 3-percent of its base inside diameter when measured not less than 30-days following completion of installation. Long term deflection shall not exceed 5-percent.

ITEM 506. OPEN CUT – WATER CONDUIT INSTALLATION

506.1. DESCRIPTION

This work shall include the installation and construction, complete in place, of water conduit and appurtenances as specified herein and in conformity with the lines, grades, dimensions, materials and designs shown on the plans.

506.2. MATERIALS

The pipe shall be of the kind and strength shown on the plans and provided in the proposal and contract. Unless otherwise specified, materials shall meet the requirements of [Item 501](#), Underground Conduit Materials and [Item 502](#), Appurtenances. Materials for corrosion protection of water conduits and appurtenances shall be of the type as may be called for on the plans or in the special specifications.

Any pipe, fitting, solder or flux which is used in the installation or repair of any public water system must be lead-free. For the purpose of these Specifications, the term 'lead free' means:

- (1) Not containing more than 0.2 percent lead when used with respect to solder and flux; and
- (2) Not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.

506.3. LAYING WATER CONDUIT

Laying pipe shall not begin until after the initial embedment has been placed in the trench and after the condition of trench, line and grade have been approved by the OWNER.

The pipe, after being visually inspected and approved for laying by the OWNER, shall be laid, beginning at an existing opening, unless otherwise approved by the OWNER and, in any event, shall be laid with the bell or collar away from the last section placed.

All pipe shall be so laid that the contact in the joint between 2 lengths of pipe shall be uniform throughout the circumference of the joint. Where curves in the alignment are indicated on the drawings and the curves are flat, standard pipe shall be used with the outside edge of the joint pulled away from the seat to make a smooth curve. Deflection of the joint to form curves shall not exceed the limits of Table 2, AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances. Where curves are sharp, short sections of pipe, bevels or bends shall be used and blocked.

When pipe is cut by the CONTRACTOR to insert a valve or fitting, the bell and remaining section may be laid beyond the valve or fitting.

All pipe, fittings, valves, and hydrants shall be carefully delivered to the site and lowered into the trench, piece by piece, by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water conduit materials, protective coatings, and linings. Under no circumstance shall water conduit materials be dropped or dumped into the trench.

The pipe and fittings shall be inspected for defects. All lumps, blisters, and excess coating material shall be removed from the bell and spigot ends of each pipe. Additionally, the inside of the bell or coupling and the outside of the spigot shall be wire brushed and wiped clean, dry, and free of all foreign and objectionable material before the pipe is laid. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in line.

506.4. PIPE JOINTS

All joints in pipe shall be thoroughly cleaned at the time the joint is made.

506.4.1. Rubber Gasket Joints. Rubber gaskets shall conform to the applicable specifications under which the pipe is supplied. Loose gaskets shall be protected from sunlight, contamination and contact with gasoline or fuels.

Rubber gasket joints for water conduits consist of 4 general types:

- (1) Push-on type used for ductile iron, steel and plastic pipe.
- (2) Mechanical type used for ductile iron and fittings.
- (3) Rubber and steel joint ring type used for steel cylinder type, reinforced concrete pipe.
- (4) Double rubber gasket couplings used for pressure pipe.

Each type, except mechanical, requires the use of a lubricant to facilitate assembly. The lubricant shall be nontoxic, shall not support the growth of bacteria and shall have no deteriorating effect on the gasket. The lubricant shall not impart taste or odor in a pipe that has been flushed in accordance with [Item 506.7](#). Purging and Disinfection of Water Conduits. Care should be taken not to over-use the lubricant since it would then require excess effort to disinfect.

506.5. HYDROSTATIC TEST

Before being accepted, all ductile iron and plastic pipelines constructed shall be tested with a hydraulic test pressure of not less than 150-psi, maintained over a period of not less than 4-hours unless otherwise specified by the OWNER, except that polyethylene pipe shall be tested as described below in [Item 506.5.1](#). Hydrostatic Testing Polyethylene Pipe, unless otherwise specified by the OWNER. Alternately, a 2-hour test may be conducted on PVC in accordance with AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water and a 2-hour test may be conducted on ductile iron in accordance with AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances. Concrete pressure pipe shall be tested with a hydraulic test pressure of 120-percent of the design pressure. Steel pressure pipe shall be tested with a hydraulic test pressure not to exceed 150-percent and not less than 120-percent of the design working pressure. The rate of leakage of all pipe tested shall not exceed 11.65-gallons-per-inch of nominal diameter of pipe per mile over a 24-hour period. Water lines of materials in combination shall be tested for the type of pipe (material) with the least stringent hydraulic test pressure maintained over a period of not less than 4-hours. Acceptable test values are provided in Table 506.5.(a) Allowable Leakage for 4-Hours at Test Pressure of 150-psi.

All newly laid pipe, or any valve section thereof, shall be subjected to the test with the gauge located at the lowest point in the system to be tested. If the line cannot be tested at its lowest point, a correction factor of minus 0.43 lb./vert. ft. shall be made.

Table 506.5.(a) Allowable Leakage for 4-Hours at Test Pressure of 150-psi (gallons)

Length (Ft.)	Pipe Diameter (Inches)															
	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60	66
5	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.06	0.07	0.08	0.09	0.10	0.11	0.12
10	0.02	0.03	0.04	0.04	0.05	0.06	0.07	0.07	0.09	0.11	0.13	0.15	0.18	0.20	0.22	0.24
15	0.03	0.04	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.17	0.20	0.23	0.26	0.30	0.33	0.36
20	0.04	0.06	0.07	0.09	0.10	0.12	0.13	0.15	0.18	0.22	0.26	0.31	0.35	0.40	0.44	0.49
25	0.06	0.07	0.09	0.11	0.13	0.15	0.17	0.18	0.22	0.28	0.33	0.39	0.44	0.50	0.55	0.61
50	0.11	0.15	0.18	0.22	0.26	0.29	0.33	0.37	0.44	0.55	0.66	0.77	0.88	0.99	1.10	1.21
75	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.55	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.82
100	0.22	0.29	0.37	0.44	0.51	0.59	0.66	0.74	0.88	1.10	1.32	1.54	1.77	1.99	2.21	2.43
200	0.44	0.59	0.74	0.88	1.03	1.18	1.32	1.47	1.77	2.21	2.65	3.09	3.53	3.97	4.41	4.85
300	0.66	0.88	1.10	1.32	1.54	1.77	1.99	2.21	2.65	3.31	3.97	4.63	5.30	5.96	6.62	7.28
400	0.88	1.18	1.47	1.77	2.06	2.35	2.65	2.94	3.53	4.41	5.30	6.18	7.06	7.94	8.83	9.71
500	1.10	1.47	1.84	2.21	2.57	2.94	3.31	3.68	4.41	5.52	6.62	7.72	8.83	9.93	11.03	12.14
600	1.32	1.77	2.21	2.65	3.09	3.53	3.97	4.41	5.30	6.62	7.94	9.27	10.59	11.92	13.24	14.56
700	1.54	2.06	2.57	3.09	3.60	4.12	4.63	5.15	6.18	7.72	9.27	10.81	12.36	13.90	15.45	16.99
800	1.77	2.35	2.94	3.53	4.12	4.71	5.30	5.88	7.06	8.83	10.59	12.36	14.12	15.89	17.65	19.42
900	1.99	2.65	3.31	3.97	4.63	5.30	5.96	6.62	7.94	9.93	11.92	13.90	15.89	17.87	19.86	21.85
1000	2.21	2.94	3.68	4.41	5.15	5.88	6.62	7.36	8.83	11.03	13.24	15.45	17.65	19.86	22.07	24.27
Valve	0.19	0.25	0.31	0.37	0.44	0.50	0.56	0.62	0.75	0.94	1.12	1.31	1.50	1.68	1.87	2.06

Allowable Leakage (gal.) for 4 hours = $4 \times (S \times D \sqrt{P}) \div 133,200$

S = Length of Pipe, Ft.

D = Diameter of Pipe, In.

P = 150 psi

Height Correction = 0.43 psi/Ft.

Valve Leakage Allowable = 0.0078 Gal./Hour/In. of nominal valve size

Test — Ductile Iron, Plastic, and at 150 psi

— Concrete 120% of Design Pressure

— Steel 120% Min. to 150% Max. Design Working Pressure

If the tests indicate a leakage in excess of the above rate, then the CONTRACTOR shall be required to find and repair the leak. Even if the test requirements are met, all apparent leaks shall be stopped. Allowance for valve

leakage to the atmosphere may be determined as no more than 0.0078-gal. /hr. /in. of nominal valve size. The OWNER cannot guarantee that an old existing system valve shall hold the required pressure. The CONTRACTOR has the option of plugging the new conduit prior to tying onto the existing system and testing against the old valve. If the old valve does not hold against the test pressure, then the CONTRACTOR must cut and plug the new conduit, hydrostatic test the new conduit, and then complete the tie-in. Internal test plugs may be used in larger reinforced concrete conduits in lieu of plugging prior to making a tie-in.

The cost of testing and repairing the leaks, including all uncovering, repairing, backfilling and incidental work, shall be at the expense of the CONTRACTOR.

506.5.1. Hydrostatic Testing Polyethylene Pipe. Pipe shall be tested after installation is complete and in accordance with ASTM F2164 Standard Practice for Field Testing of Polyethylene (PE) and Cross linked Polyethylene (PLEX) Pressure Piping Systems using Hydrostatic Pressure.

Testing may be conducted on the full system or in sections. Test section length shall be determined by the capacity of the testing equipment. Lower capacity pressurizing or filling equipment may not be capable of completing the test within permissible time limits. If so, higher capacity test equipment or a shorter test section may be required by the OWNER.

Before applying test pressure, CONTRACTOR shall allow time for the test fluid and the test section to equalize to a common temperature. For pressure piping systems that include polyethylene pipe or fittings:

- (1) The maximum permissible test pressure is measured at the lowest elevation in the test section.
- (2) The maximum permissible test pressure is 150% of the system design operating pressure when the test section is all polyethylene pressure piping.
- (3) The maximum permissible test pressure is the pressure rating of the lowest pressure rated, non-polyethylene part in the system when the system contains non-polyethylene parts.

CONTRACTOR shall not subject lower pressure rated, non-polyethylene parts or devices to pressures above their pressure ratings. Lower pressure rated parts may be removed or isolated from the test section to avoid damage or failure. CONTRACTOR shall vent isolated parts or equipment to atmosphere.

All thermoplastic pipes have reduced strength at elevated temperature. Test pressure must be reduced when the test section is at elevated temperature from service conditions or from environmental conditions such as being warmed by the sun. To determine the allowable elevated temperature test pressure, CONTRACTOR shall multiply the test pressure by the appropriate multiplier in Table 506.5.1.(a) Polyethylene Pipe Elevated Temperature Test Pressure Multipliers.

Table 506.5.1.(a) Polyethylene Pipe Elevated Temperature Test Pressure Multipliers

Test Section Temperature, T							
°F	$T \leq 80^1$	$80 < T \leq 90$	$90 < T \leq 100$	$100 < T \leq 110$	$110 < T \leq 120$	$120 < T \leq 130$	$130 < T \leq 140^2$
°C	$T \leq 27^1$	$27 < T \leq 32$	$32 < T \leq 38$	$38 < T \leq 43$	$43 < T \leq 49$	$49 < T \leq 54$	$54 < T \leq 60^2$
Multiplier	1.00	0.90	0.80	0.75	0.65	0.60	0.50

1. Use the 80°F multiplier for 80°F and lower temperatures.

2. The maximum service temperature for polyethylene pressure piping is 140°F.

When testing at pressures above system design pressure or up to 150% of the system design pressure, the maximum test duration is 8-hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section. If the test is not completed due to leakage, equipment failure, or for any other reason, CONTRACTOR shall depressurize the test section completely, and allow it to relax for at least 8-hours before pressurizing the test section again.

Testing procedure shall be carried out as follows:

- (1) Filling. CONTRACTOR shall fill the restrained test section completely with test liquid.

WARNING – CONTRACTOR shall ensure that there is no air trapped in the test section. Failure with entrapped air can result in explosive release. CONTRACTOR shall use equipment vents at high points to remove air.

- (2) Initial Expansion Phase. CONTRACTOR shall gradually pressurize the test section to test pressure, and maintain test pressure for 3-hours. During the initial expansion phase, polyethylene pipe will expand slightly. Additional test liquid will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.
- (3) Test Phase. Immediately following the initial expansion phase, CONTRACTOR shall reduce test pressure by 10-psi, and stop adding test liquid. If test pressure remains steady (within 5% of the target value) for 1-hour, no leakage is indicated.
- (4) Depressurizing. At the conclusion of the test, CONTRACTOR shall carefully depressurize the test section by the controlled release of test liquid. The test liquid may need to be drained and its disposal shall be subject to applicable environmental regulations.

506.6. CONNECTIONS TO EXISTING WATER CONDUITS

Connection to an existing water conduit shall include not only branch connections but in-line connections for the purpose of making required pipe adjustments as well. Any connection or series of connections required to be performed on an existing water conduit shall meet with the OWNER'S specific approval as to the seasonal period when the work can be performed, the length of time required for the work to be completed, the work procedures proposed, and/or any other facet that could affect quality or quantity of water supply to the affected area. The work shall be performed with stringent built-in safeguards (such as adequate back-up equipment, labor and materials available) to insure that time schedules are met without failure and subsequent set-back. Every effort shall be made to accomplish as much of the work as possible before actual tie-in is made into the existing conduit. This is especially applicable where vertical and horizontal concrete thrust blocks are a necessity to impose proper restraint of the pipe when the conduit is returned to full service. See Standard Drawings 4010A – 4040 for vertical and horizontal thrust blocks.

The CONTRACTOR shall notify the OWNER at least 48-hours in advance of a required valve shutdown.

Where indicated on the plans and/or herein specified, the CONTRACTOR shall connect the new conduit to existing conduits. The CONTRACTOR shall furnish all labor, materials, equipment and services required for the locating and uncovering of the existing line; the making of cuts in the existing line; the removal, relocation, and/or lowering of existing lines as required (See Standard Drawing 4200); dewatering of the trench; connecting of the existing lines to the new conduit; and all appurtenant work required for complete connection. Appurtenant work shall follow the requirements stated herein and as specified in [Item 502](#), Appurtenances. Relocated conduits or lines shall be laid so that all valves shall be set vertically. The CONTRACTOR shall be required to plug and block lines, crosses, tees or other fittings installed in the new conduit to permit hydrostatic testing and chlorination prior to making connections. Such plugs and blocking shall be adequate to withstand an applicable test pressure.

Where cut-ins are made immediately adjacent to valves which are under pressure, the CONTRACTOR shall take all necessary precautions to brace such valves with temporary blocking. Bracing shall be of ample size and properly placed to prevent movement or blowing off of any pipe, valves or fittings due to water pressure on the conduit.

Connections to existing water conduits shall be made at the locations shown, as specified, and/or as directed by the OWNER. All such connections shall be made in a most expeditious and workmanlike manner to cause the least inconvenience to water customers and to traffic. The detailed schedule of operations for making each connection shall be approved by the OWNER before any work thereupon is commenced.

In the case where blow-off connections or fire hydrants are not provided for flushing, the CONTRACTOR shall be required to leave one end of the new conduit open for flushing and then plug and block the end for chlorination and testing.

There shall be no separate pay items for taps, blow-offs for hydrostatic testing, disinfection purposes, and connections to existing water mains unless otherwise approved by the OWNER. Taps and blow-offs for hydrostatic testing and disinfection purposes shall be installed by the CONTRACTOR, at locations specified by the OWNER. This may include placing a blow-off on an existing conduit at the tie-in, or addition of a blow-off(s) at an isolated existing valve, for facilitation of hydrostatic testing and/or chlorination. Compression type curb stops are not permitted for blow-offs

Upon completion of the hydrostatic testing and disinfection the CONTRACTOR shall return to the job site and remove the blow-off down to the corporation stop. CONTRACTOR shall leave the corporation stop and backfill,

replacing all pavement. Removal of the blow-off shall include all labor, materials, tools, equipment, and incidentals necessary to complete the work, including excavation, disposal of surplus materials, and backfill with no separate pay item.

506.6.1. Water Main Tie-In During Off Hours. Tie-in connections affecting curtailment of quality or quantity of water to an area, businesses, etc., must be performed during the weekend or off-hours. All work must be coordinated through the OWNER or its representatives. Delay costs due to shut down and connection issues are considered incidental work and shall be borne by the CONTRACTOR. Unless otherwise stated in the contract, this item is a No Separate Pay Item.

506.7. PURGING AND DISINFECTION OF WATER CONDUITS

506.7.1. General. Before any newly constructed water conduit shall be permitted to be placed into service, it shall be purged and tested or purged, disinfected and tested until the bacterial count within the conduit meets the standards of disinfection according to Federal and State regulations.

The CONTRACTOR shall perform the purging, disinfection and testing activities unless the OWNER specifies otherwise. Should the CONTRACTOR's carrier be required to transport potable water to the job site for conduit testing, tankage and all piping, including pumps used to transport or transfer potable water into the conduit, shall be disinfected and/or approved for that use by the OWNER.

When the entire pipeline or selected sections, as approved by the OWNER, have been completed, the line or section shall be disinfected according to the following procedures.

Table 506.7.1.(a) Required Flow and Openings to Flush Pipelines at 40 psi Pressure

Pipe Diameter (in)	Flow Required 2.5 ft/sec (gpm)	Size of Tap			Number of 2½ " Hydrant Outlets on Pipe
		1	1½	2	
4"	100	1	-	-	1
6"	200	-	1	-	1
8"	400	-	2	1	1
10"	600	-	3	2	1
12"	900	-	-	2	2

506.7.2. Pre-Disinfection. Before being chlorinated, the main(s) shall be filled to eliminate air pockets and shall be flushed to remove particulates. The flushing velocity in the main shall not be less than 2.5 ft/s unless the OWNER determines that conditions do not permit the required flow to be discharged to waste. Flushing is no substitute for disinfection measures during construction.

Certain contaminants, such as caked deposits, resist flushing at any feasible velocity. In mains of 24 inch diameter and larger, an acceptable alternative to flushing is to broom-sweep the main, carefully removing all sweepings prior to chlorinating the main.

For convenience in certain locations, it may be directed by the OWNER that hypochlorite be placed in the pipe as laid.

506.7.3. Purging. Purging may be accomplished by passing an appropriate sized "poly-pig(s)" through the pipe or by flushing, as determined by the OWNER.

506.7.3.1. Poly-Pig Method. If the poly-pig method of purging is to be used, the CONTRACTOR shall be required to prepare the conduit for the installation and removal of "poly-pigs." The OWNER shall purge the system unless the CONTRACTOR is specified to do the work. This method shall include the following:

- (1) In general, this shall consist of furnishing all equipment, material, and labor to satisfactorily expose cleaning wye, remove cleaning wye covers, etc., as directed by the OWNER.
- (2) Where expulsion of the "poly-pig" is required through a dead-ended conduit, the CONTRACTOR shall make every effort to prevent back flow of purged water into the conduit after passage of the pig. On small pipe, such as cast iron pipe through 12-in., backwater re-entry into the pipe can be prevented

by the temporary installation of mechanical joint shallow bends and pipe joints to provide a riser out of the trench. On larger pipe, additional excavation of the trench may serve the same purpose.

- (3) Where the pipe in the conduit forms a loop distribution system, every effort shall be made to sweep the entire system.
- (4) Short dead-end pipe sections not swabbed by the pig shall be flushed.
- (5) Backflow water which has inadvertently entered the pipe under conditions similar to those described in [Item 506.7.3.1](#), (2) preceding shall be flushed from the system.
- (6) After passage of the “poly-pig,” flushing of all backwater from the pipe, and satisfactory test results, at the direction of the OWNER, the CONTRACTOR shall: secure test location openings by plugging and blocking, installing cleaning wye blind flanges, etc.; then backfill; and complete all appurtenant work necessary to secure the system, or proceed with disinfection.

506.7.3.2. Flushing Method. If the “flushing” method of purging is used, the CONTRACTOR shall be required to prepare the conduit by installing blow-offs at locations and sized as directed by the OWNER. This method shall also include the following:

- (1) In general, this shall consist of furnishing all equipment, material and labor to satisfactorily install blow-offs of sizes shown in Table 506.7.3.2.(a) Flushing Method Blow-Off Requirements.

Table 506.7.3.2.(a) Flushing Method Blow-Off Requirements

Size Conduit	Size Blow-Off
2-in. thru 8-in.	¾-in.
10-in. thru 12-in.	1½-in.
16-in. and greater	2-in.

- (2) After flushing is complete and satisfactory test results are received at the direction of the OWNER, the CONTRACTOR shall secure the conduit, backfill, and complete all appurtenant work to secure the system, or proceed with disinfection. The CONTRACTOR shall, in the securing of the conduit, remove the blow-off down to the corporation stop.

506.7.4. Water Sample Analysis. After purging, an analysis may be made on the water sample drawn from a chlorination blow-off and sampling point at the OWNER’S request. (Samples drawn from fire hydrants have in the past proved unreliable and except in extreme cases shall not be used for the purpose of analysis.) Should the analysis indicate that the bacteria count is below the limits of the established standards for purity, no further disinfection is necessary unless specifically required by the OWNER.

506.7.5. Disinfection. Disinfection of the conduit shall be accomplished by the “continuous feed” method or the “slug” method as directed by the OWNER and described as follows. The free chlorine amounts shown are minimum. Higher rates may be required by the OWNER. Calcium hypochlorite granules shall be used as the source of chlorine.

506.7.5.1. CONTRACTOR Requirements. No matter who performs the disinfection activities described below, the CONTRACTOR shall be required, as a minimum, to prepare the conduit for disinfection and secure same after chlorination is complete. This shall include the following:

- (1) In general, this shall consist of furnishing all equipment, material and labor to satisfactorily prepare the conduit for the disinfection method selected by the OWNER. The CONTRACTOR shall also be required to provide adequate provisions for sampling.
- (2) Unless otherwise specified in the special contract documents, the CONTRACTOR shall make all necessary taps into the pipe to accomplish chlorination of a new line.
- (3) After satisfactory completion of the disinfection operation and at the direction of the OWNER, the CONTRACTOR shall remove surplus pipe at the chlorination and sampling points, plug the remaining pipe, backfill, and complete all appurtenant work necessary to secure the conduit.

506.7.5.2. Continuous Feed Method. If the “continuous feed” method of chlorination is used, the following steps shall be taken:

- (1) Water from the existing distribution system or other approved source of supply shall be made to flow at a constant rate in the newly laid conduit.

- (2) At a point not more than 10-ft. downstream from the beginning of the new conduit, water entering the new conduit shall receive a dose of chlorine such that the water shall have not less than 100-mg/L free chlorine, or as required by TCEQ, whichever is greater. Chlorine applications shall not cease until the entire conduit is filled with heavily chlorinated water.
- (3) The chlorinated water shall be retained in the conduit for at least 24-hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. Every effort shall be made to prevent the flow of chlorinated water into conduits in active service. At the end of the 24-hour period, the treated water in all portions of the conduit shall have a residual of at least 10-mg/L free chlorine.
- (4) The heavily chlorinated water shall then be flushed from the conduit and disposed of in a manner and at a location specified by the OWNER.
- (5) The chlorine residual shall be tested prior to flushing operations. If the chlorine residual exceeds 4-mg/L, the water shall remain in the new water conduit until the chlorine residual is less than 4-mg/L. The CONTRACTOR may choose to evacuate the water into water trucks or other approved storage facility and treat the water with Sodium Bisulfite or another dechlorination chemical or method appropriate for potable water and approved by the OWNER until the chlorine residual is reduced to 4-mg/L or less. After the specified chlorine residual is obtained, the water may then be discharged into the drainage system or utilized by the CONTRACTOR.

506.7.5.3. Slug Method. If the “slug” method of chlorination is used, the following steps shall be taken:

- (1) Water from the existing distribution system or other approved source of supply shall be made to flow at a constant rate in the newly laid conduit.
- (2) At a point not more than 10-ft. downstream from the beginning of the new conduit, water entering the conduit shall receive a dose of chlorine such that the water shall have not less than 100-mg/L free chlorine. The chlorine shall be applied continuously and for a sufficient time to develop a solid column or “slug” of chlorinated water that shall expose all interior surfaces to the “slug” for at least 3-hours.
- (3) As the chlorinated water flows past the fittings and valves, they shall be operated so as to disinfect the appurtenances. Every effort shall be made to prevent the flow of chlorinated water into conduits in active service.
- (4) The heavily chlorinated water shall then be flushed from the conduit and disposed of in a manner and at a location specified by the OWNER.

506.7.5.4. Sampling. Unless otherwise specified, the OWNER’S personnel or representative shall inject the chlorine disinfectant into the conduit, monitor the solution and perform the water analysis.

An OWNER’S representative shall take water samples from a suitable tap (not through a fire hydrant) for analysis by the OWNER’S laboratory, unless otherwise specified in the special provisions or in the plans. No hose or fire hydrant shall be used in the collection of samples.

Microbiological sampling shall be done prior to connecting the new conduit into the existing distribution system in accordance with AWWA C651 Disinfecting Water Mains. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. Two consecutive sets of acceptable samples, taken at least 24-hours apart, shall be collected from the new conduit. At least one set of samples shall be collected from every 1,000-linear-feet of the new water conduit, plus one set from the end of the line and at least one set from each branch. If trench water has entered the new conduit during construction or, if in the opinion of the Engineer, excessive quantities of dirt or debris have entered the new conduit, bacteriological samples shall be taken at intervals of approximately 200-linear-feet. Samples shall be taken of water that has stood in the new conduit for at least 16-hours.

Unsatisfactory test results shall require a repeat of the disinfection process and resampling as required above until a satisfactory sample is obtained.

506.8. PLUGS

Permanent plugs shall be placed at the ends of all pipe.

506.8.1. Cut and Plugs. Cut and plugs will only be paid when a CONTRACTOR is required to excavate at a separate location outside of the on-going pipeline installation. All other cut and plugs (those that require plugs only) associated with the same excavation when connecting the new pipeline to an existing pipeline is considered incidental work and is not a separate pay item. Actual cut & plugs shall be paid under appropriate bid item numbers.

506.9. MEASUREMENT AND PAYMENT

506.9.1. Measurement. Pipe, including corrosion protection if in place on the pipe, shall be measured for payment in linear feet along the center line of the pipe actually laid. No deductions shall be made for fittings and valves, measurements being from center to center of fittings. Where a change in the size of the pipe occurs in the line, the measurement shall be to the center of the fitting. Where a change in the size of the pipe occurs in line, the measurement shall be to the center of the reducer. Conduits shall not be classified for payment according to the depth of the cut.

A pay item shall be included for connections to existing conduits unless otherwise specified in the Contract.

506.9.2. Payment. Pipe, including corrosion protection in placed on the pipe, shall be paid for at the contract unit price per linear foot, and completed in place, as provided by the proposal and contract.

Connections to existing conduits shall include furnishing and placing of fittings, valves, pipe and concrete blocking in accordance with [Item 502](#). Appurtenances.

Where plugs are classified separately as contract pay items, payment shall be made in accordance with the contract unit price per each, complete in place, as provided in the contract. Such price shall be total compensation for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work, including all excavation, disposal of surplus material and backfill, all in accordance with the plans and specifications.

The contract price per linear foot of conduit shall be the total compensation for the furnishing of all labor, materials, tools, equipment and incidentals necessary to complete the work, including excavations, backfill, and disposal of surplus materials in accordance with the plans and these specifications.

Measurement and payment for hydrostatic testing and disinfection shall not be applicable under this construction specification unless specified otherwise. The CONTRACTOR shall provide materials, equipment and services in support of both purging and disinfection of the conduit. All costs for these services shall be included in the unit price bid in the proposal per foot of pipe complete in place, and no other compensation shall be allowed.

ITEM 508. OPEN CUT – STORMWATER CONDUIT INSTALLATION

508.1. DESCRIPTION

This item shall govern and control the furnishing and placing of culvert pipe and/or conduits or drainage lines, including pipe fittings, connecting drain lines to curb inlets, all joints, all connections to new or existing pipe or headwalls, manholes, catch basins etc., to the lines and grades shown on the plans. All pipe and fittings shall be of the types, shapes, classes, sizes and dimensions as shown thereon; and as may be required to complete the work as shown on the plans.

508.2. GENERAL

508.2.1. Excavation, Embedment, and Backfill. All excavation, pipe embedment, and backfill shall conform to the relevant requirements of [Item 504](#), Open Cut – Backfill, with modifications specified herein.

508.2.2. Trenchless Installation. Where tunneling or jacking methods are shown on the plans or permitted by the OWNER, methods shall conform to the requirements of [Item 503](#), Trenchless Installation.

508.3. REINFORCED CONCRETE PIPE AND BOX FOR STORMWATER

This item shall govern and control the furnishing and placing of reinforced concrete storm water collection system.

508.3.1. Materials. Reinforced concrete pipe and jointing materials shall conform to the requirements of [Item 501.6](#), Reinforced Concrete Culvert, Storm Drain, Pipe and Box Section.

508.3.2. Installation.

508.3.2.1. Pipe. All activities shall be in compliance with ASTM C1479. Bedding and backfill shall be as described in [Item 504](#), Open Cut - Backfill. The CONTRACTOR shall furnish, at its own expense, and place in position as directed by the OWNER all necessary batter boards, string lines, plummets, graduated poles, lasers, etc., required in establishing and maintaining the lines and grades. The batter boards and all location stakes must be protected from possible damage or change of location.

All pipe and fittings shall be laid and jointed in a dry trench.

Unless otherwise authorized, start the laying of pipe on the bedding at the outlet end with the spigot or tongue end pointing downstream, and proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades. Fit, match, and lay the pipe to form a smooth, uniform conduit. Where bell-and-spigot pipe is used, cut cross trenches in the foundation to allow the barrel of the pipe to rest firmly upon the bedding. Do not cut cross trenches more than 2 in. larger than the bell ends of the pipe. Lower sections of pipe into the trench without damaging the bedding and the sides of the trench. Carefully clean the ends of the pipe before the pipe is jointed. Prevent the earth or bedding from entering the pipe when it is laid. Fill all lifting holes with plugs.

The bedding grade under the middle third of the pipe outside diameter shall be prepared before laying the pipe section. Making adjustments in grade by exerting force on the barrel of the pipe with excavating equipment, by lifting and dropping the pipe, or by lifting the pipe and packing bedding material under it shall be prohibited. If the installed pipe section is not on grade, the pipe section shall be completely unjoined, the grade corrected, and the pipe then rejoined.

When elliptical pipe with circular reinforcing or circular pipe with elliptical reinforcing is used, the pipe shall be laid in the trench in such a position that the markings "top" or "bottom" shall not be more than 5° from the vertical plane through the longitudinal axis of the pipe.

508.3.2.2. Box. All activities shall be in compliance with ASTM C1675. Bedding and backfill shall be as described in [Item 504](#), Open Cut - Backfill. When precast boxes are used to form multiple barrel structures, place the box sections in conformance with the plans or as directed. Place material to be used between barrels as shown on the plans or as directed. Unless otherwise authorized, start the laying of boxes on the bedding at the outlet end and proceed toward the inlet end with the abutting sections properly matched. Fit, match, and lay the boxes to form a smooth, uniform conduit true to the established lines and grades. For trench installations, lower the box sections into the trench without damaging the box or disturbing the bedding and the sides of the trench. Carefully clean the ends of the box before it is placed. Prevent the earth or bedding material from entering the box as it is laid. Proper facilities and equipment shall be provided for hoisting and lowering the box sections without disturbing

the leveling course and the sides of the excavation or damaging the box section. Proper equipment, such as a come-along or puller, should be utilized to join the sections together. Remove and re-lay, without extra compensation, boxes that are not in alignment or that show excessive settlement after laying. Unless otherwise approved by the OWNER, loads from construction equipment transferred to a box before, during, or after fill placement, either directly or through the fill, shall not be greater than the loads assumed in the design.

508.3.3. Jointing. Jointing shall be one of the following types: Cold applied preformed plastic gaskets, flexible joint sealant, expanded cellular gaskets, or rubber gaskets. Jointing materials shall conform to the requirements of [Item 501.6.1.3](#). Joints. Gasket installation practices shall be in accordance with the manufacturer's recommendations.

508.3.3.1. Cold Applied Preformed Plastic Gaskets or Flexible Joint Sealant (Mastic). If required by OWNER, a suitable primer of the type recommended by the manufacturer of the gasket joint sealer may be brush applied to the tongue-and-groove joint surfaces and the end surfaces and allowed to dry and harden. No primer shall be applied over mud, sand or dirt or sharp cement protrusions. The surface to be primed must be clean and dry when primer is applied. Primer that shows cracking or flaking at time of installation shall not be accepted.

Before laying the pipe in the trench, attach the plastic gasket sealer around the tapered tongue or tapered groove near the shoulder or hub of each pipe joint. Remove the paper wrapper from one side only of the two-piece wrapper on the gasket and press it firmly to the clean, dry pipe-joint surface. The outside wrapper is not to be removed until immediately before pushing the pipe into its final position.

When the tongue is correctly aligned with the flare of the groove, remove the outside wrapper on the basket and pull or push the pipe home with sufficient force and power (backhoe shovel, chain hoist, ratchet hoist or winch) to cause the evidence of squeeze-out of the gasket material on the inside or outside around the complete pipe joint circumference. Remove any joint material that pushed out onto the interior of the pipe that would tend to obstruct the flow. Pipe shall be pulled home in a straight line with all parts of the pipe on line and grade at all times. Pipe damaged by this operation shall be subject to review by the OWNER and, if necessary, a change in the jointing procedure may be required. Backfilling of pipe laid with plastic gasket joints may proceed as soon as the joint has been inspected and approved by the OWNER. Special precautions shall be taken in placing and compacting backfill to avoid damage to the joints.

When the atmospheric temperature is below 60°F, plastic joint seal gaskets shall either be stored in an area warmed to above 70°F, or artificially warmed to this temperature in a manner satisfactory to the OWNER. Gaskets shall then be applied to pipe joints immediately prior to placing the pipe in the trench, followed by connection to previously laid pipe.

Refer to ASTM C990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

508.3.3.2. Flexible Cellular Materials. Joints using flexible cellular gaskets do not need to be primed. If they are primed, be certain the primer is cured and non-tacky before installing gaskets.

The CONTRACTOR shall provide a copy of the manufacturer's installation instructions to the OWNER. Just before laying the pipe in the trench, stretch the gasket around the tapered tongue (or wedge it into the tapered groove) near the shoulder or hub of each pipe joint. Treat these low-tensile gaskets gently when handling. When the tongue is correctly aligned with the flare of the groove, pull or push home with sufficient force and power (winch, ratchet hoist, chain hoist or backhoe shovel) to compress the gasket to the extent that the joint gap falls within the recommended range around the entire pipe joint circumference.

CAUTION: Do not close the joint flush, or completely flatten the gasket.

Joint gap ranges for each gasket size are shown in Table 508.3.3.2.(a) Joint Gap Ranges.

Table 508.3.3.2.(a) Joint Gap Ranges

Gasket Sizes as Printed on Parts	Joint Gap Range	
	Minimum	Maximum
3/8" x 3/8"	3/8"	3/4"
1/2" x 3/8"	3/8"	7/8"
3/4" x 3/8"	3/8"	1"
1/2" x 1/2"	1/2"	1-1/8"
3/4" x 1/2"	1/2"	1-1/4"
7/8" x 1/2"	1/2"	1-1/4"
1-1/8" x 1/2"	1/2"	1-3/8"
1/2" x 3/4"	3/4"	1-1/2"
5/8" x 3/4"	3/4"	1-1/2"
3/4" x 3/4"	3/4"	1-5/8"
7/8" x 3/4"	3/4"	1-5/8"

508.3.3.3. Rubber Gaskets.

- (1) Ensure that bell and spigot are free from cracks, chips, and other defects.
- (2) Brush loose dirt and debris from the inside surface of the bell, the spigot, and the gasket.
- (3) Stretch the gasket around the spigot, with the nose against the step, and the tube lying flat against the spigot.
- (4) If not self-lubricating, apply manufacture recommended water-based lubricant on the gasket and bell.
- (5) Align the spigot with the bell, ensuring that the gasket is in contact with the bell around the complete periphery, then thrust pipe home using suitable manual or mechanical means.

508.3.4. Fittings.

508.3.4.1. Poured Concrete Pipe Collars. At all changes in pipe sizes in the conduit line, except at manholes, a pipe collar, as shown in detail on the plans, shall be provided. The locations at which such collars are to be provided are shown on the plan-profile sheets, and their costs are to be included in the price bid for furnishing and installing reinforced concrete pipe. No extra payment shall be made for the installation of concrete pipe collars as shown on the plan-profile sheets.

508.3.4.2. Shop and Field Fabricated Wyes, Tees, Crosses and Bends. Shop or field fabricated wyes, tees, crosses or bends shall be furnished and installed where indicated or required by the OWNER. Fittings for pipe, the largest size of which is less than 24-in. in diameter, shall be shop fabricated. Fittings for larger pipe, which is 24-in. in diameter and increasingly larger, may be field fabricated. Care shall be taken in the fabrication that the concrete walls of the pipe are broken back only enough to provide the required finishing opening. The reinforcing mesh or bars in each pipe shall be joined by bending, twisting or spot welding, which shall provide a rigid connection. Concrete or mortar meeting the requirements of [Item 303](#), Portland Cement Concrete Pavement or [Item 702](#), Concrete Structures shall be wiped over the reinforcing wires connecting the two-pipe joints, compacted by light blows, shaped to the contour of the pipe barrels, lightly brushed for finish and cured under wet burlap.

508.3.4.3. Poured Concrete Pipe Plugs. When conduit lines terminate at locations which do not include connection to drainage structures, the end of the pipe shall be plugged with a field-cast unit as shown on the plan-profile sheets, and the costs thereof are to be included in the price bid to furnish and install reinforced concrete pipe. No extra payment shall be made for the installation of concrete pipe plugs as shown on the plan-profile sheets.

508.4. CORRUGATED METAL PIPE

This item shall govern and control the furnishing and placing of corrugated metal storm water collection system.

508.4.1. Pipe Materials. Unless otherwise specified on the plans or required herein, corrugated metal pipe may be aluminum, galvanized steel, aluminized steel, or precoated galvanized or aluminized steel. Pipe

shall be full circle or pipe arch type as shown on the plans. Damage to materials incurred prior to backfilling shall be corrected according to [Item 501.11.7](#). Repairs.

508.4.2. Couplings. Materials shall conform to the requirements of [Item 501.11.9](#). Couplings. Joints shall prevent infiltration of side material during the life of the installation. Connecting bands shall be placed with the clamping angles and bolts at the tops of the pipe. When it is necessary to join a new pipe of helical corrugations to an existing pipe which was installed with no circumferential end corrugations, the two pipes shall be field jointed with helically corrugated bands.

508.4.3. Excavation of Backfilling. In addition to the requirements of [Item 508.2.1](#). Excavation, Embedment, and Backfill, the provisions contained herein apply.

When pipes are laid in a trench, the trench when completed and shaped to receive the pipe shall be of sufficient width to provide free working space for satisfactory bedding and jointing and thorough tamping of the backfill and bedding material under and around the pipe.

Backfilling for the metal pipe structures is a critical phase of the construction and strict adherence of [Item 504](#). Open Cut – Backfill is required. Unless otherwise shown on the plans or permitted in writing by the OWNER, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of 4-ft. of permanent or temporary, compacted fill has been placed thereon. Until a minimum cover over pipe of 12-in. is obtained, only hand operated tamping equipment will be allowed within vertical planes 2-ft. beyond the horizontal projection of the outside surfaces of the structure. Prior to adding each new layer of loose backfill material, until a minimum of 12-in. of cover is obtained, an inspection will be made of the inside periphery of the structure for local or unequal deformation caused by improper construction methods. Evidence of such will be reason for such corrective measures as may be directed by the OWNER. OWNER may require CONTRACTOR to remove and replace pipe damaged by the CONTRACTOR'S backfilling operation at no additional cost to the OWNER.

508.4.4. Laying Corrugated Metal Pipe. Unless otherwise authorized by the OWNER, the laying of pipes on the prepared foundation shall be started at the outlet end, and separate sections firmly joined together, with outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Any metal in joints which is not protected by galvanizing or aluminizing shall be coated as approved by the OWNER. Proper facilities shall be provided for hoisting and lowering the sections of pipe in to the trench without damaging the pipe or disturbing the prepared foundation and the sides of the trench. Any pipe which is not in alignment or which shows any undue settlement after laying, or is damaged, shall be taken up and re-laid without extra compensation.

Multiple installations of corrugated metal pipe and pipe arches shall be laid with the center lines of individual barrels parallel. Unless otherwise indicated on the plans, the clear distances between outer surfaces of adjacent pipes listed in Table 508.4.4.(a) Clear Distances shall be maintained.

Table 508.4.4.(a) Clear Distances

Diameter of Pipe	Clear Distance Between Pipes Full Circle and Pipe Arch	Pipe Arch
18-in.	1-ft. 2-in.	21-in. x 15-in.
24-in.	1-ft. 5-in.	28-in. x 20-in.
30-in.	1-ft. 8-in.	35-in. x 24-in.
36-in.	1-ft. 11-in.	42-in. x 29-in.
42-in.	2-ft. 2-in.	49-in. x 33-in.
48-in.	2-ft. 5-in.	57-in. x 38-in.
54-in.	2-ft. 10-in.	64-in. x 43-in.
60-in.	3-ft. 2-in.	71-in. x 47-in.
66-in.	3-ft. 2-in.	77-in x 52-in.
72-in. through 84-in.	3-ft. 2-in.	—
90-in. through 120-in.	3-ft. 5-in.	—

508.4.5. Connections. Where new structures are constructed as extensions to structures in place or are joined to existing structures, the construction shall include all work necessary to provide a proper connection between the new structure and the old as indicated on the plans, including coating of the connection when required.

508.4.6. Reuse of Existing Headwalls. When existing headwalls and aprons are specified on the plans for reuse, the portion to be reused shall be severed from the existing pipe and moved to the new position previously prepared, by approved methods.

Connections shall conform to the requirements for joining sections of pipes as indicated herein or as shown on the plans. Any headwalls, aprons or pipe attached to the headwall damaged during moving operations shall be restored to their original condition at the CONTRACTOR'S expense. The CONTRACTOR, if it so desires, may remove and dispose of the existing headwalls and aprons and construct new headwalls at its own expense, in accordance with the pertinent specifications and design indicated on the plans or as furnished by the OWNER.

508.5. STRUCTURAL PLATE CONDUIT

This work shall consist of furnishing and installing structural plate conduit of standard or special shapes conforming to these specifications of the sizes, out dimensions, the minimum gage or thickness of metal, footing design, if required, and material required by plans, at the places designated on the plans or by the OWNER, in conformity with established lines and grades.

508.5.1. Materials.

508.5.1.1. Structural Plates. The plates used for construction of structural plate conduits shall conform to the specifications in [Item 501.12](#) Structural Plate Structures.

508.5.1.2. Concrete. Concrete, curing and reinforcing steel shall conform to [Item 702](#), Concrete Structures. Unless otherwise shown on the plans, concrete for footings and headwalls shall be Class A or Class PA as specified by the OWNER. Concrete for longitudinal stiffeners (thrust beams), when specified for steel structures, shall be Class B or Class PB as specified by the OWNER and shall be reinforced in accordance with the plans. Concrete used in longitudinal stiffeners (thrust beams) on steel structures shall cure a minimum of 3-days before backfilling against or over the stiffener. Riprap for slope protection and for invert paving, when required, shall be Class B or Class PB concrete as specified by the OWNER, with reinforcement as specified on the plans and shall conform to the requirements of [Item 803.3](#), Riprap.

508.5.2. General Construction Methods. Structural plate conduits shall be constructed from the specified materials in accordance with the plans and this item.

Steel plates will have approximately a 2-in. lip beyond each end crest, which results in the actual length of a given structure being approximately 4-in. longer than the nominal length, except when skewed or beveled. Footings for arches shall be designed and constructed to accommodate this additional length.

The distance between multiple structures shall be shown on the plans with the minimum distance being that space required to permit adequate compaction of backfill material.

508.5.3. Excavation. Unless otherwise required, all structural excavation shall be in accordance with the requirements of [Item 701.2](#), Structural Removal, Excavation, and Backfill, and the additional requirements herein. The excavation will be of sufficient width to provide ample working space for erection and proper compaction of backfill and bedding material. The CONTRACTOR shall provide adequate drainage of the cut and bedding during the construction operation.

If the quality of the native soil is as good as or better than the proposed backfill material, excavation shall be to the limits set forth in the [Item 701.2](#), Structural Removal, Excavation, and Backfill. If the quality of the native soil is less than that of the proposed backfill material, the excavation shall extend, from each side of the barrel, a minimum horizontal distance of $\frac{1}{2}$ -span or $\frac{2}{3}$ -rise, whichever is greater.

508.5.4. Substructures for Structural Plate Arches. The substructure for structural plate arches shall be as detailed on the plans. Concrete footings, when required, shall be placed entirely on either rock or firm soil. When footing area is partially rock and partially soil, the rock shall be removed below grade and replaced with suitable materials so that a slightly yielding, compacted earth cushion is provided below the

footing for a minimum of 12-in. When a thin layer of soil is partially covering rock within the bearing area and when practical to do so, the soil may be removed and the footings placed directly on rock in accordance with details shown on the plans.

Footings shall be formed and finished to true lines and grades as established by the OWNER. Anchors or slots shall be set to true line and grade when placing concrete for each substructure unit. No plates for arch structures shall be placed until the substructure has cured for a minimum of 3-days.

Any portion of an aluminum structure that is in contact with a metal other than aluminum or in contact with concrete containing chlorides shall be insulated from this other metal or concrete containing chlorides by a coating of bituminous material or a plastic coating, such as asphalt, mastic or polymeric coating. The coating shall be applied to the aluminum structure to provide insulation between the aluminum and other metal or concrete containing chlorides and shall extend a minimum distance of 1-foot beyond the area of contact.

508.5.5. Foundations for Structural Plate Conduits with Metal Inverts. Horizontal ellipses, box culverts, or other structural plate shapes with metal invert shall be placed on a shaped bed of granular material carefully and accurately shaped to fit the lower part of the structure for at least 10-percent of its overall height, except that the length of bedding arc need not exceed the width of the bottom plate. The granular material shall be at least 3-in. in thickness, so as to obtain uniform seating of the corrugations on the structure bed. For culverts, the bedding specified herein shall be the full width of the invert. Where rock, in either ledge or boulder formation, is encountered, it shall be removed below grade and replaced with a compacted earth cushion having a thickness of not less than ½-in.-per-foot height of fill over the top of the structure, with the minimum allowable thickness of 12-in. and a maximum of 24-in. under the structure. Where the soil encountered at the established grade is a quicksand, muck or similar unstable material, it shall be removed and replaced in accordance with the requirements of [Item 701.2](#), Structural Removal, Excavation, and Backfill.

508.5.6. Skewed Structures. The end skew shall not exceed 45°. When the skew of arches is more than 15°, the length of the structure shall be such that no portion of the live load will be carried by the cut portion of the arch end. Where right-of-way or other conditions do not permit the required length, the cut end shall be supported by a rigid headwall designed to meet the conditions. When the skew angle of pipes exceeds 20° and the structure has the ends cut to fit a slope, the ends shall be reinforced with concrete riprap or other suitable end treatment as indicated on the plans or as directed by the OWNER. If headwalls are required, the plates shall be anchored to the headwall with not less than ¾-in. diameter by 6-in. minimum length bolts, at not over 19-in. centers. If structures are to have skewed ends, bevels, step-bevels or other special end treatment, this information will be shown on the plans.

508.5.7. Erection and Shape Control. When all plates of a structure are in position, all bolts not already in place shall be inserted and all nuts tightened progressively and uniformly, beginning at one end of the structure. All nuts shall be tightened a second time to a torque of not less than 150-ft.-lbs. nor more than 300-ft.-lbs. for steel structures, and not less than 125-ft.-lbs. nor more than 150-ft.-lbs. for aluminum structures.

It is essential that bolts be well tightened. If an impact wrench is used, a sufficient number of bolts shall be checked with a long-handled, structural or socket wrench or torque wrench to insure that they are properly tightened. All service bolts used in drawing the plates together shall be replaced with standard high strength bolts.

Lateral ties, struts and/or false-work may be required on some structures to maintain proper shape and alignment during erection and backfill operations. Monitoring of the structure shape throughout erection and backfill requires careful observations of the symmetry and uniform curvature of the periphery of the structure. If there is any tendency toward loss of symmetry in shape or loss of curvature in the structure periphery, even though the structure is within the tolerances stated herein, construction involving the structure shall cease until a proper course of action is established.

CONTRACTOR shall furnish acceptable devices for monitoring the horizontal and vertical shape of the structure. For box culverts and structures not requiring longitudinal or transverse stiffeners, the shape shall be kept within 2-percent of design measurements (span or rise, whichever is greater) or 5-in., whichever is less, during erection and backfilling. For structures requiring either longitudinal stiffeners or transverse

stiffeners (except box culverts), a minimum of 5 monitoring devices shall be furnished at transverse sections, with one at each longitudinal stiffener, one at the top of the structure, and one at each mid span of the top arc. These shall be installed at each end and as a minimum on 24-ft. increments for the entire structure length.

For the shape factor furnished (shape factor = R_t/R_s , where R_t is the radius of the top arc and R_s is the radius of the side arc), unless otherwise shown on the plans, the allowable sag from design shape during erection, as a percentage of the rise shall not exceed tolerances shown in Table 508.5.7.(a) Allowable Sag.

Table 508.5.7.(a) Allowable Sag

Shape Factor	Allowable Sag (expressed as percentage of the rise)
up to 2.74	4%
2.75 through 3.24	2%
3.25 and greater	1%

Shape shall be checked at least after each two, 1-ft. compacted lifts of backfill, with the upward movement of the top of the structure during backfilling, not to exceed 2-percent of the rise, nor more than 50-percent loss of the mid-ordinate of the side plates, nor more than 25-percent deviation of any mid-ordinate of the top plates, all measured from the design shape. Selective top loading of the structure may sometimes be required to prevent distortion in excess of tolerances given herein.

508.5.8. Backfilling. Backfilling and/or construction of the embankment around and over the structure is a critical phase of the construction, and strict adherence to these construction methods is required. Backfilling and/or embankment construction around the structure shall be performed in accordance with [Item 203](#). Site Preparation and [Item 504](#). Open Cut – Backfill, except as modified herein.

Any damage to plates or structures caused by equipment and/or backfilling operations shall be corrected or removed and replaced to the OWNER'S satisfaction at the entire expense of the CONTRACTOR.

508.5.8.1. Structural Plate Conduits Without Longitudinal or Transverse Stiffeners and Box

Culverts. Unless otherwise shown on the plans or permitted in writing by the OWNER, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of 4-ft. of permanent or temporary compacted fill has been placed thereon. Within vertical planes 2-ft. beyond the horizontal limits of the structure and until a minimum of 2-ft. of cover has been compacted over the structure, only hand operated, mechanical tamping equipment will be permitted.

During the backfilling operations, extreme care shall be taken to avoid unequal pressures and to obtain uniformly compacted backfill material of uniform density throughout the length of the structure and to insure proper backfill under the structure.

The structure shall be backfilled so that when backfill is complete, the inside dimensions shall be within tolerances set forth in [Item 508.5.7](#). Erection and Shape Control. Backfill material will be placed and compacted in maximum 8-in. lifts simultaneously along each side of the structure until the height of the backfill has reached the crown of the structure. Backfill shall continue to be placed in maximum 12-in. lifts over the crown in layers extending laterally from the crown and compacted using hand operated or light compaction equipment until the design height is obtained.

For multiple structures the same backfill phases will be performed for all structures more or less simultaneously. Backfilling between the barrels will usually require that the material be placed with a crane and bucket or other suitable equipment. Backfill material shall not be dropped from a height or concentrated in such an amount prior to distribution over the top arc that damage to the flexible structure will result. Compaction of this backfill shall be with hand operated tampers or other acceptable equipment.

508.5.8.2. Structural Plate Conduits Requiring Longitudinal or Transverse Stiffeners Except Box

Culverts. The plans will designate, when appropriate, the longitudinal stiffener designs for steel structures or a transverse stiffener design for aluminum structures. The backfill material to be used adjacent to and over the structure to the minimum required cover (as shown on the plans) shall be a

granular type material such as a well graded sand and gravel (preferably sharp, rough and angular if possible), or a uniform sand or gravel. Plastic soils will not be permitted. The structure backfill material shall conform to one of the following soil classifications as defined in Table 508.5.8.2.(a) Classification of Soils and Soil-Aggregate Mixtures.

- (1) For height of fill less than 12-ft.: A-1, A-3, A-2-4 and A-2-5 may be used.
- (2) For height of fill of 12-ft. or greater: A-1 and A-3 may be used.

Table 508.5.8.2.(a) Classification of Soils and Soil-Aggregate Mixtures

GENERAL CLASSIFICATIONS = GRANULAR MATERIALS (35-Percent or Less Passing No. 200)					
Characteristic	Group Classification				
	A-1		A-3	A-2	
	A-1-a	A-1-b		A-2-4	A-2-5
Sieve Analysis, Percent Passing: (No. 10) (No. 40) (No. 200)	50 max. 30 max. 15 max.	— 50 max. 25 max.	— 51 max. 10 max.	— — 35 max.	— — 35 max.
Characteristics of Fraction Passing 0.425 mm. (No. 40) Liquid limit Plasticity index	— 6 max.		— N. P.	40 max. 10 max.	41 min. 10 max.
Usual Types of Significant Constituent Materials	Stone Fragments, Gravel and Sand		Fine Sand	Silty or Clayey Gravel and Sand	

The backfill material shall be compacted to at least 95-percent of maximum density as determined by ASTM D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³). Moisture content shall be within minus-2- to plus-4-of-optimum. It may not be possible to develop this compacted density in the first lift of material over the top arc (Phase 2 described below) due to the influence of the flexible structure; therefore, density in at least the first lift over the top arc (Phase 2) will be the highest density attainable using equipment authorized herein.

The backfill pattern and sequence, up to at least the depth of minimum required cover, shall be in three phases. Phase 1 of the backfill operation will be to backfill under the haunches and/or along the side-walls of the structure. Backfill material will be placed in maximum 8-in. lifts simultaneously along each side of the structure until the height of backfill has reached the top of the longitudinal stiffeners or that longitudinal seam (edge of structure crown where the top arc plates connect to the side arc plates).

Phase 2 will be to work simultaneously symmetrically from both sides of the structure with light track type equipment pushing material over the crown until three 12-in. lifts of backfill have been placed and compacted uniformly over the crown. The light track equipment shall not exceed 20,000-pounds gross weight with a track pressure less than 1700-pounds-per-square-foot.

After the crown has been uniformly covered, Phase 3 will be to continue to place maximum 12-in. lifts of backfill, compacted, which extend laterally from the crown and compact over the crown and at the sides of the structure using hand operated or light tractor drawn compaction equipment working at the same time on each side of the structure at the same longitudinal location, until at least the minimum required depth of cover is attained. Wheel type equipment will not be allowed over the crown of the structure until Phase 3 is complete.

For multiple structures the same backfill phases will be performed for all structures more or less simultaneously. Backfilling between the barrels will usually require that the material be placed with a crane and bucket or other suitable equipment. Backfill material shall not be dropped from a height or concentrated in such an amount prior to distribution over the top arc that damage to the flexible structure will result. Compaction of this backfill shall be with hand operated tampers or other acceptable equipment.

508.6. CORRUGATED THERMOPLASTIC PIPE

This item shall govern and control the furnishing and placing of corrugated thermoplastic pipe to be used in storm water collection systems.

508.6.1. Pipe Materials. Unless otherwise specified on the plans or as required herein, corrugated thermoplastic pipe shall meet the requirements of [Item 501.23](#). Thermoplastic Corrugated Drainage Tubing and Corrugated Smooth Lined Storm Water Pipe and Fittings. Pipe shall be full circle as shown on the plans. Damage to the materials incurred prior to backfilling shall be removed and replaced.

508.6.2. Couplings. Materials shall conform to the requirements of [Item 501.23.4](#). Joints shall prevent infiltration of side material during the life of the installation. Soil-tight Joints shall be bell and spigot or utilize couplings that engage at least two full corrugations on each pipe section in accordance with AASHTO M330.

508.6.3. Installation of Pipe. The CONTRACTOR shall furnish, at its own expense, and place in position as directed by the OWNER all necessary batter boards, string lines, plummets, graduated poles, lasers, etc., required in establishing and maintaining the lines and grades. The batter boards and all location stakes must be protected from possible damage or change of location. The cost of replacement of location stakes shall be at no additional cost to the OWNER.

All pipe and fittings shall be laid and jointed in a dry trench of a minimum width as shown in Table 508.6.3.(a) Minimum Trench Widths for the Installation of Corrugated Thermoplastic Pipe.

The minimum depth of cover and trench width should be established by the OWNER based on evaluation of specific project conditions or ASTM D2321.

Table 508.6.3.(a) Minimum Trench Widths for the Installation of Corrugated Thermoplastic Pipe

Nominal Inside Pipe Diameter (Inches)	Typical Outside Pipe Diameter (inches)			Minimum Trench Width ¹ (Inches)
	HDPE	PP	PVC	
4	4.9	NA	4.3	21
6	6.9	NA	6.4	23
8	9.1	NA	8.6	25
10	11.2	NA	10.8	27
12	14.3	14.5	12.8	30
15	17.5	17.6	15.7	33
18	21.5	21.2	19.2	38
24	28.0	28.0	25.6	46
30	35.5	35.4	32.2	55
36	42.0	41.1	38.7	63
42	47.5	47.2	NA	71
48	54.0	53.8	NA	79
54	61.0	NA	NA	88
60	67.0	66.5	NA	95

¹For pipe sizes larger than those shown above, use pipe manufacturer's recommendation or ASTM D2321.

Install foundation and bedding as required by the OWNER. Unless otherwise authorized by the OWNER, the laying of the pipe on the prepared foundation shall be started at the outlet or downstream end with the spigot or tongue end of the pipe joint pointing downstream. Place pipe and fittings in the trench with the invert conforming to the required elevations, slopes, and alignment. Place embedment materials by methods that will not disturb or damage the pipe. Work in and tamp the haunching material in the area between the bedding and the underside of the pipe before placing and compacting the remainder of the embedment in the pipe zone.

Laying shall proceed toward the inlet or upstream end with each abutting section of pipe properly matched, true to the established lines and grades. Approved facilities shall be provided for hoisting and lowering the sections of pipe or the sides of the trench. The ends of the pipe shall be carefully cleaned before the pipe is placed in the trench. As each length of the pipe is laid, the open end shall be protected to prevent

the entrance of earth or bedding material. The pipe shall be fitted and matched so that when laid in the prepared bedding, it shall form a smooth, uniform conduit.

508.6.4. Jointing. Jointing shall be one of the following types: Soil-tight joints shall meet the requirements of [Item 501.23.4](#). Joints; Water-tight Joints shall meet the requirements of [Item 501.23.4](#). Joints. The CONTRACTOR is to comply with manufacturer's recommendations for assembly of joint components, lubrication, and making of joints.

508.6.5. Excavation and Backfilling. In addition to the requirements of [Item 504](#). Open Cut – Backfill, the provisions contained herein apply.

When pipes are laid in a trench, the trench when completed and shaped to receive the pipe shall be of sufficient width to provide free working space for satisfactory bedding and jointing and thorough tamping of the backfill and bedding material under and around the pipe. Backfilling for thermoplastic pipe structures is a critical phase of the construction and strict adherence of [Item 504](#). Open Cut – Backfill is required. Unless otherwise shown on the plans or permitted in writing by the OWNER, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of 2 feet of depth for 24 inch diameter and smaller pipes or a minimum of 3 feet on pipes larger than 24 inches in diameter of permanent or temporary, compacted fill has been placed thereon. Until a minimum cover over pipe of 12 inches is obtained, only hand operated tamping equipment will be allowed within vertical planes 2 feet beyond the horizontal projection of the outside surfaces of the structure. Prior to adding each new layer of loose backfill material, until a minimum of 12 inches of cover is obtained, an inspection will be made of the inside periphery of the structure for local or unequal deformation caused by improper construction methods. Evidence of such will be reason for such corrective measures as may be directed by the OWNER. OWNER may require CONTRACTOR to remove and replace pipe damaged by the CONTRACTOR'S backfilling operation at no additional cost to the OWNER.

508.6.5.1. Shaping and Bedding. Bed the pipe in a foundation of compacted cohesionless material, such as sand, crushed stone, or pea gravel, with a maximum allowable size of 1 in. Extend this material a minimum of 6 in. below the outermost corrugations or ribs, and carefully and accurately shape it to fit the lowest part of the pipe exterior for a minimum of 10% of the overall height. When requested by the OWNER, furnish a template for each size and shape of pipe to be placed for use in checking the shaping of the bedding. Provide a template consisting of a thin plate or board cut to match the lower half of the cross section of the pipe.

508.6.5.2. Backfilling. Backfill from the pipe bedding up to 1 ft. above the top of the pipe to provide necessary structural support to the pipe and control pipe deflection. Take special precautions when placing and compacting backfill material. Place special emphasis obtaining uniform compacted density throughout the length of the pipe, to avoid unequal pressure. Use extreme care to ensure proper backfill under the pipe, in the haunch zone.

Provide backfill material meeting the following specifications:

- (1) Type I- Provide backfill consisting of flowable fill in accordance with [Item 504.2.3.4](#) Flowable Backfill. Place the flowable backfill across the entire width of the trench and maintain a minimum depth of 12 in. above the pipe. Wait a minimum of 24 hours before backfilling the remaining portion of the trench with other backfill material in accordance with [Item 504.2.3](#). Final Backfill.
- (2) Type II- Provide backfill consisting of cement stabilized backfill in accordance with [Item 504.2.3.5](#). Modified Flowable Backfill. Place and compact cement stabilized backfill to completely fill any voids.
- (3) Type III- Provide backfill consisting of hard, durable, clean granular material that is free of organic matter, clay lumps, and other deleterious matter. Provide backfill meeting the gradation requirement shown in Table 508.6.5.2.(a). Place the backfill material along both sides of the completed structure to a depth of 12 in. above the pipe. Place the backfill in uniform layers a minimum of 6 in. deep (loose measurement), wet if required and thoroughly compacted between adjacent structures and between the structure and the sides of the trench. Until a minimum cover of 12 in. is obtained, only hand-operated tamping equipment will be allowed within vertical planes 2 ft. beyond the horizontal projection of the outside surfaces of the structure. If using Type III backfill,

place filter fabric between the native soil and the backfill as directed by OWNER. Filter fabric shall meet TxDOT Specification DMS-6200.

Table 508.6.5.2.(a) Gradation Requirements for Type III Backfill Material

Sieve Size	Percent Retained (Cumulative)
1 in.	0-5
7/8 in.	0-35
1/2 in.	0-75
3/8 in.	0-95
No. 4	35-100
No. 10	50-100
No. 200	90-100

508.6.6. Pipe Testing. Upon completion of pipe installation, the CONTRACTOR shall test thermoplastic and thermoset pipe for deflection. Deflection tests shall be performed no sooner than 30-days after densification of backfill.

Deflection testing shall be performed by the CONTRACTOR at no cost to the OWNER. No payment will be made for delays that result from the CONTRACTOR's performance of deflection testing.

The CONTRACTOR shall test all thermoplastic pipes for deflection by one of the following methods: 1. Mandrel, or 2. Laser Video.

Nominal diameter 27-in. or smaller shall be tested by mandrel. The mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded. Pipe with nominal ID larger than 27-in. may be tested by an alternate method as approved by the OWNER. If a mandrel is selected to test pipe 27-in. and larger, the minimum diameter, length and other requirements shall conform to the dimensions and requirements as stated below. Deflection measurement for ID's nominally larger than 27-in. shall be determined using a 1-in. diameter rigid, nonadjustable metal bar approved by the OWNER; a minimum-radius rigid template; or by a method approved by the OWNER.

508.6.6.1. Mandrel. Prior to use, the mandrel shall be certified by the OWNER. Mandrel requirements are as follows:

- (1) odd-number of legs with 9 legs minimum
- (2) effective length not less than its nominal diameter
- (3) fabricated of steel
- (4) fitted with pulling rings at each end
- (5) stamped or engraved on some segment other than a runner indicating the pipe specification, nominal size, and mandrel OD

If the mandrel fails to pass, the pipe shall be considered to be "overdeflected". Any overdeflected pipe shall be uncovered and, if not damaged, reinstalled. Damaged pipe shall not be reinstalled, but shall be removed and replaced. Any pipe subjected to any method or process other than removal, which attempts, even successfully, to reduce or cure any overdeflection, shall be uncovered, removed and replaced with new pipe. Final remediation to be approved by OWNER.

508.6.6.2. Laser Video Equipment. A combination color CCTV pipeline survey system with a cable distance counter, laser profiling system, non-contact video micrometer and measurement software shall be used to perform a measurement survey of thermoplastic pipelines with nominal inside diameter 60-in. or smaller. The equipment used shall be certified by a recognized independent testing group and includes a certified accuracy of 0.5% or better and a repeatability of 0.12% or better. Refer to ASTM E691 and ASTM E177 for equipment calibration.

508.6.7. Multiple Installations of Corrugated Thermoplastic Pipe. Multiple installations of corrugated thermoplastic pipe shall be laid with the center lines of individual barrels parallel. Unless otherwise indicated on the plans, the clear distances between outer surfaces of adjacent pipes are listed in Table 508.6.7.(a) Clear Distances shall be maintained.

The minimum clear distance should be established by the OWNER based on evaluation of specific project conditions or pipe manufacturer's recommendations.

Table 508.6.7.(a) Clear Distances

Diameter of Pipe (Inches)	Clear Distance Between Outside surfaces of Pipes – Full Circle (Inches)
18 and smaller	14 in.
24	17 in.
30	20 in.
36	23 in.
42	26 in.
48	29 in.
54	34 in.
60	38 in.
66	38 in.

508.7. MEASUREMENT AND PAYMENT FOR STORMWATER CONDUIT INSTALLATION

508.7.1. Measurement. Pipe, including corrosion protection, if in place on the pipe, or unless otherwise covered by a special bid item, shall be measured for payment in linear feet along the centerline of the pipe measured from centerline of manhole to centerline of manhole or to the end of the line in a case where no manhole exists. Deductions shall be made for special structures. Pipe which extends only through the wall of the structure shall be measured to the actual end of the pipe. No deductions shall be made for fittings, measurements being from center to center of fitting. Conduits shall not be classified for payment according to depth unless a separate trenching item is not included.

508.7.2. Payment. Pipe, including corrosion protection in place on the pipe, or unless otherwise covered by a separate bid item, shall be paid for at the contract unit price per linear foot, complete in place, as provided by the contract. The contract price per linear foot shall be the total compensation for furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work in accordance with the plans and these specifications.

ITEM 601. PIPELINE REHABILITATION

601.1. DESCRIPTION

This item shall govern the rehabilitation of pipe using materials and methods that may be used as an alternative to pipeline replacement. Unless indicated otherwise, these methods shall be used for non-pressure (gravity flow) pipeline rehabilitation. Other processes not specified in this section may be approved for use by OWNER.

601.2. GENERAL

No pipe shall be reconstructed without prior notification of the OWNER. Work shall include the furnishing of all labor, equipment and materials necessary to complete the rehabilitation of pipelines and service reconnections as stipulated herein and as specified in Contract Documents. Work shall include the preparation of the construction site, including cleaning and flushing of existing piping; flow control bypass pumping; protection of existing conditions during installation work; unloading; hauling; distributing and installation; testing of all pipe, fittings, scaffolding, valves, boilers, etc. and other accessories as required for proper installation. It shall also include restoration or replacement of all removed or damaged pavement, curb, sidewalk, gutter, shrubbery, fence, sod or other disturbed surfaces or structures in a condition equal to that before the work began, to the satisfaction of the OWNER, and shall furnish all labor and material incidental thereto.

The OWNER shall locate and designate all manhole access points open and accessible for the work, and provide rights of access to these points. The OWNER shall also provide access to water hydrants for cleaning, inversion, and other work items requiring water.

601.2.1. Submittals. Submittals shall be made according to the OWNER'S schedule so that project schedules can be met.

CONTRACTOR shall submit the following to the OWNER:

- (1) Method of pipe rehabilitation and restoration of existing service connections. This shall include detail drawings and written description of the entire construction procedure to install pipe, bypass flow in the section of existing pipe to be reconstructed, and reconnection of service connections. Drawings shall include showing the cross sectional profile of the pipe wall and pipe joint details. For pipes larger than 12-in diameter, bypass specifications shall be sealed by a registered OWNER. The process shall not be detrimental to liner pipe material and its properties;
- (2) A complete list of all materials proposed to be furnished and installed, including manufacturer's name and catalog number for each item, complete information on material composition, physical properties, and dimensions of new pipe and fittings and technical data, and manufacturer's recommendations for handling, storage, installation, and repair of pipe and fittings damaged;
- (3) Manufacturer's design calculations, including minimum thickness of the pipe materials being supplied;
- (4) Prior to use of the materials, if required, written certification of the CONTRACTOR'S compliance with the manufacturer's standards and specifications for all materials;
- (5) After reviewing the site, but prior to starting any rehabilitation process, the CONTRACTOR shall make a plan of all work activities. If required by the OWNER, the CONTRACTOR shall plan its work after review of pre-construction television inspection tape and reports. If required by the OWNER, the CONTRACTOR shall furnish its work plan to the OWNER;
- (6) Flow control implementation plan shall be pre-approved by OWNER prior to any construction.

601.2.2. Inspections and Testing. Prior to all work, the CONTRACTOR shall carefully inspect the area for existing conditions.

Each pipe or pipe material shall be subject to inspection by the OWNER immediately before it is installed and defective pipe or pipe material may be rejected at no cost to the OWNER.

CONTRACTOR shall perform pre-construction and post-construction television inspection. Television inspection shall be performed according to [Item 507.5.2. Television Inspection](#), with the following modifications:

- (1) The interior of the pipeline shall be carefully inspected to determine the location of any condition that may prevent proper installation of the new pipe;

- (2) These conditions shall be indicated to the OWNER prior to installation and corrected as determined by the OWNER;
- (3) A digital file and suitable log shall be submitted to the OWNER prior to and after installation of the pipe, which become property of the OWNER.

Where applicable, the CONTRACTOR shall provide a pipe "coupon" specimen from each run of pipe for testing, after installation, by an approved laboratory. All expenses for the testing of these specimens will be paid by the OWNER. The cost of retests made necessary by the failure of the samples of specimens to meet the specified requirements shall be paid for by the CONTRACTOR. CONTRACTOR shall conduct Pre- and Post-TV inspections at no cost to the OWNER.

601.3. GENERAL MATERIALS

Materials shall be appropriate to the size of the existing pipeline to be reconstructed.

Pipe interior shall be a light color to facilitate video inspection.

The CONTRACTOR shall verify all existing pipe diameters prior to ordering pipe materials.

The CONTRACTOR shall not permit any pipe rehabilitation component to be brought onto the job site until it has been approved by the OWNER.

Tests for compliance with these specifications shall be made as specified herein and in accordance with applicable ASTM specifications. Upon request, the manufacturer shall furnish a certificate for all material furnished under this specification.

All materials shall be transported, handled, and stored as recommended by manufacturer.

Pipe, pipe materials, or fittings may be rejected for failure to meet any requirements of these specifications.

601.4. GENERAL METHODS

601.4.1. Pre-Construction. Methods used shall minimize disruption or interference with traffic flow, public right-of-way, local business, or adjacent private property in the area.

Any required excavation shall conform to the requirements of [Item 203](#). Site Preparation, including identification and protection of utilities.

Upon approval of the OWNER, the manufacturer's recommendations shall become the basis for acceptance or rejection of actual methods of installation.

The CONTRACTOR shall make every effort to maintain service usage throughout the duration of the project. In the event that a service connection will be out of service, the CONTRACTOR shall notify the OWNER and each customer whose service will be disrupted by construction in writing a minimum of 24-hours in advance of construction. Notice shall include the work to be conducted, work schedule including when service will be off-line, effect to each customer, and a local telephone number of the CONTRACTOR to call to discuss the project or any problems that could arise. The maximum amount of time of no service shall be 12-hours for any property served by the existing pipeline. The OWNER may also require the CONTRACTOR to attempt personal contact with affected residents prior to the beginning of work being conducted on the section relative to the residents affected. The CONTRACTOR shall attempt personal contact with any home or business that cannot be reconnected within the time schedule stated in the written notice.

601.4.2. General Construction Requirements. The CONTRACTOR shall certify it has a minimum of two (2) complete working units. Spare key components shall be on the site prior to construction.

The CONTRACTOR's supervisor shall be on the job full-time during any and all steps of the pipe installation.

The CONTRACTOR shall carry out its operations in strict accordance with all OSHA and manufacturer's safety requirements. Particular attention is drawn to those safety requirements involving working with hazardous/combustible material, scaffolding, and entering confined spaces.

In the event of a discrepancy, the CONTRACTOR shall immediately notify the OWNER. No work shall be performed in an area of discrepancy until it has been fully resolved by the OWNER.

The CONTRACTOR shall maintain in operating condition all active pipes encountered during the pipeline rehabilitation. The CONTRACTOR shall be responsible for continuity of service to each facility connected to the section of pipe being reconstructed during execution of the work. The CONTRACTOR, when necessary, shall provide for the flow around the section of pipe designated for rehabilitation. At no time shall wastewater be pumped into the streets, alleys, waterways or storm drain systems. Bypass shall be made by plugging the

line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. Pump and bypass lines shall be of adequate capacity and size to handle the flow. The CONTRACTOR shall ensure that no wastewater overflows from the existing pipe into access pit(s). If wastewater does overflow, the CONTRACTOR shall provide suitable means to contain the wastewater and return it to the existing pipe. If flow backup occurs and enters buildings, the CONTRACTOR shall be responsible for clean up, repair, property damage cost, and claims. CONTRACTOR shall be liable for any damages incurred as a result of inadequate flow bypass measures.

It shall be the responsibility of the CONTRACTOR to clear the existing pipeline of obstructions such as debris, a protruding service connection, dropped joint, or collapsed pipe that will prevent rehabilitation. Any required work must be approved in writing by the OWNER and done by the CONTRACTOR. The OWNER reserves the right to approve or disapprove of any point repairs identified. If inspection reveals an obstruction that cannot be removed by conventional pipe cleaning equipment, then the CONTRACTOR shall hydraulically reround the pipe or make a point repair excavation to uncover and remove or repair the obstruction. Extreme care shall be used to prevent debris from entering existing pipe prior to rehabilitation.

Pipe grades shall be maintained equal to the grade of the line being rehabilitated. The CONTRACTOR shall correct all grade deficiencies to the satisfaction of the OWNER at no additional cost to the OWNER.

In the event of damage caused to materials, the CONTRACTOR shall make all repairs and replacement necessary to the approval of the OWNER at no additional cost to the OWNER.

During the warranty period, defects that may affect the integrity or strength of the pipe, in the opinion of the OWNER, shall be repaired or the pipe replaced at the CONTRACTOR'S expense.

The CONTRACTOR shall make all required connections to existing pipes and manholes within 12-hours of pipe rehabilitation completion and carry out such work in accordance with local standards and requirements and as directed by the OWNER. The CONTRACTOR shall be responsible to confirm the active services prior to reconnection.

601.4.2.1. Point Repairs on Private Property. Point repairs may be required on private property. Point repairs on private property shall be excavated using mini equipment to cause as little damage as may be necessary to accomplish the work. If fences must be removed to accomplish the work, the CONTRACTOR shall install temporary fencing of like size and construction until permanent fence replacement is accomplished.

601.4.3. Post-Construction Requirements. After the installation work has been completed and all testing acceptable, the CONTRACTOR shall clean up the entire project area in accordance with [Item 107.25](#), Project Clean-Up. The CONTRACTOR shall remove surplus pipe, excess materials, tools and temporary structures. All dirt, rubbish and pipe material from the operation and debris collected as a result of cleaning shall be legally disposed of by the CONTRACTOR.

The CONTRACTOR shall restore or replace all removed or damaged pavement, curb, sidewalk, gutter, shrubbery, fence, sod or other disturbed surfaces or structures in a condition equal to that before the work began, to the satisfaction of the OWNER, and shall furnish all labor and material incidental thereto.

601.5. SECTION HELD FOR FUTURE USE.

601.6. SECTION HELD FOR FUTURE USE.

601.7. CURED-IN-PLACE PIPE LINER (CIPP LINER)

It is the intent of this specification to provide for the rehabilitation of pipelines and conduits by the installation of a resin-impregnated flexible tube, which is inverted into the original conduit by use of a hydrostatic head. The resin is cured by circulating hot water or steam within the tube.

601.7.1. Material. In case of conflicting requirements between this specification and referenced standards, this specification shall govern.

The tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM D5813 Cured-In-Place Thermosetting Resin Sewer Pipe. The tube shall be constructed to withstand inversion pressures, have sufficient strength to bridge missing pipe, stretch to fit

irregular pipe sections, and shall invert smoothly around bends. The tube shall be made to a size that when installed, will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion. Overlapped layers of felt that cause lumps in the final product shall not be allowed.

The outside layer of the tube (before wetout) shall be polyethylene- or polyurethane-coated, a translucent flexible membrane that clearly allows inspection of the resin impregnation (wetout) procedure. The plastic coating shall separate the resin inside the tube from the inversion water without leakage, accommodate inversion, stretch to size, and shall not delaminate before, during, or after curing. The wetout tube shall have a uniform thickness that when compressed at installation pressures will meet or exceed the design thickness.

The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. Seams in the tube shall be stronger than the unseamed felt. Where the length requires joining, the joint shall not be perpendicular to the long axis but spirally formed.

The outside of the tube shall be marked for distance at regular intervals along its entire length, not to exceed 5-ft. The manufacturer's name or identifying symbol shall also appear at intervals not exceeding 10-ft.

The resin system shall be a corrosion-resistant polyester, vinyl ester or epoxy, and catalyst system that when properly cured within the tube composite meets the requirements of ASTM D5813 Cured-In-Place Thermosetting Resin Sewer Pipe, the physical properties herein, and those specifications utilized in the design of the CIPP for a particular project.

The CIPP shall be designed as per ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube, Appendix X1. The CIPP design shall assume no bonding to the original pipe wall.

The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If separation of the layers occur during testing of field samples, new samples shall be cut from the work. Any reoccurrence may cause rejection of the work.

The cured pipe material (CIPP) shall conform to the minimum structural properties, as indicated in Table 601.7.1.(a) Cured-in-Place Pipe Liner Properties.

Table 601.7.1.(a) Cured-in-Place Pipe Liner Properties

1. Property	2. ASTM Test Method	3. Minimum Value	4. Materials with 5. 400,000 psi
Modulus of Elasticity	D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials	(short term) 250,000-psi	400,000-psi
Flexural Stress	ASTM D790 (same as above)	4500-psi	4500-psi

No dry or unsaturated layers shall be evident. Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

Overall, the hydraulic profile shall be maintained as large as possible. The CIPP shall have a minimum of full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition. The roughness coefficient of the CIPP shall be verified by third party test data.

CIPP samples shall be prepared and physical properties tested in accordance with ASTM F1216 Section 8.1 using either method proposed. The flexural modulus must meet or exceed the value used in design (structural requirements for the pipe size and thickness furnished in design).

When requested by the OWNER, the CONTRACTOR shall submit test results from previous field installations in the USA of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in this section have been achieved in previous field applications. Testing samples for this project shall be made and tested as described in this specification.

601.7.2. Methods. The CIPP Liner shall be continuous and tight fitting. Installation shall be in accordance with manufacturer's recommendations.

601.7.2.1. Installation. CIPP installation shall be in accordance with ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube, Section 7, or ASTM F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP), or ASTM F2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP) with the following additional requirements:

The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used. After vacuum in the tube is established, a vacuum point shall be no further than 75-feet from the leading edge of the resin. The leading edge of the resin slug shall be as near to perpendicular as possible. A roller system shall be used to uniformly distribute the resin throughout the tube. If the installer uses an alternate method of resin impregnation, the method must produce the same results. Any alternate resin impregnation method must be proven.

Curing shall be accomplished by utilizing hot water under pressure.

601.7.2.2. Finishing. Branch connections to buildings shall be reopened without excavation utilizing a remotely controlled cutting device, monitored by a video TV camera.

No additional payment shall be made for excavations for the purpose of reopening connections, and the CONTRACTOR shall be responsible for all costs and liability associated with such excavation and restoration work.

Visual inspection of the CIPP shall be in accordance with ASTM F1216, Section 8.6 or ASTM F1743.

Leakage testing of the CIPP shall be accomplished during cure while under a positive head. CIPP products in which the pipe wall is cured while not in direct contact with the pressurizing fluid (e.g., a removable bladder) must be tested by an alternative method approved by the OWNER.

601.8. PIPE BURSTING WITH POLYETHYLENE

This section includes requirements to rehabilitate existing pipelines by the pipe bursting method, which splits the existing pipe and immediately installs a new polyethylene pipe. Hydraulically- pneumatically- and statically-operated equipment may be allowed for this replacement.

The CONTRACTOR shall be certified by the particular pipe bursting system manufacturer that such firm is a licensed installer of its system.

Polyethylene pipe jointing shall be performed by personnel trained in the use of thermal butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the polyethylene pipe. Training shall be performed by qualified representative.

601.8.1. Materials. Materials shall conform to the requirements of [Item 501.21](#). Solid Wall Polyethylene Plastic Pipe for Water, Wastewater, and Pipe Rehabilitation with modifications as stated herein.

The Polyethylene Plastic Pipe shall be high density polyethylene pipe and meet the applicable requirements of AWWA C906 Polyethylene Pressure Pipe and Fittings, 4-in through 63-in. for Water Distribution and Transmission for potable water pipe replacement, or ASTM F714 for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter for other applications. All pipe shall be made of virgin material. No rework except that obtained from the manufacturer's own production of the same formulation shall be used. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

Saddles shall be heat fusion saddles, unless otherwise approved by OWNER. Mechanical saddles made of polyethylene pipe compounds shall meet the requirements of pipe as stated above. Mechanical saddles shall have stainless steel straps and fasteners, neoprene gasket and backup plate. Sizes of the pipe insertions to be used shall be as shown on the plans or to renew the pipeline to its original or greater than flow capacity. The minimum wall thickness of the polyethylene pipe shall meet the greater of either the thickness required to meet internal pressure or the thickness determined by burial depth as indicated in Table 601.8.1.(a) Pipebursting (with PE) Required Pipe Thickness.

Table 601.8.1.(a) Pipebursting (with PE) Required Pipe Thickness

Depth of Cover	Standard Dimension Ratios (Ductile Iron Pipe Size): Minimum DR of Pipe
0 - 10.0-ft.	21
> 10.0-ft	17

601.8.2. Methods. All service connections shall be identified, located, and excavated prior to the pipe insertion to expedite reconnection.

601.8.2.1. Insertion. Insertion of launching pits shall only be allowed at locations of existing or proposed manholes, unless otherwise approved by OWNER.

Equipment used to perform the work shall be located away from buildings so as to minimize noise impact. CONTRACTOR shall provide silencers or other devices to reduce machine noise as required to meet requirements.

The CONTRACTOR shall install all pulleys, rollers, bumpers, alignment control devices, and other equipment required to protect existing manholes, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances shall the pipe be stressed beyond its elastic limit.

The design, selection considerations and installation procedures for the construction of new wastewater and storm conduit by the insertion of polyethylene pipe through existing pipe and along previously existing line and grade shall be performed in accordance with ASTM F585 Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers.

Upon commencement, pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the OWNER.

The polyethylene pipe shall be assembled and joined at the site using the thermal butt-fusion method to provide a leak-free joint. Threaded or solvent-cement joints and connections are not permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment. The butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. The fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the OWNER prior to insertion. All defective joints shall be cut out and replaced at no cost to the OWNER. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten-percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness, or any other defect of manufacturing or handling as determined by the OWNER shall be discarded and not used.

The installed pipe shall be allowed the manufacturer's recommended amount of time, but not less than 4-hours, for cooling and relaxation due to tensile stressing prior to any reconnection of service lines, sealing of the annulus or backfilling of the insertion pit. Sufficient excess length of new pipe, but not less than 4-in., shall be allowed to protrude into the manhole to provide for occurrence.

601.8.2.2. Finishing. Following the relaxation period, the annular space shall be sealed. Sealing shall be made with material approved by the OWNER and/or its representative and shall extend a minimum of 8-in. into the manhole wall in such a manner as to form a smooth, uniform, watertight joint.

Terminal sections pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp. The butt gap between pipe ends shall not exceed ½-in.

Once a saddle is secured in place, CONTRACTOR shall drill hole full inside diameter of saddle outlet in pipe liner. CONTRACTOR shall make both the inside and outside of drilled holes smooth.

At all points where the polyethylene pipe has been exposed, as in starter excavations, at service connection fittings, outside of manholes, etc., the CONTRACTOR shall encase the pipe and fittings in minimum of 6-in. of concrete or flowable backfill. If flowable backfill is used, the CONTRACTOR shall remove all debris and create a void along each side of the pipe at the spring line to undisturbed soil in preparation for the cement stabilized sand backfill. Width of the void shall not exceed (main O.D. + 2-ft.) or (service line O.D. + 2-ft.).

Reconnections shall be accomplished as described in the required submittals.

601.9. PIPE BURSTING WITH RIGID PIPE

For the purpose of this specification, pipe rehabilitation by bursting is defined as the trenchless installation of new wastewater pipe by bursting the pipe behind an apparatus which expands the existing wastewater pipe, tees, wyes, and couplings into the adjacent ground forming a clear space to insert the new wastewater piping.

601.9.1. Materials. Pipe shall meet or exceed the requirements of [Item 501.3](#). Vitrified Clay Pipe Used in Trenchless Applications.

All materials supplied under this section shall be warranted for a period of two (2) years by the manufacturer and CONTRACTOR. The materials shall be warranted to be free from defects in workmanship, design, and materials.

Packaging and shipping shall be done in accordance with manufacturer instructions. Each standard and random length of pipe shall be clearly marked with the following information: pipe size, class, profile number, and production code. Each box or package shall be properly marked to show its actual weight in addition to its contents.

601.9.2. Methods. Equipment employed in the pipe bursting procedure shall be approved by the OWNER and the pipe supplier prior to award of a contract.

A hydraulic or mechanical pipe-pushing device that exerts pressure on the jacking pipe may be used. The machine operator shall closely and continuously monitor and control the jacking load imposed on the new pipe. A jacking ring or device shall be used to distribute the jacking load evenly on the entire surface perimeter of the end of the jacking pipe. The CONTRACTOR shall also utilize a device capable of holding a nearly inserted joint of liner pipe without damage or danger while the following joint is shoved home to complete the joint makeup. Joints shall be made in full view of the operator and inspector.

601.9.2.1. Access Pits. It is the CONTRACTOR's responsibility to locate, design, and determine the necessary number of access pits, excavation methods, and all other items required for the successful completion of the work. CONTRACTOR shall submit an access pit(s) plan showing location(s), dimensions, equipment set up, sheeting, shoring, bracing, and calculations.

Earthwork for access pits shall be performed in accordance with [Item 504](#). Open Cut – Backfill.

The walls of the access pit(s) shall be vertical and supported by sheeting, shoring, and bracing in accordance with [Item 107.20](#). Protection of Work and of Persons and Property with the following additions:

- (1) No side sloping of pit walls shall be allowed.
- (2) All four walls of each pit shall be properly protected against inflow of groundwater or soil materials. The control of groundwater shall be such that softening of the bottom of excavations or formation of "quick" conditions or "boils" do not occur. Dewatering systems shall be designed and operated to prevent removal of the natural soils.

Access pit dimensions shall be constructed at the minimum size necessary to accommodate the maximum length and diameter of pipe used, in addition to auxiliary pushing equipment, and to provide sufficient working room on either side of the existing pipe to be replaced. The depth of the pit(s) shall be

sufficient to expose the existing pipe to the invert, allowing for the placement of concrete or shotcrete coating, whichever is necessary, at the bottom of the pit(s). The thickness of concrete or shotcrete shall be necessary to prevent groundwater infiltration into the pit and to prevent any wastewater from infiltrating into the soil.

Access pits shall be adequately covered when not in use to control odors and shall be securely fenced and barricaded to prevent unauthorized entry.

601.9.2.2. Installation. The CONTRACTOR shall be responsible for locating and exposing all service laterals and cleanouts prior to replacement pipe insertion.

The pipe shall be jacked or pushed into the existing pipe utilizing equipment as herein specified. An aqueous solution such as bentonite may be used to minimize the jacking load and provide lubrication during the new pipe installation. For each section to be rehabilitated, insertion shall be one continuous operation until the planned termination point is reached. Pipe jointing shall be accomplished in strict accordance with the pipe manufacturer's recommendations, and each joint shall be completely made-up in the access pit(s) in full view of the OWNER.

Total jacking loads shall not exceed 75% of the manufacturer's maximum recommendations. The CONTRACTOR shall provide a suitable means of measuring a jacking load and shall monitor the load as the new pipe is being installed. If, at any time, the load appears to rise erratically indicating possible obstruction of the pipe, jacking operations shall be terminated and the obstruction or other impediment removed before continuing. The entire cost for all work associated with an unanticipated access pit(s) shall be borne by the CONTRACTOR.

If portions of the line being jacked have curves with a radius of curvature less than 700-ft, the pipe manufacturer shall be consulted. In no case should a joint be pulled in excess of the maximum degrees of angular deflection recommended by the manufacturer for any given pipe diameter.

When the pipe is pushed through a manhole, the top half of the pipe within the manhole shall be removed using a saw and additional portions shall be removed to allow side connections to flow into the new pipe. The pipe shall be inserted through the manhole such that no pipe joint is located inside the manhole. The pipe shall be cut out at manholes as required after insertion and grouting. The methods of cutting shall be such as to leave smooth, clean, straight edges. The pipe shall be suitably blocked during grout and concrete placement so that no bowing or other deviation from a parallel-sided channel occurs.

601.9.2.3. Finishing. The CONTRACTOR shall reconnect all service connections to the new pipe. A portion of the existing pipe around each service connection shall be removed to expose the new pipe and provide sufficient working space for making the new service connections. The CONTRACTOR may propose alternative methods for reinstatement of service connections. Saddle stub-out dimensions shall be the same size or larger than the existing service lateral. Saddles shall be connected to existing service laterals by using flexible couplings.

At points where the liner has been exposed, the liner pipe and fittings shall be encased to prevent deflection due to earth loading or subsidence. In preparation for the placing of the encasement material, debris and soil shall be removed along each side of the existing pipe down to the spring line. After the encasement material is in place and accepted by the OWNER, CONTRACTOR shall place and compact backfill to required finished grades in accordance with these specifications.

601.10. SEGMENTAL SLIPLINING

This section includes requirements to rehabilitate existing wastewater pipelines, storm conduit and culverts by the method of segmental sliplining with pipe as specified in [Section 501](#). Segmental sliplining is defined as a trenchless installation of new liner pipe, which is either pushed or pulled inside an existing pipeline.

601.10.1. Materials. Appropriate pipe material shall meet or exceed all requirements of [Item 501.18](#). Polyvinyl Chloride (PVC) Profile Gravity Pipe and Fittings – For Direct Bury and Sliplining Applications.

Pipe joints shall be furnished in minimum 2½-ft joints to maximum 20-ft joint. The pipe wall must be smooth and consistent on the inside surfaces. The maximum outside diameter including the bell has to be such that the liner pipe can be inserted into the existing pipe without binding, damaging or deflecting the liner pipe.

Unless otherwise specified on the plans, the pipe shall be field connected with bell and spigot joints, or as recommended by the manufacturer. Gaskets suitable for the service intended and meeting the requirements of ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe shall be used. Joint shall be designed to meet the performance requirements of ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

601.10.2. Methods. The CONTRACTOR shall completely grout the annular void between the existing host pipe and the new liner pipe with grout as recommended by the manufacturer. Bypass pumping may not be necessary when the liner pipe is installed during live flow applications. CONTRACTOR shall adhere to the following conditions, unless approved otherwise by the OWNER.

601.10.2.1. Insertion/Access Pits. The location of the insertion pits shall be determined to facilitate sliplining the amount of pipe shown on the plans. The exact location and number of insertion/access pits must be planned by the CONTRACTOR and submitted in writing for approval by the OWNER prior to excavation. Pit locations shall coincide with existing pipe joints such that the total number of pits is minimized, and the footage of liner pipe installed in a single pull maximized. Location of damaged pipe/point repairs can be used for insertion pits if approved by the OWNER. Earthwork for access pits shall be performed in accordance with [Item 504](#). Open Cut – Backfill.

Access pits shall be adequately covered when not in use to control odors and shall be securely fenced and barricaded to prevent unauthorized entry.

The cost of the insertion is incidental to the bid price for sliplining and includes all work, equipment, labor, tools, etc., required for diverting and pumping flow, opening and closing the pit(s), and restoring the site satisfactory to the OWNER.

After completing the insertion pit excavation and diverting flow as necessary, CONTRACTOR shall remove the top of the existing wastewater pipe down to the spring line by neatly sawing the pipe and shall take care not to disturb the bottom portion of the existing pipe, thus providing a stable base for the liner pipe.

601.10.2.2. Installation. CONTRACTOR shall install sliplining material according to the manufacturer's written procedures and instructions.

Liner pipe sections shall be jointed prior to insertion of the complete pipe section into the host pipe. The liner pipe shall be equipped with a lead piece to help guide the pipe through without any disruption. Liner pipe may be pulled or pushed through the existing host pipe with aid of a backhoe or jacking device, providing the pushing or jacking loads are monitored and remain in accordance with the safe compressive/jacking loads as set forth by the manufacturer.

Once insertion is complete, CONTRACTOR shall reinstall the exiting top pipe section removed and construct new manhole at the end of the pipeline. CONTRACTOR shall connect liner pipe to new manhole according to manufacturer recommendations.

601.10.2.3. Grouting. The CONTRACTOR shall utilize the grout for solidification of the annular void between the host and liner pipe. Grout mixture shall have an approximate compressive strength of 150-psi unless specified otherwise by the OWNER, and a minimum density of 30-pcf. Grout mix shall have less than 1-percent (1%) shrinkage by volume. Materials for sliplining grout shall comply with the following:

- (1) Cement shall comply with ASTM C150 Portland Cement. Pozzolans and other cementitious materials may be permitted.
- (2) Fly Ash shall comply with ASTM C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Concrete; either Type C or Type F shall be used.
- (3) Sand if utilized, shall conform to ASTM C144 Aggregate for Masonry Mortar, except as modified in Table 601.10.2.3.(a) Segmental Sliplining Grouting Sand.

Table 601.10.2.3.(a) Segmental Sliplining Grouting Sand.

U.S. Standard Sieve Size	% Passing by Weight
No. 16	100
No. 30	60 – 85
No. 50	10 – 35
No. 100	5 – 25
No. 200	0 – 10

- (4) Potable water free from deleterious amounts of alkali, acid and organic materials, which would adversely affect the set time, or strength of the sliplining grout.
- (5) Admixtures shall be selected by the manufacturer of the sliplining grout to meet the performance requirements, to improve pumpability, to control set time, and reduce segregation.

601.11. MEASUREMENT AND PAYMENT

Measurement shall be as specified in the proposal and contract documents. The unit price bid for rehabilitating pipe shall be full compensation for all materials, labor, equipment, and incidentals required to insert the liner pipe within the existing pipe or replace existing pipe. Payment shall also include the cost of flow bypass, sealing liners in the manholes, reworking the manhole inverts and benches, and other work necessary to complete installation. Payment shall be for actual linear footage of pipe installed in the field and shall be measured between the centerlines of the manholes. Cleaning, pre-construction television inspection, post-construction television inspection, testing and all relevant submittals shall be incidental to the pipe rehabilitation items. Retesting that results from failure to pass initial testing shall be at the CONTRACTOR'S expense.

If excavation is required for point removal or repair of obstructions, it shall be approved in writing by the OWNER prior to the commencement of the work and shall be considered as a separate pay item.

Reconnection of services shall be paid for per each reconnection made.

ITEM 604. REMOVAL OF ASBESTOS-CEMENT PIPE (ACP)

604.1. GENERAL

The work to be performed under this specification shall consist of providing all labor, equipment, materials, and incidentals necessary to remove and dispose of abandoned asbestos-cement pipe (ACP) water mains, as shown on the plans, directed by the OWNER.

604.2. JOB PLAN

The CONTRACTOR must provide a job specific plan of the work procedures to be used in the removal and containment or alternative abatement of asbestos. The job plan shall be prepared and submitted prior to beginning the work and shall be subject to approval by the OWNER. The OWNER shall be notified in writing 30-days prior to the start of asbestos abatement work. The job plan shall include the following:

- (1) Detailed work schedule
- (2) Written quality control program.
- (3) Written worker health and safety program.
- (4) Methodology for protection of ground surface adjacent to work.
- (5) Methodology for collecting, containing and disposing of hazardous materials when removal is specified.
- (6) A copy of the technical data sheets for all products including manufacturer's name, addresses and phone numbers and product description. The product description shall include, but not be limited to basic use, limitations, precautions, recommended application methods specific to this project, and any known environmental hazards or constraints.

604.3. PROCEDURES

CONTRACTOR shall comply with OSHA Construction Industry Standards for Occupational Exposure to Asbestos, 29 Code of Federal Regulations (CFR) 1926.1101, Subpart Z.

CONTRACTOR shall furnish and apply to broken pipe any required protective material such as plastic sheeting.

604.4. DISPOSAL

Wastes shall be handled, stored, transported, disposed, recorded, and notifications made in accordance with all applicable State and Federal regulations. Land disposal restriction notification requirements must be followed as required.

Disposal must be at a site approved by the Environmental Protection Agency and the TCEQ to accept asbestos waste material.

604.5. PAYMENT

The removal of ACP water mains shall be measured per linear foot and will be paid at the total unit price as shown in the bid proposal for the respective size, if specified. The bid price should include all excavation, backfill, compaction, protective materials, specialized equipment, abatement, transportation, disposal and any other work required to remove, protect, and dispose of the pipe as shown on the plans or as specified herein.

ITEM 702. CONCRETE STRUCTURES

702.1. DESCRIPTION

This specification shall govern for the construction of all types of structures involving the use of structural concrete except where the requirements of this section are not applicable. All concrete structures shall be constructed in accordance with the design requirements and details shown on the plans, with the pertinent provisions of other applicable sections of the specifications, and with the requirements herein provided.

702.2. CONCRETE STRUCTURE MATERIALS**702.2.1. Aggregates for Portland Cement Concrete Structures.**

702.2.1.1. General Requirements. Aggregates shall conform to the provisions of [Item 303.2.1.1.](#) General Requirements in [Item 303.2.1.](#) Aggregates for Portland Cement Concrete Pavement.

702.2.1.2. Fine Aggregates. Fine aggregates shall conform to the provisions of [Item 303.2.1.2.](#) Fine Aggregates.

702.2.1.3. Coarse Aggregates. Coarse aggregates shall conform to the provisions of [Item 303.2.1.3.](#) Coarse Aggregates.

702.2.1.4. Lightweight Aggregates. Lightweight aggregates shall consist of expanded clay or shale having strong, durable particles; and conforming to the requirements of ASTM C330 Lightweight Aggregates for Structural Concrete.

702.2.1.4.1. Foreign Material and Deleterious Substances. Deleterious substances, elements, or components are those that are damaging, harmful, undesirable, or adulterating to the integrity or purity of the specified base material. The maximum permissible percentage, by weight, of deleterious substances shall not exceed the amounts in Table 702.2.1.4.1.(a) Deleterious Substances in Lightweight Aggregates.

Lightweight aggregates that, upon being subjected to the test for organic impurities, produce a color darker than the standard shall be rejected, unless it can be demonstrated that the discoloration is due to small quantities of materials not harmful to the concrete.

If, after a test for staining materials (ASTM C641 Staining Materials in Lightweight Concrete Aggregates), the aggregates are classified as “heavy stain” or darker, a test following the chemical procedure shall be performed. If 1.5-mg or more of ferric oxide (Fe_2O_3) per 200-g sample is found, the aggregate shall be rejected.

Table 702.2.1.4.1.(a) Deleterious Substances in Lightweight Aggregates

Substance	Maximum % by Weight
Loss on ignition	5%
Clay lumps	2%

702.2.1.4.2. Gradation. The lightweight aggregate shall be well graded in size from coarse to fine. When tested by standard laboratory methods lightweight aggregate shall meet the requirements in Table 702.2.1.4.2.(a) Grading Requirements for Lightweight Aggregates for percentage passing each sieve by weight.

Table 702.2.1.4.2.(a) Grading Requirements for Lightweight Aggregates

Sieve	Percent Passing
$\frac{3}{4}$ in. sieve (19.0 mm)	90 to 100%
$\frac{3}{8}$ in. sieve (9.5 mm)	20 to 55%
Passing No. 4 sieve (4.75 mm)	0 to 10%
Passing No. 8 sieve (2.36 mm)	0 to 5%

702.2.1.4.3. Natural Fine Aggregate. At the option of the CONTRACTOR, natural fine aggregate may be substituted for fine lightweight aggregate, provided such substitution does not result in producing concrete that has a weight in excess of the permissible maximum specified herein. Natural fine aggregate shall meet the grading requirements of Table 303.2.1.2.2.(a) Grading Requirements for Fine Aggregates. Natural fine aggregate shall have a percent of wear not more than 40 when tested according to ASTM C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

702.2.1.4.4. Rejection. Lightweight aggregates which fail to meet the requirements for these specifications may be rejected by the OWNER. Such rejection shall incur no cost to the OWNER.

If lightweight aggregate with properties not meeting these specifications are delivered to the project, the source of the material may be rejected as a further supply source by the OWNER. Such rejection shall incur no cost to the OWNER.

702.2.1.5. Pit-Run and Re-Mix Aggregate. Pit-run aggregate is the natural gravel and sand obtained from pits without the addition of other fine or coarse aggregates and shall consist of hard, durable, uncoated pebbles or stone particles mixed with sand. Pit-run aggregate shall not be used for high strength concrete of 3000-psi and above. Pit-run aggregate may be used only for concrete cushion, cradle and protection for pipe.

Re-mix aggregate is native rock and sand that has been washed and screened and meets the specified gradation. Re-mix aggregate shall not be used for high-strength concrete of 3000-psi and above. Re-mix aggregate may be used only as a substitute for pit-run aggregate or when specified.

702.2.1.5.1. Foreign Material and Deleterious Substances. Pit-run and re-mix aggregate shall be free from lumps of clay and from injurious amounts of dust, shale, soft or flaky particles, salt and alkali.

702.2.1.5.2. Gradation. Pit-run and re-mix aggregate shall be well graded from coarse to fine when tested by standard laboratory methods and shall meet the minimum requirements for percentages by weight in Table 702.2.1.5.2.(a) Grading Requirements for Pit-Run and Re-Mix Aggregate.

Table 702.2.1.5.2.(a) Grading Requirements for Pit-Run and Re-Mix Aggregate

Sieve	Percent Retained by Weight
$\frac{1}{4}$ -in. (6 mm) sieve	55 to 60%

702.2.1.5.3. Rejection. Pit-run and re-mix aggregate may be rejected for failure to meet any of the requirements of this specification. Such rejection shall incur no cost to the OWNER.

Aggregate sources from which materials with properties not meeting these specifications are delivered may be rejected as a further supply source to the project by the OWNER. Such rejection shall incur no cost to the OWNER.

702.2.1.6. Alkali-Silica Reactions (ASR) and Delayed Ettringite Formation (DEF) Mitigation. Refer to TxDOT Item 421 Hydraulic Cement Concrete.

702.2.2. Portland Cement. Portland Cement shall conform with the requirements of [Item 303.2.2](#). Portland Cement.

702.2.3. Concrete Additives and Modifiers. Concrete additives and modifiers shall conform to the applicable requirements of [Item 303.2.3](#). Chemical Admixtures, [Item 303.2.4](#). Mineral Admixtures, [Item 303.2.5](#). Mineral Filler, and/or [Item 303.2.6](#). Fibrous Reinforcement.

702.2.4. Water. Water shall conform to the requirements of [Item 303.2.7](#). Water.

702.2.5. Reinforcement. Reinforcement, if any, shall conform to the requirements of [Item 303.2.9](#). Steel Reinforcement, except that axle steel shall not be permitted on structures and the use of rail steel or axle steel shall not be permitted for use in railroad underpass structures. At the OWNER's option the use of welded wire fabric in accordance with [Item 303.2.10](#). Steel Wire Reinforcement may be used.

702.2.5.1. Epoxy Coated Bars. For use of epoxy coated bars, refer to TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

702.2.6. Joint Filler and Joint Sealer. Joint filler shall conform to the requirements of [Item 303.2.12](#). Joint Filler. Joint sealer shall conform to the requirements of [Item 303.2.14](#). Joint Sealant.

702.2.7. Curing Materials. Curing materials shall conform to the requirements of [Item 303.2.13](#). Curing Materials.

702.2.8. Elastomeric Materials. Elastomeric materials shall conform to the requirements of [Item 303.2.15](#). Elastomeric Materials.

702.3. MIX DESIGN AND MIXING CONCRETE FOR STRUCTURES

702.3.1. Description. This section shall govern for the concrete used in bridges, box culverts, and such other miscellaneous structures and incidentals necessary to complete the work.

702.3.2. Equipment. All machinery and equipment necessary for the prosecution of the work specified herein shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin operations on which the machinery or equipment is to be used. All machinery and equipment shall be maintained in good condition to insure the completion of the work without excessive delays for repairs and replacements.

702.3.3. Concrete Mix Design and Control. The OWNER shall furnish plant control of the concrete by securing the services of an independent local testing laboratory. Within a period of not less than 10-days prior to the start of concreting operations, the CONTRACTOR shall submit to the OWNER a design of the concrete mix it proposes to use, together with samples of all materials to be incorporated into the mix and a full description of the source of supply of each material component. The design of the concrete mix shall produce a concrete complying with the requirements of concrete classes in Table 702.3.4.2.(a) Standard Classes of Structural Concrete or Table 702.3.4.3.(a) Performance Classes of Structural Concrete and slump in Table 702.3.4.4.(a) Structural Concrete Slump Requirements.

The dry loose volume of coarse aggregate shall not be more than 0.82 cubic-feet-per-cubic-foot of concrete, except in cases where the voids in the coarse aggregate as determined by standard test methods exceed 48-percent of the total dry loose volume. Where voids exceed 48-percent, the dry loose volume of coarse aggregate shall not exceed 0.85-cubic-feet-per-cubic-foot of concrete.

If the strength required for the class of concrete being produced is not secured with the cement specified in Table 702.3.4.2.(a) Standard Classes of Structural Concrete or Table 702.3.4.3.(a) Performance Classes of Structural Concrete, the CONTRACTOR may use, or the OWNER may require, an approved cement dispersing agent, or the CONTRACTOR shall furnish additional aggregates or aggregates with different characteristics which shall produce the required results. Additional cement may be required or permitted as a temporary measure until aggregates are changed and designs checked with the different aggregates or cement dispersing agent.

All material samples submitted to the OWNER shall be sufficiently large to permit laboratory batching for the construction of test beams to check the adequacy of the design. When the design mix has been approved by the OWNER, there shall be no change or deviation from the proportions thereof or sources of supply except as hereinafter provided. No concrete may be placed on the job site until the mix design has been approved by the OWNER in writing to the CONTRACTOR.

702.3.4. Quality of Concrete.

702.3.4.1. Consistency. In general, the consistency of concrete mixtures shall be such that:

- (1) the mortar shall cling to the coarse aggregate,
- (2) the aggregate shall not segregate in concrete when it is transported to the place of deposit,
- (3) the concrete, when dropped directly from the discharge chute of the mixer, shall flatten out at the center of the pile, but the edges of the pile shall stand and not flow,
- (4) the concrete and mortar shall show no free water when removed from the mixer,
- (5) the concrete shall slide and not flow into place when transported in metal chutes at an angle of 30° with the horizontal, and
- (6) the surface of the finished concrete shall be free from a surface film or laitance.

(7) The concrete shall be uniform and workable.

The cement content, maximum allowable water cement ratio, the average and maximum slump and the strength requirements of the various classes of concrete shall conform to the requirements of the tables below, and as required herein.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When field conditions are such that additional moisture is needed for the final concrete surface finishing operation, the required water shall be applied to the surface by misting only and shall be held to a minimum amount. The concrete shall be workable, cohesive, possess satisfactory finishing qualities and be of the stiffest consistency that can be placed and vibrated into a homogeneous mass. Excessive bleeding shall be avoided.

If the strength or consistency required for the class of concrete being produced is not secured with the minimum cement specified or without exceeding the maximum water/ cement ratio, the CONTRACTOR may use, or the OWNER may require, an approved cement dispersing agent (water reducer); or the CONTRACTOR shall furnish additional aggregates, or aggregates with different characteristics, or the CONTRACTOR may use additional cement in order to produce the required results. The additional cement may be permitted as a temporary measure, until aggregates are changed and designs checked with the different aggregates or cement-dispersing agent.

The CONTRACTOR is solely responsible for the quality of the concrete produced. The OWNER reserves the right to independently verify the quality of the concrete through inspection of the batch plant, testing of the various materials used in the concrete, and by casting and testing concrete cylinders or beams on the concrete actually incorporated in the structure.

Unless otherwise shown on the plans or detailed specifications, the Standard Classes of Concrete table shall be used.

702.3.4.2. Standard Classes. Standard classes of structural concrete shall meet the requirements in Table 702.3.4.2.(a) Standard Classes of Structural Concrete.

Table 702.3.4.2.(a) Standard Classes of Structural Concrete.

Class of Concrete ¹	Minimum Cementitious Lb./CY	Minimum Cementitious Sacks/CY	28 Day Min. Compressive Strength ² psi	28 Day Min. Beam Strength ^{2,3} psi	Maximum Water/ Cementitious Ratio	Coarse Aggregate Maximum Size ⁴
A	470	5.0	3000	500	0.58	1½"
B	376	4.0	2000	330	0.71	1½"
C	564	6.0	3600	600	0.53	1½"
D	282	3.0	1500	250	0.97	1½"
E	564	6.0	3000	500	0.62	1½"
F	611	6.5	4200	700	0.49	1½"
S	564	6.0	3600	600	0.44	1½"
H ⁵	611	6.5	As Specified On Plans	N/A	0.49	1"
M	As directed by the OWNER or as shown on the plans					

1. All exposed concrete shall have entrained – air (See [303.2.3](#), Chemical Admixtures).

2. Minimum Strength Required by OWNER [Compressive or Flexural]

3. ASTM C78 (Third-Point); Reduce by 10% when Type II Cement is Used

4. Smaller Nominal Maximum Size Aggregate May be Used if Strength requirement is Satisfied

5. Prestressed Concrete

702.3.4.3. Performance Classes. Performance Classes of structural concrete shall meet the requirements in Table 702.3.4.3.(a) Performance Classes of Structural Concrete.

Table 702.3.4.3.(a) Performance Classes of Structural Concrete

Class of Concrete ¹	Minimum Cementitious Lb./CY	Minimum Cementitious Sacks/CY	28-Day Compressive Strength ² psi	28-Day Flexural Strength ^{3,4} psi	Maximum Water/Cementitious Ratio ⁴	Coarse Aggregate Maximum Size ⁵
PA	423	4.5	3000	425	0.58	1½"
PB	350	4.0	2000	N/A	0.71	1½"
PC	517	5.5	3600	510	0.53	1½"
PD	250	3.0	1500	N/A	0.97	1½"
PE	470	5.0	3000	425	0.62	1½"
PF	564	6.0	4200	595	0.49	1½"
PS	517	5.5	3600	510	0.44	1½"
PH ⁶	611	6.5	As specified on plans	N/A	0.49	1"
PM	As directed by the OWNER or as shown on the plans					

1. All exposed concrete shall have entrained – air (See [303.2.3](#), Chemical Admixtures).

2. Calculated Average Required Compressive Strength Considering ACI 318 - Sec. 5.3.2.1 shall be strength shown times 1.15.

3. ASTM C78 (Third-Point); Reduce by 10% when Type II Cement is Used

4. Consistent with ACI 211.1 Table 6.3.4(a) Relationship between water-cementitious materials ratio and compressive strength of concrete

5. Smaller maximum size aggregate may be used if strength requirement is satisfied

6. Prestressed Concrete

702.3.4.4. Slump. Slump requirements for structural concrete shall be as specified in Table 702.3.4.4.(a) Structural Concrete Slump Requirements. No concrete shall be permitted with slump in excess of the maximums shown. Any concrete mix failing to meet the above consistency requirements, although meeting the slump requirements, shall be considered unsatisfactory, and the mix shall be rejected and changed to correct such unsatisfactory conditions at no cost to the OWNER.

Table 702.3.4.4.(a) Structural Concrete Slump Requirements.

Concrete Use	Avg. Slump (in.)	Max. Slump (in.)
Cased Drilled Shafts and Thin-walled Sections (9 in. or less)	6	7
Slabs, Caps, Wall Sections Over 9 in., etc.	3	4
Columns, Piers	4	5
Underwater or Seal Concrete	7	8
Other Miscellaneous Concrete	As specified by OWNER	

702.3.4.5. Tests. During the progress of the work, the CONTRACTOR shall cast test cylinders in accordance with ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field to maintain a check on the compressive strengths of the concrete being placed. In accordance with ASTM C31 and ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete, four test cylinders shall be taken from a representative portion of the concrete being placed for every 40-cubic-yards of concrete placed. After the cylinders have been cast, they shall remain on the job site and then transported, moist cured, and tested by the OWNER in accordance with ASTM C31 and C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

The CONTRACTOR shall provide and maintain curing facilities for the purpose of curing concrete test specimens on site in accordance with ASTM C31. The CONTRACTOR shall be responsible for the proper storage, maintenance, and any required curing of concrete test samples made by the OWNER, and any costs thereof.

In each set, two of the cylinders shall be tested at 7-days, two cylinders shall be tested at 28-days. If the 28-day test results indicate deficient strength, the CONTRACTOR may, at its option and expense, core the concrete in question and have the cores tested by an approved laboratory, in accordance with ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete and ACI 318 protocol, to override the results of the cylinder tests.

Cylinders and/or cores must meet the specified strength in accordance with ACI 318 protocol. The testing does not in any way change the penalties imposed on the CONTRACTOR for deficient strength outlined elsewhere in these specifications.

At the OWNER'S direction, beam test may be required and utilized for acceptance of the final product.

702.3.5. Mixing.

702.3.5.1. General. Concrete shall be mixed in a machine, of approved design and capacity, which receives a complete charge of proportioned materials and thoroughly and evenly mixes the charge as a whole before any part is withdrawn from the machine. The mixing shall be continued until each particle of stone or gravel is completely covered with mortar and the batch is of uniform color and consistency. The manufacturer's recommended mixing time shall be adhered to or mixing shall continue until a uniform concrete mixture is obtained. The mixer shall be equipped with an attachment for satisfactorily locking the discharging device so as to prevent the emptying of the mixer until all the materials have been mixed together for the minimum time required. The entire contents of the drum shall be discharged before any materials are placed therein for the succeeding batch.

702.3.5.2. Transit Mix Concrete. Transit mix concrete shall meet the following conditions:

- (1) all requirements otherwise specified for mixing on the job shall apply,
- (2) sufficient transit mix equipment shall be assigned exclusively to the project as required for continuous operation,
- (3) satisfactory evidence shall be furnished so that the delivery of concrete shall be continuous at regular and uniform intervals, without stoppages or interruption,
- (4) the supplier of transit mix concrete shall furnish a written statement addressed to the OWNER, stating that the concrete shall be produced in accordance with these specifications and subject to the approval of the OWNER, and
- (5) concrete shall not be placed on the job after a period of 1½-hours after the cement has been placed in the mixer.

702.3.5.3. Continuous Volumetric Mix Concrete. For all miscellaneous concrete placements, a mobile, continuous, volumetric mixer of the rotating paddle type may be used when approved or specified by the OWNER.

These mixers shall be designed to receive all the concrete ingredients, including admixtures, required by the mix design in a continuous uniform rate and mix them to the required consistency before discharging. The mixers shall have adequate water supply and metering devices. Calibration of these mixers will be required.

The mixing time shall be in accordance with the recommendations of the manufacturer of the mixer unless otherwise revised by the Engineer.

For continuous volumetric mixers, the materials delivered during a revolution of the driving mechanism, or in a selected time interval, will be considered a batch, and the proportion of each ingredient will be calculated in the same manner as for a batch type plant.

702.4. MIX DESIGN AND MIXING LIGHTWEIGHT CONCRETE FOR STRUCTURES

702.4.1. Description. This item shall govern the equipment used; the storing, measuring and handling of materials; and for the mixing, placing, finishing and curing of lightweight concrete for bridges and other structures. The concrete shall be composed of Portland cement, natural sand fine aggregate, lightweight coarse aggregate, a cement dispersing agent, an air-entraining admixture and water, proportioned and mixed as hereinafter provided.

702.4.2. Quality of Concrete.

702.4.2.1. Consistency. Concrete shall be of such consistency so as to insure the required workability and result in compact masses having dense, uniform surfaces. The proportions of the ingredients shall be varied only with the approval of the OWNER. In general, the consistency of lightweight concrete should be similar to that of natural aggregate concrete. Batches which are harsh and unworkable shall be redesigned at the CONTRACTOR'S expense.

702.4.2.2. Classification and Proportions. Lightweight concrete shall be proportioned by weight in such manner as to secure a uniform and workable mix which shall produce cured concrete of the weight and strength specified herein. Prior to mixing any concrete which shall be used in the structure, the CONTRACTOR shall prepare trial batches, proportioned and tested in accordance with TxDOT Construction Bulletin C-11. Additional sand may be required to improve workability of the mix.

The cement content, maximum air content and slump of the various classes of concrete, shall conform to Table 702.4.2.(a) Classes of Lightweight Concrete. If the strength required for the class of concrete being produced is not secure with the minimum cement content specified, additional cement shall be used or other aggregates provided at the CONTRACTOR'S expense.

Table 702.4.2.(a) Classes of Lightweight Concrete

Class	Min. - Max. Bags Cement per C.Y.	Min. Comp. Strength 28-Day (psi)	Max. Slump (in.)	Air-Dried Weight Max. (lb./CF) ¹	Total Air Content, %	Use
X	5.5 - 7.5	3000	See note ²	110	6 – 9	General Structural
Y	5.5 - 7.0	5000	3	115	6 – 9	Prestressed Concrete
Z	5.5 - 8.0	As specified on plans	3	118	6 – 9	Prestressed Concrete

1. Air-dried weight shall be measured after 7-days moist curing at 100-percent relative humidity at 73°±2°F and stored for 21-days at 50±2-percent relative humidity.

2. Class X concrete shall be placed so that the average slump shall be maintained at approximately 3-in. No concrete shall be permitted with a slump in excess of 4-in.

702.4.2.3. Tests. During the progress of the work, the OWNER shall cast and test cylinders to maintain a check on the compressive strength of the concrete being placed.

For prestressed lightweight concrete, two tests (6-test cylinders) for each pertinent strength test required by Table 702.4.2.(a) Classes of Lightweight Concrete shall be required for each separate stressing line of beams, spans, piling, etc., as the case may be. Testing and curing of cylinders shall be in accordance with [Item 702.3.4.5. Tests](#). Job control cylinders may be tested on a hand operated compression machine. Equipment shall be furnished by the CONTRACTOR if required.

Air content shall be checked by use of a pressure type air meter in accordance with ASTM C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

Test for wet weight shall be made in accordance with ASTM C138 Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

The relationship between the air-dried weight of concrete and the wet weight of concrete shall be established by the OWNER, based upon trial batches and checks made during progress of the work.

For each change in batch design weight and for each 25-cubic-yards of concrete placed in the structure, two tests for weight shall be made. At any time that the average of these tests indicates a wet weight in excess of that which has been determined to produce air-dried concrete of the specified weight, the batch shall be adjusted to reduce the wet weight of concrete by the amount required.

702.4.3. Mixing. The following shall govern the mixing of lightweight concrete:

- (1) The cement dispersing agent and at least two-thirds of the total mixing water shall be introduced in the mixer and mixed for 15-seconds,

- (2) the fine and coarse aggregate shall be added and mixed for 45-second, and
- (3) the cement and final water shall be added and mixing completed. The minimum mixing time shall be determined by the OWNER for the concrete batch and the equipment used, but in no case shall the total mixing time be less than 3-minutes. Minimum mixing for concrete mixed in trucks shall be 100 revolutions of the drum.

The drum on truck mixers shall be operated at high speed while charging it with aggregate. Cement shall be introduced into the mixing drum while it is rotating at slow speed. Immediately prior to discharge of the concrete, the drum shall be rotated at high speed for 30-seconds.

702.5. CONSTRUCTING CONCRETE STRUCTURES

702.5.1. Submittals. Before starting work, the CONTRACTOR shall inform the OWNER fully of the methods of construction it proposes to follow and the amount and character of equipment it proposes to use, the adequacy of which shall be subject to the approval of the OWNER. Plans for forms and false-work for concrete piers and concrete superstructure spans over 20-ft. in length and for all widening details shall be submitted to the OWNER for review and approval. Similar plans shall be submitted for other units of the structure if required by the OWNER. The plans shall be prepared on standard 24-in. by 36-in. sheets or on mutually agreeable standard sheet sizes, such as, 11-in. by 17-in. sheets. Plans shall show all essential details of the proposed forms, false-work and bracing so that a structural analysis may be made. Six sets (or as directed by OWNER) of such plans, sealed by a Professional Engineer registered in the state of Texas shall be required.

Concurrence on the part of the OWNER in any proposed construction methods, approval of equipment or approval of form and false-work plans does not relieve the CONTRACTOR of the responsibility for the safety or correctness of its methods and adequacy of its equipment or from carrying out the work in full accordance with the contract.

702.5.2. Time Sequence. Unless otherwise provided, the following requirements shall govern for the time sequence in which construction operations may be carried on:

- (1) No superstructure members, forms, false-work or erection equipment shall be placed on the substructure before the substructure concrete has attained 75-percent design strength, as indicated by field-cured test specimens as approved by the OWNER.
- (2) The use of completed portions of a structure for storage of materials shall not be permitted until all curing requirements for the particular part of the structure have been met.
- (3) Forms for wall or columns shall not be erected on concrete footings until the concrete in the footing has cured at least 2-days. Concrete may be placed in the wall or column as soon as the forms and reinforcing steel placement are approved.
- (4) The support tie beam and/or cap forms by false-work placed on previously placed tie beams is permissible, provided such supporting beams have attained 75-percent design strength as indicated by field-cured test specimens as approved by the OWNER, curing requirements are completed, and the beams are properly supported to eliminate stresses not provided for in the design.

702.5.3. Drains. Weep hole drains and roadway drains shall be installed and constructed as shown on the plans in the designated locations. When the concrete is not formed at the weep hole location, a sheet of building paper shall be placed over the gravel to prevent the entrance of concrete into the pocket during operations.

702.5.4. Joints.

702.5.4.1. Expansion Joints. Expansion joints and devices to provide for expansion and contraction shall be constructed where indicated herein or on the plans.

The bearing area under the expansion ends of concrete slabs, prestressed concrete beams, girders and slab and girder spans shall be given a steel trowel finish. These areas shall be finished to the exact grades required. The material used in separate expansion surfaces shall be that shown on the plans and shall be placed carefully so that concrete or mortar cannot be subsequently worked around or under the material.

Immediately after the removal of forms and again when necessary after surface finishing, all projecting concrete shall be removed along exposed edges in order to secure full effectiveness of the expansion joints.

Refer to [Item 303.5.4.2](#), Expansion Joints for more information.

702.5.4.2. Construction Joints. The joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set shall be deemed a construction joint. When concrete is to be placed monolithically, the term monolithic shall be interpreted to mean that the manner and sequence of concrete placing shall be such that construction joints shall not be created.

Construction joints shall be of the type and at the locations shown on the plans. Additional joints shall not be permitted without written authorization from the OWNER. Any additional construction joints shall have details equivalent to those shown on the plans for joints in similar locations.

Unless otherwise provided, construction joints shall be square and normal to the forms. Bulkheads shall be provided in the forms for all joints except horizontal joints.

Construction joints requiring the use of joint sealing material shall be as detailed on the plans. The material shall be specified on the plans without reference to joint type.

The top surface of a concrete placement which terminates at a horizontal construction joint shall have the surface roughened thoroughly as soon as practicable after the concrete has attained initial set. The surfaces at bulkheads shall be roughened as soon as the forms are removed.

Before joining plastic concrete to concrete that has already set, the surface of the concrete in place shall be free from all loose material, laitance, dirt or foreign matter; shall be washed, scrubbed clean and drenched thoroughly with water until saturated; and shall be kept moist until the plastic concrete has been placed. Immediately prior to the placing of additional concrete, all forms shall be drawn tight against the existing concrete and the existing joint surface shall be flushed with a coating of grout mixed in the proportions of one part of cement to two parts of sand.

Refer to [Item 303.5.4.4](#), Construction Joints for more information.

702.5.5. False-work. All false-work shall be designed and constructed to safely carry the maximum anticipated loads and to provide the necessary rigidity. Details of false-work construction shall be subject to review and approval by the OWNER in accordance with the provisions of [Item 702.5.6](#), Forms. When the false-work is no longer required, it shall be removed. False-work piling shall be pulled or cut off a minimum of 6-in. below finished ground level. False-work and piling in a stream or lake shall be removed completely to a point specified by the OWNER to prevent any obstruction to the waterway. Removal shall also be subject to the provisions of [Item 702.5.11](#), Removal of Forms and False-Work.

702.5.6. Forms.

702.5.6.1. General. Forming plans shall be submitted for approval. Forms shall be designed for the pressure exerted by a liquid weighing 150-lb-per-cubic-foot. The rate of placing the concrete shall be taken into consideration in determining the depth of the equivalent liquid. An additional live load of 50-lb-per-square-foot shall be allowed on horizontal surfaces. The maximum unit stresses shall not exceed 125-percent of the allowable stresses used by TxDOT for the design of structures.

Forms shall be of suitable material and of a type, size, shape, quality and strength to insure construction as designed. Wood products for use in forming concrete shall conform to ACI Standard SP-4 Formwork for Concrete. The forms shall be true to line and grade, mortar tight and sufficiently rigid to resist deflection during placing of the concrete. The responsibilities for adequacy shall rest with the CONTRACTOR. All dirt, chips, sawdust, nails and other foreign matter shall be completely removed from forms before any concrete is deposited therein. The surfaces of forms shall be smooth and free from irregularities, dents, sags and holes that would deface the finished surfaces. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being reused. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent which shall leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete, reinforcement or embedded metal items.

Forms for all surfaces that shall not be completely enclosed or hidden below the permanent surface of the ground shall be made of surfaced lumber or material which shall provide a surface at least equal to surfaced lumber or plywood. Any lumber or material which becomes badly checked or warped prior to placing concrete shall not be used.

Forms for all exposed surfaces of bridges, viaducts, over-crossings and similar structures shall be constructed of plywood or an approved equal. Plywood for forms shall be exterior type, of the grade "Concrete-Form Exterior," conforming to the specifications of the U.S. Department of Commerce, "National Bureau of Standards, Commercial Standards," latest edition. Plywood shall be furnished and placed in 48-in. widths and in uniform lengths of not less than 96-in., except where the dimension of the member formed is less than the specified panel dimension. Plywood shall be placed with the grain of the outer plies in the direction of the span. Where plywood is attached directly to the studs or joists, the panels shall not be less than $\frac{5}{8}$ -in. thick, and the studs or joists shall be spaced not more than 12-in. center to center. Plywood form panels otherwise conforming to the requirements specified herein may be used with a continuous backing of $\frac{3}{4}$ -in. sheeting. All form panels shall be placed in a neat, symmetrical pattern with the horizontal joints level and continuous. All joints shall be filled with an approved quick-setting compound and finished flush with the interior of the form.

Forms for round columns exposed to view shall be of steel, except that other materials shall be allowed with written permission of the OWNER.

Removal shall be accomplished according to the provisions of [Item 702.5.11](#). Removal of Forms and False-Work.

702.5.6.2. Molding. Molding specified for chamfer strips and other uses shall be made of redwood, cypress or white pine materials of such grade that it shall not split when nailed and which can be maintained to a true line without warping. The molding shall be mill-cut and dressed on all surfaces.

702.5.6.3. Form Ties and Spreaders. Metal form ties of an approved type or an approved substitute shall be used to hold forms in place. Pipe spreaders shall not be permitted. Metal and wooden spreaders which are separate from the forms shall be entirely removed as the concrete is being placed. All metal ties, wire or other appliances used inside the forms to hold them in correct alignment shall be removed to a depth of at least $\frac{1}{2}$ -in. from the surface of the concrete. Burning off of rods, bolts or ties shall not be permitted. The cavities produced shall be carefully cleaned and completely filled with retempered sand-cement mortar mixed in proportions of 1-to-3 and the concrete shall be left smooth and even.

702.5.6.4. Form Supports for Overhanging Slabs. Form supports which transmit a horizontal force to a steel girder or beam or to a prestressed concrete beam shall be permitted but shall not be used unless a structural analysis has been made of the effect on the girder or beam and approval is granted by the OWNER.

Holes in steel members for support of overhanging brackets may be punched or drilled full size or may be torch cut to $\frac{1}{4}$ -in. under size and reamed full size as provided for in [Item 703](#). Steel Structures. In no case shall the holes be burned full size. All such holes must be approved by the OWNER in writing prior to punching, drilling or burning. Holes shall be left open unless specified on the plans to be filled with a button head bolt. In no case shall the holes be filled by welding.

702.5.7. Placing Reinforcement. Reinforcement in concrete structures shall be placed carefully and accurately and rigidly supported as provided in [Item 303.5.3](#). Placing Reinforcing Steel, Tie, and Dowel Bars and as shown on the plans.

702.5.8. Placing Concrete.

702.5.8.1. General. The CONTRACTOR shall give the OWNER sufficient advance notice before starting to place concrete in any unit of the structure to permit the inspection of forms, the reinforcing steel placement and preparation for casting. No concrete shall be placed in any unit prior to the completion of the formwork, the placement of the reinforcement and approval by the OWNER. Concrete mixing, placing and finishing shall be done in daylight hours, unless adequate provisions are made to light the entire site of all operations.

The minimum temperature of all concrete at the time of placement shall be not less than 50°F. The maximum temperature of Class C, F, H, X, Y and Z or Class PC, PF, PH (as specified by the OWNER) cast-in-place concrete used in bridge superstructures shall not be more than 85°F at the time of placement. Concrete diaphragms, parapets, concrete portions of railings, curbs and sidewalks, unless monolithically placed with the slab, may not be subject to the preceding control if approved by the OWNER in writing. Other portions of structures, when so noted on the plans, shall require the temperature control specified thereon.

A retarding admixture shall be used when the continuous placing method is used in the deck of continuous units. The initial set of the concrete shall be retarded sufficiently to insure that the concrete remains plastic in not less than 3 spans immediately preceding the one being placed. For simple spans, retardation shall be required only if necessary to complete finishing operations or as required by [Item 303](#), Portland Cement Concrete Pavement. The retarding admixture shall be in accordance with the requirements of [Item 702.2.3](#), Concrete Additives and Modifiers.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When conditions are such that additional moisture is needed for finishing, the required water shall be applied to the surface by misting only and shall be held to a minimum amount.

The maximum time interval between the addition of cement or mixing water to the batch and the placing of concrete in the forms shall not exceed amounts shown in Table 702.5.8.1.(a) Interval Between Mixing and Placing Concrete.

Table 702.5.8.1.(a) Interval Between Mixing and Placing Concrete.

Type	Air or Concrete Temperature		Maximum Time ¹
	°F	°C	
Nonagitated Concrete			
	80°F or above	26.6°C or above	15 minutes
	38°F ² or 79°F	3.3° to 26.1°C	30 minutes
Agitated Concrete			
	90°F or above	32.2°C or above	45 minutes
	75°F to 89°F	23.9° to 31.6°C	60 minutes
	38°F ² to 74°F	3.3° to 23.3°C	90 minutes

1. The use of an approved cement dispersing agent in the concrete shall permit the extension of each of the temperature-time maximums by 30-minutes, except that for non-agitated concrete, the maximum time shall not exceed 30-minutes.
2. Minimum temperature is 38°F and rising.
3. The maximum temperature shall not be more than 85°F at the time of placement.

The sequence of placing concrete shall be as provided on the plans or in the specifications. The placing shall be so regulated that the pressures caused by the plastic concrete shall not exceed the loads used in the design of forms.

The method of handling, placing and consolidation of concrete shall minimize segregation or the displacement of the reinforcement and shall produce a compact mass of uniform texture. Concrete shall not have a free fall of more than 3-ft. except in the case of thin walls such as culvert walls. The spattering of forms or reinforcement bars shall be prevented if the concrete so spattered shall dry or harden before being incorporated into the mass.

Laitance or foreign matter of any kind shall not be permitted to accumulate inside the forms, and openings in forms necessary for removal of same shall be provided.

Any hardened concrete spatter ahead of the plastic concrete shall promptly be removed from the work.

Each part of the forms shall be filled by depositing concrete as near its final position as possible. The coarse aggregate shall be worked back from the face and concrete forced under and around the

reinforcement bars without displacing them. Depositing large quantities at one point in the forms and running or working it along the forms shall not be allowed.

After the concrete has taken initial set, the forms shall not be jarred or any strain placed on projecting reinforcement.

Chutes, troughs, conveyors or pipes used in placing concrete shall be arranged and used so that the ingredients of the concrete shall not be separated. When steep slopes are necessary, the chutes shall be equipped with baffle boards or made in short lengths that reverse the direction of movement, or the ends of such chutes shall terminate in vertical downspouts. Open troughs and chutes shall extend, if necessary, down inside the forms or through holes left in the forms. All chutes, troughs, conveyors and pipes shall be kept clean and free from coatings of hardened concrete by a thorough flushing with water before and after each placement. Water used for flushing shall be discharged clear of the concrete.

Concrete shall be deposited in the forms in layers of suitable depth but not more than 36-in. in thickness, unless otherwise directed by OWNER.

Holes for anchor bolts in piers, abutments, bents or pedestals may be drilled or may be formed by the insertion of oiled wooden plugs or metal sleeves in the plastic concrete. The plugs or sleeves shall be withdrawn after the concrete has set. Formed holes shall be of such diameter to permit horizontal adjustments of the bolts. The bolts shall be set carefully in mortar in lieu of the above methods of placing. Anchor bolts may be set to exact location in concrete when it is placed.

The placing of concrete for deck slabs shall be done from a mixing plant located off the structure. Carting or wheeling concrete batches over a completed slab shall not be permitted until the slab has reached its specified compressive strength. If carts are used, timber planking shall be required for the remainder of the curing period. Carts shall be equipped with pneumatic tires. Curing operations shall not be interrupted for the purpose of wheeling concrete over finished slabs.

702.5.8.2. Vibration. Successive layers or adjacent portions of concrete shall be placed in a sequence so that they can be vibrated into a homogeneous mass with the previously placed concrete without a cold joint. No more than one hour shall elapse between adjacent or successive placement of concrete. Unauthorized construction joints shall be avoided by placing required portions of abutments, piers, walls or superstructure in one continuous operation. For mass placements, placements on false-work where differential setting time may include stress cracking, placement in deep girder stems, etc., an approved retarder (cement dispersing agent) in accordance with [Item 702.2.3. Concrete Additives and Modifiers \(Chemical Admixtures\)](#) shall be used to control stress cracks and/or unauthorized cold joints.

All concrete shall be well consolidated and the mortar flushed to the surface of the forms by continuous working with mechanical vibrators of an approved type. Vibrators of the type which operate by attachment to forms or reinforcement shall not be permitted, except that external vibration may be allowed when the forms are of steel, but shall be subject to regulation by the OWNER.

At least one standby vibrator shall be provided for emergency use in addition to ones required for placement.

For lightweight concrete, vibrators of the high-frequency type, which produce a minimum of 7,000-impulses-per-minute, shall be required.

The vibrators shall be applied to the concrete immediately after deposit. Prior to the beginning of work, a systematic spacing of the points of vibration shall be established to insure complete consolidation of the concrete being placed and the thorough working of the concrete around the reinforcement, embedded fixtures and into the corners and angles of the forms. Immersion type vibrators shall be inserted vertically, at points 18-in. to 30-in. apart and slowly withdrawn.

For shallow slabs or for concrete inaccessible to vertical insertion of the vibrator, the vibrator may be inserted in a sloping horizontal position. The entire depth of each lift of concrete shall be vibrated, and the vibrator shall be allowed to penetrate several inches into the preceding lift of plastic concrete. New concrete placed against hardened concrete or against fresh concrete that is not plastic shall be thoroughly consolidated along the joint surface. The vibration shall be of sufficient duration to produce thorough consolidation and complete embedment of reinforcement and fixtures but shall not be done to an extent that shall cause segregation. Vibration may be supplemented by hand spading or rodding, if necessary, to insure the flushing of mortar to the surface of all forms.

702.5.8.3. Fogging. For Curing methods, see [Item 702.5.10.2.2. Water Curing](#).

702.5.8.4. Placing Concrete Under Adverse Weather Conditions. Concrete placement shall not be permitted when impending weather conditions may result in rainfall or low temperatures which shall impair the quality of the finished work. In case rainfall should occur after placing operations are started, the CONTRACTOR shall provide ample covering to protect the work. In case of a drop in temperature, the provisions set forth herein shall be applied.

Concrete for structures shall not be placed on frozen ground nor shall it be mixed or placed while the atmospheric temperature is below 40°F, unless adequate means are employed to heat the aggregates and water and satisfactory provisions have been made for protecting the work.

Concrete slabs shall not be placed on frozen ground, nor shall concrete be mixed or placed when the atmospheric temperature is below 40°F or when conditions indicate that the temperature may fall to 40°F within a 24 hour period, except with the written permission of the OWNER and only after such precautionary measures for the protection of the work have been taken as the OWNER may direct.

Concrete shall be effectively protected from freezing or frost for a period of 5 days after placing. When the temperature of the air is above 85°F, an approved retarding mixture shall be required in all concrete used in superstructures, top slabs of direct traffic culverts and cased drilled shafts.

Concrete placement shall be stopped when rainfall is sufficient to cause damage to the work.

702.5.8.5. Placing Concrete in Water. Concrete shall be deposited in water only when specified on the plans or with written permission of the OWNER. The forms, cofferdams or caissons shall be sufficiently tight to prevent any water current passing through the space in which the concrete is being deposited. Pumping shall not be permitted while the concrete is being placed, or until it has set for at least 36-hours.

The concrete shall be placed carefully in a compact mass by means of a tremie or other approved method that does not permit the concrete to fall through the water without adequate protection. The concrete shall not be disturbed after being deposited. Depositing shall be regulated to maintain approximately horizontal surfaces at all times.

When a tremie is used, it shall consist of a tube having a diameter of not more than 10-in., constructed in sections having watertight connections. The tremie shall be equipped with a device for sealing the bottom of the tube, the positive opening thereof and for the placing of the tremie through the water to the point of placement. The means of supporting the tremie shall permit the movement of the discharge over the entire surface of the work and shall permit the tremie to be lowered rapidly when necessary to choke off or retard the flow.

702.5.8.6. Placing Concrete in Superstructure. To insure operation and maintenance of grades and clearances, one or more passes of the screed shall be made over the section of bridge spans to be placed prior to the placement of concrete.

For transverse finishing, concrete in the superstructure shall be placed in transverse strips, beginning at the lowest end of the unit or length of spans to be placed and proceeding to the other end.

For longitudinal screeding, concrete shall be placed in longitudinal strips. Placing, preferably, shall be started at a point in the center of the section adjacent to one curb. The strip thus started shall be completed by depositing concrete uniformly in both directions toward the ends except that for spans on a grade of 1 1/2-percent or more, the placing shall start at the lowest end. The width of strips shall be such that the concrete therein shall remain plastic until the adjacent strip is placed.

The forms for the bottom surface of concrete slabs, girders and overhangs shall be maintained true to the required vertical alignment during the concrete placing. For convenience in checking the vertical alignment, an approved system of "tell-tales" attached to the forms shall be installed and maintained by the CONTRACTOR. They shall provide a convenient means of match-marking with reference to points set on stakes or other suitable reference points set independently of the forms and false-work for the span being placed. Unless otherwise provided, the girders, slab and curbs of deck girder spans shall be placed in one continuous operation.

The filling of girder stems ahead of placing the concrete in the slab shall be permitted, provided the slab concrete is placed in the time as specified in [Item 702.5.8.1. General](#). The location of construction

joints and the sequence of placements of the slab on steel and prestressed concrete beams shall be as shown on the plans. Where plans do not specify a particular sequence, any logical placing sequence which shall not result in the over-stressing of any of the supporting members shall be permitted subject to the approval of the OWNER.

On steel truss spans the false-work under the span shall be released and the span swung free on its permanent supports before placing any concrete in the floor slab.

As soon as concrete is placed in a section of the slab of sufficient width to permit finishing operations, the slab shall be finished as specified in [Item 702.5.13](#). Finishing Exposed Surfaces. When the surface of the slab is to receive an additional wearing surface or level-up (widening), the slab shall be given a reasonably smooth float or screed finish and shall not be finished as stated above.

702.5.8.7. Placing Concrete in Box Culverts. In general, construction joints shall be permitted only at the points shown on the plans.

Where the top slabs and side-walls are placed monolithically in culverts more than 4-ft. in clear height, an interval of not less than 1-hour nor more than 2-hours shall elapse between the placing of the concrete in the walls and that in the top slab. Such interval is to allow for shrinkage in the wall concrete.

The top surface of the base slab shall be finished accurately at the proper time to provide a smooth uniform surface. The upper surface of the top slab which shall carry direct traffic shall be finished as specified for finishing roadway slabs in [Item 303.5.6](#). Finishing. On a fill-type culvert which does not carry direct traffic, the top slab shall be given a reasonably smooth finish.

702.5.8.8. Vaults. Vaults shall be provided as specified and/or detailed for access to manholes, gate valves, air release valves, etc.

702.5.8.8.1. Construction. Vaults may be of concrete, reinforced concrete, or precast reinforced concrete pipe as detailed in [Item 501.6](#). Reinforced Concrete Culvert, Storm Drain, Pipe and Box Section or as shown on the project plans. General construction shall include the following:

- (1) Vaults used for blow-off manhole applications shall be of water containment construction, utilizing either the monolithic pour-in-place concrete or precast reinforced concrete pipe with trapped O-ring gasket as further defined in [Item 501.6](#). Reinforced Concrete Culvert, Storm Drain, Pipe and Box Section.
- (2) Vaults used for non-water containment construction, such as for valve installations, shall be either pour-in-place 2500# reinforced concrete or precast reinforced concrete tongue-and-groove design pipe meeting ASTM C76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, Class III, using trapped O-ring type rubber seals.
- (3) Material requirements for vaults shall be as controlled under the material requirements of these specifications and the contract documents, as applicable, with specific inference placed on material specifications.

Walls. For in-place vaults, walls shall be formed on all sides to the thickness specified. Unless specified otherwise, walls shall not be less than 6-in. thick.

Top Slabs and Grade Adjustment. Top slabs shall normally be poured below final grade and grade rings used to achieve final grade ring elevations. Manhole grade rings, covers, vents, etc. shall be installed as detailed in [Item 502.1](#). Manholes, shown on project plans, or as directed by the OWNER.

Finish. The vault top slab invert and inside wall shall be given a rubbed finish in accordance with [Item 702.5.13](#). Finishing Exposed Surfaces.

702.5.8.8.2. Testing. Water-containment vault structures shall be tested for exfiltration as required in [Item 507.5.1.2](#). Exfiltration of this specification. In the event that leakage occurs in excess of allowable limits, the vault shall be completely sealed with an approved mastic sealer. Any visible seepage of free water shall require sealing on either water containment vaults or manholes.

702.5.8.8.3. Measurement and Payment for Vaults. Measurement and payment for vaults shall be as hereinafter defined, unless specified otherwise in the special contract documents.

Measurement for vault structures shall be on a per each basis complete in place with all accessories and shall include appurtenant work including excavation through backfill to provide for the structure complete in place as designed for the project. Each vault structure is to be complete in place with all system components to be housed as further outlined as follows:

- (1) Access Manhole Vault. Since the flanged access outlet and cover are usually furnished as a fitting for concrete cylinder pipe, the vault shall be the only item considered for payment under this bid item category in the proposal.
- (2) Air Valve or Combination Air and Vacuum Release Valve in Vault. Payment under this bid item category in the proposal shall include furnishing and installing the air valve or combination air and vacuum release valve, together with all subsidiary piping valves and other appurtenances complete in place as detailed as well as construction of the vault structure. The connecting taps on the main shall be included in the bid price for furnishing and installing fittings or shall be subsidiary to the price bid for furnishing and installing pipe, whichever is more applicable for a specified project.
- (3) Gate Valve in Vault. Payment under this bid item category in the proposal shall include the construction of the vault as well as furnishing and installing the gate valve complete in place on concrete blocking along with all appurtenances as detailed for complete and functional installation.
- (4) Blow-off and Vault. Payment under this bid item category in the proposal shall include the construction of a water containment vault structure as well as furnishing and installing piping (exclusive of the M.J. bell outlet on concrete mains or M.J. tee on cast iron mains), valves, blocking and other appurtenances as detailed with polyethylene wrapping.

702.5.8.9. Placing Concrete in Foundations and Substructure. Concrete shall not be placed in footings until the depth and character of the foundation has been inspected by the OWNER and permission has been given to proceed.

The placing of concrete bases above seal courses shall be permitted after the caissons or cofferdams are free from water and the seal course cleaned. Any necessary pumping or bailing during the concreting operations shall be done from a suitable sump located outside the forms.

All temporary wales or braces on the inside of cofferdams or caissons shall be constructed or adjusted as the work proceeds to prevent unauthorized construction joints in bases or shafts.

When footings can be placed in dry foundation pits without the use of cofferdams or caissons, forms may be omitted, if desired by the CONTRACTOR and approved by the OWNER, and the entire excavation filled with concrete to the elevation of the top of footing. Where this procedure is followed, no measurement for payment shall be made for concrete placed outside of the footing dimensions shown on the plans.

Concrete in columns shall be placed monolithically unless otherwise provided. Columns and caps and/or tie beams supported thereon may be placed in the same operation. To allow for shrinkage of the column concrete, it shall be placed to the lower level of the cap or each tie beam and placement delayed for not less than 1-hour nor more than 2-hours before proceeding.

702.5.9. Finishing Concrete. All upper horizontal surfaces not covered by forms shall be struck off to grade and finished. The use of mortar topping for surfaces under this classification shall not be permitted.

After concrete has been struck off as described above, the surface shall be floated with a suitable float. Bridge sidewalks shall be given a wood float or broom finish or may be striped with a brush, as specified by the OWNER. Unless otherwise specified, top of caps and piers shall be given a smooth finish with a steel trowel. Other surfaces shall be wood float finished and striped with a fine brush leaving a fine-grained texture.

702.5.10. Curing Concrete. Careful attention shall be given to the proper curing of all concrete. CONTRACTOR shall inform OWNER fully of the methods and procedures proposed for curing, shall provide proper equipment and material in adequate amounts, and shall have approval of the proposed method, equipment and material prior to placing concrete.

Inadequate curing facilities or lack of attention to the proper curing of concrete shall be cause for OWNER to stop all construction on the job until approved curing is provided.

702.5.10.1. Curing Period. All concrete shall be cured for a period of time noted in Table 702.5.10.1.(a) Curing Period, unless otherwise specified by the OWNER. In continuous placement of concrete, the required curing period shall begin when all concrete has been placed and has attained its initial set.

Table 702.5.10.1.(a) Curing Period

Concrete Structure	Curing Days ^{1,2}
Top Slabs of Direct Traffic Culverts	8-days
Other Structures	4-days

1. A curing day is defined as a day when the ambient temperature, taken in the shade away from artificial heat, is above 50°F for at least 19-hours, or the ambient temperature is 50°F or less; and if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 40°F for the entire 24-hours.
2. In addition, concrete must meet 75-percent of the minimum compressive strength requirements.

702.5.10.2. Curing Methods. The following methods are permitted for curing concrete subject to the restrictions of Table 702.5.10.2.(a) Curing Methods, and the requirements of this specification for each method of curing.

Table 702.5.10.2.(a) Curing Methods

Structure Unit Description		REQUIRED		PERMITTED	
		Water for Complete Curing	Membrane for Interim Curing	Water for Complete Curing	Membrane for Interim Curing
1.	Top slabs of direct traffic culverts, top surface of any concrete unit upon which concrete is to be placed and bonded at a later interval (stub walls, risers, etc.). Other superstructure concrete (wing-walls, parapet walls, etc.).	X			
2.	Top surface of precast and/or prestressed piling	X	X		
3.	All substructure concrete, culverts, box sewers, inlets, manholes, retainer walls, riprap.			X ¹	X ¹

1. Polyethylene sheeting or burlap polyethylene mats fastened to prevent outside air from entering shall be considered equivalent to water or membrane curing per this item.

702.5.10.2.1. Form Curing. When forms are left in contact with the concrete, other curing methods shall not be required except for cold weather protection.

702.5.10.2.2. Water Curing. All exposed surfaces of the concrete shall be kept wet continuously for the required curing time. The water used for curing shall meet requirements for concrete mixing water as specified in [Item 303](#), Portland Cement Concrete Pavement.

Wet Mat. Cotton mats shall be used for this curing method. The mats shall not be placed in contact with the concrete until such time that damage shall not occur to the surfaces. Damp burlap blankets made from 9-oz. stock may be placed on the damp concrete surface for temporary protection prior to the application of the cotton mats. The mats may be placed dry and wetted down after placement. Mat curing, except for continuous placements, shall commence not later than 3-hours after finishing the roadway slab. The mats shall be weighted down adequately to provide continuous contact with all concrete surfaces where possible. The surfaces of the concrete shall be kept wet for the required curing time. Surfaces which cannot be cured by contact shall be enclosed

with mats, anchored positively to the forms or to the ground, so that outside air cannot enter the enclosure to keep all surfaces of the concrete wet.

Water Spray. This method shall be accomplished by overlapping sprays or sprinklers, so that all unformed surfaces are kept continuously wet.

Ponding. This method requires the covering of the surfaces with a minimum of 2-in. of clean granular material, kept wet at all times, or water to a minimum depth of 1-in. Satisfactory provisions shall be made to provide a dam to retain the granular material or water.

Fogging. All the unformed surfaces of slab concrete for bridge decks and the top slab of direct traffic culverts shall be protected against rapid surface drying by the use of fog sprays. Fog sprays, powered by pressure pumps and capable of covering the entire area of freshly placed concrete with a fine mist, shall be installed, ready for use prior to the start of placing operations.

On individual placements of 15-cubic-yards or less, hand operated spray nozzle equipment of the stirrup pump type may be substituted for the equipment specified above.

Fogging shall be carefully controlled to prevent accumulation of standing or flowing water on the surface of the fresh concrete. Fogging shall continue, as required, through the finishing operations and shall be used as interim curing until the selected curing medium is in place, except that in lieu of continuous fogging over the entire area, that portion of the finished concrete surface which is sufficiently hardened may be covered with wet burlap. The burlap shall be kept wet until the final curing media is in place.

702.5.10.2.3. Membrane Curing. Membrane curing shall not be applied to dry surfaces but shall be applied to horizontal surfaces just before free moisture has disappeared. Formed surfaces and surfaces which have been given a first rub shall be dampened and shall be moist at the time of application of the membrane. Unless otherwise shown on the plans, Type 2 membrane curing compound in accordance with [Item 303.2.13](#). Curing Materials may be used where permitted. Membrane shall be applied in a single, uniform coating at the rate of coverage recommended by the manufacturer and as approved by the OWNER. Tests for acceptance shall be at the specified rate of application.

When membrane is used for complete curing, the film shall remain unbroken for the minimum curing period specified. Membrane which is damaged shall be corrected immediately by re-application of membrane.

702.5.11. Removal of Forms and False-Work. Except as herein provided, forms for vertical surfaces may be removed when the concrete has aged not less than 1 curing day. A curing day is defined as a day when the ambient temperature, taken in the shade away from artificial heat, is above 50°F for at least 19-hours, or the ambient temperature is 50°F or less; and if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 40°F for the entire 24-hours.

Weight supporting forms and false-work for all bridge components, culverts and slabs shall remain in place a minimum of 4-curing-days. Forms may then be removed if the concrete has attained 75-percent of design strength, as evidenced by strength tests using test specimens made from the same concrete and cured under the same conditions as the portion of the structure involved. Forms for other structural components may be removed as specified by OWNER. If all test specimens made for the purpose of form removal have been tested without attaining the required strength, forms shall remain in place for a total of 14-curing-days.

The above provisions relative to form removal shall apply only to forms or parts of forms which are so constructed as to permit removal without disturbing forms or false-work which are required to be left in place for a longer period on other portions of the structures.

702.5.12. Defective Work. Any defective work discovered after the forms have been removed shall be repaired or replaced as soon as possible. If the surface of the concrete is bulged, uneven or shows excess honeycombing or form marks which in the opinion of the OWNER cannot be repaired satisfactorily, the entire section shall be removed and replaced. In repairing honeycombed areas, all loose material shall be removed before the repair work is started. No extra compensation shall be allowed for extra work or materials involved in repairing or replacing defective concrete.

702.5.13. Finishing Exposed Surfaces. The type of surface finish shall be one of the types described herein and as designated on the plans. Where the plans do not specify the type of finish, a Type 1 Finish shall be required.

702.5.13.1. Type 1 Finish. The following areas shall require lined forms and shall receive a first and second rubbing:

- (1) The top, exterior and roadway faces of curbs; all concrete surfaces of railing, including the parapet types; the exterior vertical faces of slab spans, rigid frames, arches and box girders; the outside and bottom surfaces of fascia beams or girders (precast prestressed concrete beams excluded); the underside of overhanging slabs to the point of juncture of the supporting beam; all vertical surfaces of piers, columns, bent caps, (including the bottom sloped portions only of variable depth caps), abutments, wing-walls and retaining walls, which are exposed to view after all backfill and embankment are placed.
- (2) On slab spans and rigid frame structures, the underside of the slab shall be finished for a width of 2-feet in from the outer edge, but lined forms shall be required for the entire bottom surfaces.
- (3) For rigid frame structures, finishing shall be required on the inside sloping and vertical surfaces.
- (4) Culvert headwalls and wing-walls, inlets, manholes and sewer appurtenances shall receive a first rubbing only.

No rubbing shall be required on any area inside culvert barrels. Horizontal surfaces of bridge sidewalk slabs shall be finished in accordance with [Item 303.5.6](#). Finishing.

702.5.13.2. Type 2 Finish. All concrete surfaces of railing, including the parapet types, the top and roadway faces only of curbs, and wing-walls of bridges shall be given a first and second rubbing. All other surfaces described under Type 1 Finish shall be given a first rubbing only. Lining of forms shall be as required in a Type 1 Finish.

702.5.13.3. Type 3 Finish. All concrete surfaces of railing, including the parapet types, the top and roadway faces only of curbs, and wing-walls of bridges shall be given a first and second rubbing. All other surfaces described under Type 1 Finish shall not require rubbing but shall require lining of forms.

702.5.13.4. Type 4 Finish. All concrete surfaces of railing, including the parapet types, the top and roadway faces of curbs, and wing-walls of bridges and culverts shall be given a first rubbing only. Form lining shall not be required. Rubbing of culvert wing-walls shall not be required, provided lined forms are used.

702.5.13.5. Surface Finishing Methods. The first rubbing shall be done immediately upon removal of the forms. Membrane curing, if used, shall be applied after the first rub has been completed. Prior to the second rubbing, any remaining curing membrane shall be removed from the surface by brushing, buffing or other satisfactory methods. Removal of the membrane shall not be required except when a second rubbing is required.

After all repair work and pointing has set sufficiently, rubbing shall be performed as follows:

- (1) All surfaces to be finished shall be wet and given a first rubbing with a carborundum stone. The rubbing shall bring the surface to a paste and produce a smooth dense surface without pits, form marks or other irregularities. The use of cement to form a paste shall not be permitted.
- (2) Where a single rubbing is specified, the paste shall be spread uniformly, striped with a brush and allowed to take a reset, after which the surfaces shall be washed with clean water, leaving them with a neat and uniform appearance and texture. Chamfered corners shall also be rubbed.
- (3) When a second rubbing is required, striping with a brush and washing after the first rubbing shall not be required. Chambered corners generally should not be rubbed in the first rubbing.
- (4) The second rubbing shall be performed during the process of conditioning the structure for final acceptance. The surfaces requiring finish shall be cleaned of drip marks and discolorations and shall be given a final rubbing with a carborundum stone. The surface shall be striped neatly with a brush, and the mortar shall be allowed to take a reset, after which the surfaces shall be washed with clean water, leaving them with a neat and uniform appearance and texture.

Surfaces other than those specified herein shall not require rubbing unless they are not true or have porous or honeycombed areas which are not designated for replacement. When such defects occur,

the areas affected shall be given a first rubbing, which shall extend over a sufficient area to blend it into the surrounding unfinished surface. This shall not be construed to require the rubbing of large adjacent unblemished areas to gain absolute uniformity of color and texture on the structure part in question. All surfaces shall be free of discolorations and should present a uniform appearance. Unsightly discoloration shall be removed prior to acceptance.

702.5.13.6. Painting in Lieu of Rubbing. When so indicated on the plans, or with written permission of the OWNER, painting of concrete surfaces in lieu of rubbing shall be permitted. When painting is permitted, it shall be accomplished as follows or as according to the OWNER:

- (1) Soon after form removal, any porous spots, honeycombed areas, untrue surfaces and lines shall be corrected. All fins, form marks, runs, drips or mortar shall be removed, leaving a smooth and uniform surface.
- (2) When preparing the completed structure for final acceptance, all grease, dirt, mortar drips and remaining curing membrane shall be removed from the pertinent surfaces.
- (3) Surfaces shall be painted with a latex-base adhesive grout. The grout shall consist of one part latex-base adhesive, two parts white cement, two parts natural cement, two parts fine masonry sand and one part water. Mixture should have the consistency of a thick paint.
- (4) The finished surface shall have a uniform appearance and texture. Thickness of coating shall be approximately $\frac{1}{16}$ -in. to $\frac{1}{8}$ -in.

702.5.14. Measurement and Payment. The quantity of concrete which constitutes the completed structure shall be measured by the cubic yard of accepted work in place. The dimensions used shall be those shown on the plans or ordered in writing by the OWNER. No deductions in measurement shall be made for embedded reinforcing steel or for embedded portions of structural steel members.

The concrete quantities, measured as provided, shall be paid for at the unit price bid per cubic yard for concrete, which price shall be full compensation for furnishing, hauling and mixing all concrete materials, including trial batches; placing, curing and finishing all concrete; all grouting and joints; furnishing and placing all expansion and construction joints, except as hereinafter provided; furnishing and placing metal flashing strips and waterstops; and all forms and false-work, labor, tools, equipment and incidentals necessary to complete the work.

The above provision for payment for expansion joints shall not be interpreted to provide payment for cast steel or structural steel shapes and plates, used expansion joints and armored joints, or for structural steel, cast iron or cast bearing plates. Payment for these materials shall be as provided for in [Item 806](#). Metal Materials.

The preceding provisions for payment shall not be interpreted to provide payment for concrete in railing, piling, precast prestressed concrete units or other concrete items for which provision is otherwise made in these specifications or in the contract documents.

702.6. PRESTRESSED CONCRETE FOR STRUCTURES

702.6.1. Description. This item shall govern the complete construction, furnishing, storing, handling and erection of precast prestressed concrete structures, in accordance with the plans, with the exception of piling, which shall be in accordance with [Item 704.1.2](#). Concrete Piling. For additional information, refer to TxDOT Specifications and OWNER-provided specifications.

702.6.2. General. The method of construction and of prestressing shall be as shown on the project plans and on the approved shop drawings. Prior to beginning the casting of prestressed members, the CONTRACTOR shall give the OWNER notice.

702.6.3. Materials. Materials for concrete shall be in accordance with [Item 702.2](#). Concrete Structure Materials, and [Item 702.3](#). Mix Design and Mixing Concrete for Structures. Reinforcing steel, not prestressed, shall conform to the requirements of [Item 303.2.9](#). Steel Reinforcement. Structural steel bearing plates, fittings, etc. shall be in accordance with [Item 806](#). Metal Materials. Bearing pads shall be in accordance with TxDOT Item 435. Elastomeric Materials and with special specifications contained in the Contract.

702.6.4. Handling and Erection. Fabrication and erection plans shall indicate the method of handling and erecting prestressed members. An adequate factor of safety shall be included in all calculations for handling and erection to preclude over-stressing any part of the member due to dynamic forces or impact.

Prestressed concrete beams shall be maintained in an upright position at all times and shall be picked up and supported near the end of the beams only and in such a way as to prevent torsional stress in the beam. Beams may be lifted with the lifting devices as approved on the shop plans or by other methods approved by the OWNER in writing.

No prestressed concrete structural member shall be moved from the casting yard until all requirements for tensioning, curing and strength have been attained. The strength of a prestressed member shall be considered adequate after curing and tensioning requirements are fulfilled if the design strength compressive cylinders indicate that the required design strength has been attained.

702.6.5. Defects and Breakage. If any prestressing tendon or portion thereof is broken prior to placing concrete in the member, it shall be replaced with a satisfactory unit properly prestressed at no cost to the OWNER. The breaking of one wire of a 7-wire strand in a unit during concrete placing operations shall be subject to a structural review prior to acceptance.

Fine hair cracks or checks on the surface of the member which, as determined by the OWNER, do not extend to the plane of the nearest reinforcement, shall not be cause for rejection unless such cracks are so numerous and extensive as to indicate inadequate curing, in which case the members shall be rejected. Diagonal cracks on the vertical surfaces which indicate damage from torsion shall be subject to a structural review prior to acceptance or rejection by the OWNER. Vertical and horizontal cracks which are $\frac{1}{16}$ -in. or less in width and which tend to close upon release of stress are acceptable. Cracks in excess of this are subject to review prior to acceptance or rejection by the OWNER. Cracks which extend into the plane of reinforcing steel and/or prestressed tendons and are acceptable otherwise shall be repaired by sealing with a latex-base adhesive grout or with epoxy.

All replacements as herein specified as well as all other replacements due to faulty materials or construction methods shall be made at the CONTRACTOR'S expense.

702.6.6. Workmanship and Tolerance. Variations greater than specified shall be cause for rejection.

702.6.6.1. Prestressed Beams, Girders, Spans and Box Type Beams. Requirements shall include the following:

- (1) variation from shop plan lengths: plus or minus 1-in.
- (2) variation from plan height, box type beams: plus or minus $\frac{1}{4}$ -in. Others: plus or minus $\frac{1}{2}$ -in. maximum deviation of $\frac{1}{4}$ -in. per 10-ft. of length. Box-type beams $\frac{3}{4}$ -in total deviation.
- (3) out-of-square (vertical or horizontal) or deviation from plane skew angle: maximum $\frac{1}{8}$ -in.-per-ft. of dimension.
- (4) bearings. Requirements include:
 - (a) out-of-perpendicular with vertical axis: maximum $\frac{1}{16}$ -in.
 - (b) honeycomb in bottom soffit of beams at the bearing shall not exceed 15-percent of the bearing area (width x length). No tendon shall be exposed and the maximum depth of honeycomb shall not exceed 1-in. Honeycomb shall be chipped out to sound concrete and repaired satisfactorily prior to acceptance.
- (5) form fit-up. Where sections of forms are to be butt-jointed, an offset of $\frac{1}{16}$ -in. for flat surfaces and $\frac{1}{8}$ -in. for corners and bends shall be permitted.

702.6.6.2. Repair. Small areas of honeycomb which are purely surface in nature (not over 1-in.) may be repaired. Honeycomb extending to the plane of the prestressed strands shall be rejected tentatively, subject to structural review prior to acceptance or rejection by the OWNER.

702.6.6.3. Steel. Reinforcing steel shall not project above the top of the member more than $\frac{1}{2}$ -in. nor less than $\frac{3}{4}$ -in. from plan dimension. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than $\frac{1}{4}$ -in. or $\frac{1}{12}$ of the spacing between bars, whichever is greater. In the plane of the steel perpendicular to the nearest surface of the concrete, bars shall not vary from plan placement by more than $\frac{1}{4}$ -in.

702.6.7. Measurement and Payment.

702.6.7.1. Measurement. Precast, prestressed concrete beams or girders of the type specified, cast and stressed, as required on the plans, shall be measured by the linear foot complete in place.

Precast, prestressed concrete spans of the size and type specified, cast and stressed, as required by the plans, shall be measured as each prestressed span, complete in place.

Other precast, prestressed members of the type and size specified, cast and stressed, as required by the plans, may be measured by the linear foot or by each member as the case may be and as noted on the plans.

Cast-in-place structures (or structures where the CONTRACTOR has the option of casting-in-place) shall be measured as follows:

- (1) concrete, non-prestressed reinforcing steel and structural steel (except bearing and anchorage devices integrally a part of the post-tensioning system) shall be measured by the cubic yard or by the pound in accordance with the applicable specifications for these items. Grout and ducts for post-tensioning shall not be measured but shall be considered subsidiary to this item.
- (2) the prestressing steel required and the work involved in the prestressing of the cast-in-place structures or units shall not be measured but shall be considered as one unit for “prestressing” each different structure type or unit as itemized on the plans and in the proposal.

702.6.7.2. Payment. Precast, prestressed concrete beams or girders shall be paid for at the unit price bid per linear foot (m) for “prestressed concrete beams” of the type specified.

Precast, prestressed concrete spans shall be paid for at the unit price bid for each “prestressed concrete span.”

Other prestressed concrete members shall be paid for at the unit price bid per linear foot for “prestressed concrete members” (specify name and type) as the case may be.

A partial allowance shall be made for materials and for precast or prestressed concrete members cast, but not erected.

The above prices shall be full compensation for constructing the member; furnishing and tensioning prestressed steel; furnishing and placing reinforcing steel, conduit and attached bearing plates, etc. for same; grouting holes; and for all bars, anchorage plates, and other appurtenances which become an integral part of the precast structure and for any special treatment of end anchorages and shoes as indicated on the plans; and for furnishing all materials, tools, equipment, labor and incidentals necessary to fabricate, transport and erect the members in the structure as indicated on the plans. The cost of all materials used in the test specimens and the cost of providing and maintaining curing facilities shall be included in the unit price bid for the various prestressed concrete members.

702.7. PNEUMATICALLY PLACED CONCRETE (GUNITE)

702.7.1. Description. Pneumatically placed concrete shall consist of premixed sand and Portland cement pneumatically transported through a pipe or hose in a dry state to a nozzle where hydration takes place immediately prior to expulsion. For additional information, refer to TxDOT Specifications and OWNER-provided specifications.

702.7.2. Materials. The concrete shall conform to the requirements of [Item 702.2](#). Concrete Structure Materials. Bar reinforcement and wire fabric reinforcement shall conform to the requirements of [Item 303.2.9](#). Steel Reinforcement. Expansion joints shall conform to the relevant requirements [Item 303](#). Portland Cement Concrete Pavement.

Steel drive pins or studs used for the attachment of reinforcing when covering designed portions of concrete structures with pneumatically placed concrete shall be capable of being driven to the specified depth without deforming or otherwise becoming unsuitable for the purpose intended. The pins shall have a minimum diameter of 1/8-in. and a minimum length of 2-in. Size and location of drive pins or studs and method of attachment of reinforcing shall be as specified herein or as detailed on the plans.

702.7.3. Equipment and Workers. The gun mechanism should be operated at a minimum air pressure of 45-psi on the gun tank when 100-ft. or less of material hose is used and the pressure should be increased 5-psi for each additional 50-ft. of hose required. Nozzles used for guniting shall have a maximum size of 1½-

in. unless otherwise permitted by the OWNER. Water used for hydration shall be maintained at a uniform pressure, which shall be at least 15-psi above air pressure at the gun.

The equipment used for driving the pins or studs shall be of the type which uses an explosive for the driving force and shall be capable of inserting the stud or pin to the required depth without damage to the concrete. The OWNER may require that a test be made of equipment prior to approving it for use.

Only experienced foremen, gunmen, nozzlemen, and rodmen shall be employed, and satisfactory written evidence of such experience shall be furnished to the OWNER or its representative upon demand.

702.7.4. Proportions, Mixing, and Testing. Unless otherwise specified, the concrete shall consist of a mixture of cement and sand in the proportions by volume of 1 part of cement to 4½ parts of sand.

The sand shall contain not less than 3-percent nor more than 6-percent moisture by weight. The sand and cement shall be mixed thoroughly in a power mixer for at least 1½-minutes before placement in the chamber of the gun mechanism. The dry mixed material shall be used promptly after mixing. Any material that has been mixed for more than 45-minutes shall be rejected and removed from the worksite.

The use of approved admixtures conforming to the requirements of [Item 702.2.3](#). Concrete Additives and Modifiers shall be permitted at the option of the CONTRACTOR.

The mixer shall be cleaned at regular intervals to remove all adherent material from the mixing vanes and from the drum.

At the beginning of work the OWNER may require that cylinders be made to represent the quality of the pneumatically placed concrete. Additional cylinders shall be made during performance of the work as directed by the OWNER. If in the opinion of the OWNER, the cylinder strengths are indicating undesirable variation in the concrete, the CONTRACTOR may be required to change the mix design and/or method of placing so as to correct this condition. The CONTRACTOR shall furnish specially constructed cylinders 6-in. in diameter and 12-in. high, made of ¾-in square mesh hardware cloth. Test cylinders for pneumatically placed concrete shall be shot with the same air pressure and nozzle tip as the pneumatically placed concrete. At the end of the first 24-hour curing period, the hardware cloth form shall be removed and the cylinders stored and cured as directed by the OWNER.

702.7.5. Construction Methods. Concrete shall not be applied to a surface containing frost or ice. Where standing or running water is encountered, it shall be removed before applying the concrete. No work shall be done without the permission of the OWNER when the temperature is lower than 40°F. After placing, the concrete shall be protected from freezing or quick drying.

702.7.5.1. Placement. Earth surfaces to which concrete is to be applied shall be neatly trimmed to line and grade and shall be free of all loose material. The surface need not be compacted by slope rolling or other measure unless required by the plans or specifications.

No high subgrade shall be permitted. Excavation made below subgrade shall be backfilled with compacted fill or, at the CONTRACTOR'S option, with concrete. However, no additional compensation shall be allowed for such compacted fill nor for increased thickness of concrete placed because of low subgrade.

Asphaltic concrete surfaces shall be thoroughly cleaned of any organic material, silt and clay, or any other material detrimental to the concrete and then washed with water under pressure. Masonry, rock and concrete surfaces shall be examined and all loose material removed therefrom. The surface shall be thoroughly cleaned with steel scrapers or brushes to remove all dust, dirt, mortar, grease or other deleterious substances and then washed with water. Whenever brushing and scraping do not secure suitable results, sandblasting may be required.

All surfaces shall be wetted with water before application of concrete. Concrete shall not be applied to surfaces on which free water exists.

The velocity of the material as it leaves the nozzle shall be maintained uniformly at a rate determined for given job conditions. Material which rebounds and does not fall clear of the work, or which collects on the surfaces, shall be blown off or otherwise removed. Rebound shall not be used in any portion of the work, and no payment shall be made for rebound or other concrete losses.

The nozzle shall be held at such distance and position that the stream of flowing material shall impinge at approximately right angles to the surface being covered. Any portion of the placed concrete

which tends to sag or which shows soft or sandy pockets or is otherwise unsatisfactory shall be cut out and replaced with new concrete. Reinforcement damaged or destroyed by such repairs shall be replaced by trimming the concrete back and properly lapping and tying additional steel as may be required by the OWNER.

Reinforcement shall be firmly supported in the position shown on the plans. Mortar blocks, metal chairs, clips or spacers with wire ties or other acceptable means shall be used to anchor and place the reinforcement properly.

Where material is placed on overhead surfaces, the amount of water used shall be so adjusted that approximately $\frac{3}{4}$ -in. of the placed material shall adhere without support. The limit of thickness shall be considered to have been exceeded when the material begins to sag or slough.

702.7.5.2. Forms and Ground Wires. The forms shall be built in accordance with applicable provisions of the specifications, except all forms shall be built so as to permit the escape of air and rebound.

Ground wires shall be installed in such a manner that they accurately outline the finished surfaces as indicated on the plans. They shall be located at intervals sufficient to insure proper thickness throughout. Wire shall be stretched tight and shall not be removed prior to application of the finish coat.

Headers shall be required where the plans indicate a formed edge and at plane joints.

702.7.5.3. Joints. Construction joints shall be sloped off at an angle of approximately 45° to the surface to which the concrete is being applied. Before applying concrete in the adjacent sections, the sloped portion shall be thoroughly cleaned and wetted by means of air and water blast.

The plane joints shall be formed in accordance with and placed in the locations designated on the plans.

702.7.5.4. Finish. Upon reaching the thickness and shape outlined by forms and ground wire, the surface shall be rodded off to true lines. Any low spots or depressions shall be brought up to proper grade by placing additional concrete. Ground wires shall then be removed. Unless otherwise specified, the surface shall then be broom finished to secure a uniform surface texture. Rodding and working with a wood float shall be held to a minimum.

Rebound or accumulated loose sand shall be thoroughly cleaned up and disposed of by the CONTRACTOR. In no case shall they be floated into the surface of the work.

When a nozzle finish is specified on the plans, ground wires shall not be used, and the surface shall be left as uniform as possible without rodding. Nozzle finish shall not be permitted where the underlay has been floated.

702.7.5.5. Curing. Pneumatically placed concrete shall be cured in accordance with [Item 702.5.10.2. Curing Methods](#).

702.7.6. Measurement and Payment. Measurement for pneumatically placed concrete shall be made by the square foot in place. For encasement of structural steel members and covering portions of structures, the actual contact area shall be the basis for measurement.

Pneumatically placed concrete, measured as provided in this item, shall be paid for at the unit price bid per square-foot for “pneumatically placed concrete” of the type specified. The unit price bid per square-foot shall be full compensation for all cement, sand, water, reinforcement, furnishing and driving all steel drive pins, mixing and placing pneumatically placed concrete, and for all labor, tools, equipment and incidentals necessary to complete the work. Excavation for channel and canal lining shall be paid for in accordance with [Item 203.2. Unclassified Excavation](#). Shaping and fine grading of channel or canal slopes and floors are not to be paid for directly but shall be included in the unit price bid for “pneumatically placed concrete.” When header-banks upon which “pneumatically placed concrete” is to be placed have been built by prior contract, excavation for shaping of slopes shall be paid for in accordance with [Item 701.2. Structural Removal, Excavation, and Backfill](#).

702.8. DRILLED SHAFT FOUNDATIONS

702.8.1. Description. This item shall govern the construction of foundations consisting of reinforced concrete shafts with or without bell type concrete footings. Such foundations shall be constructed in

accordance with this item and in conformance with the details and governing dimensions shown on the plans.

702.8.2. Materials. All concrete materials and their preparations shall be in accordance with the requirements of [Item 702.2](#), Concrete Structure Materials, [Item 702.3](#), Mix Design and Mixing Concrete for Structures, and the additional requirements herein. All concrete shall be Class A or Class PA, as specified by the OWNER, unless otherwise shown on the plans.

When casing of the shaft is required, the following shall apply:

- (1) The maximum size coarse aggregate shall be 1½-in.
- (2) The elapsed time from beginning of placement of concrete in the cased portion of the shaft until extraction of the casing is begun shall not exceed 30 minutes. If a cement dispersing agent is used, this time shall not exceed one hour. If non-agitating equipment is used to haul the concrete from a central mixing plant, the elapsed time for discharge of concrete from the mixer to placement in the shaft shall not exceed 10-minutes. If a cement dispersing agent is used, this time shall not exceed 30-minutes.
- (3) When the temperature of the air or concrete is above 85°F., an approved cement reactive polymeric dispersant shall be required in all drilled shaft concrete. Reinforcing steel shall conform to the requirements of [Item 303.2.9](#), Steel Reinforcement.

702.8.3. Construction Methods.

702.8.3.1. Excavation. The CONTRACTOR shall do all excavation required for the shafts and bell footings, through whatever materials are encountered, and to the dimensions and elevations shown on the plans or required by the site conditions. Unless otherwise shown on the plans, all shafts shall be bored to plumb to a tolerance of 1-in. for depths up to and including 10-ft. For shafts over 10-ft., tolerance will be approved by OWNER. Shafts and bells shall be excavated so as to form a bearing area of the size and shape shown on the plans. Blasting methods shall not be used without prior written approval of the OWNER. If blasting methods are approved, methods shall conform to [Item 203.2.7](#), Alternate Methods of Excavation.

The plans indicate the expected depths and elevations at which satisfactory bearing material shall be encountered; this information shall be used as a basis for the contract. If satisfactory foundation materials are not encountered at plan elevations, the footings may be raised or lowered as determined by the OWNER. Alterations in plan depths shall be made as judged proper to satisfactorily comply with the design requirements.

Casings shall be required for shaft excavations when such provision is necessary to prevent caving of the material or when necessary to shut off seepage water. Casings shall be of ample strength to withstand handling stresses, along with the pressure of concrete and of the surrounding earth or backfill materials, and shall be watertight. The inside diameter of the casing shall not be less than the normal size of the shaft. No extra compensation shall be allowed for the concrete required to fill an oversize casing or oversize excavation.

When the drilling operation reaches a point where caving condition and/or excess ground water is encountered, no further drilling shall be allowed until a construction method is employed which shall prevent any caving that tends to make the excavation appreciably larger than the size of casings to be used. Construction methods that control the size of the excavation, such as drilling in a mud slurry without the removal of cuttings, shall be permitted.

If the elevation of the top of the shaft is below ground level at the time of concrete placement, an oversize casing from ground elevation to a point below the top of the shaft shall be required to control caving of any material into the freshly placed concrete.

Any excavation for the footing bells or shafts beyond the lines required shall be backfilled with Class A or Class PA concrete as specified by the OWNER at the CONTRACTOR'S expense. Where casings are used, the CONTRACTOR shall be permitted to backfill around the upper portion of the casing with pea gravel or other granular material. Where a double casing is required for a portion of the shaft, no material shall be placed between the casings but rather this area shall be filled with Class A or Class PA concrete as specified by the OWNER.

Under normal operations when the casing is to be removed, the removal shall not be started until concrete placement is completed in the shaft. Movement of the casing for short pulls of a few inches or rotating of the casing shall be permitted. When unusual conditions warrant, the casing may be pulled in partial stages. In all cases a sufficient head of concrete shall be maintained at all times above the bottom of the casing to overcome hydrostatic pressure. Extraction of the casing shall be at a slow, uniform rate and the full pull shall be in a truly vertical direction. If any upward movement of the concrete and/or inside the casing occurs at any time during the pulling operations, the following criteria shall govern:

- (1) if the upward movement is 1-in. or less, the casing shall be left in place. Vibration or rodding shall not be used to attempt to break the casing loose for extraction unless the entire shaft is to be replaced.
- (2) if the upward movement is greater than 1-in., all of the material shall be removed and the entire drilled shaft operation shall be redone.

Placing of drilled shaft concrete under water shall not be done without the permission of the OWNER.

Material excavated from shafts and bells and not used in the backfill around the completed bents or piers shall be disposed of as directed by the OWNER. The disposal of such material shall be in such manner as not to impair adjacent water bodies or otherwise impair the efficiency or appearance of the structure or other parts of the work.

At the time concrete is placed, the excavation shall be free from accumulated seepage water and all loose material shall be removed from the base area.

The CONTRACTOR shall provide suitable access and lighting for the OWNER to inspect the completed foundation excavation and check the dimensions and alignment of drilled shafts and the under-reamed excavation when under-reaming is required. Any required lighting shall be by electric lights. Any mechanical equipment used in the excavations shall be operated by air or electricity. The use of gasoline-driven engines placed in the excavation for pumping or drilling shall not be permitted.

In order that the OWNER may judge the adequacy of a proposed foundation, the CONTRACTOR, if requested, shall make soundings or take cores at its expense to determine the character of the supporting materials. The depth of such soundings or cores shall not be required to exceed 5-ft. below the proposed footing grade. It is the intent of this provision that soundings shall be made or cores taken at the time the excavation in each foundation is approximately complete.

When the plans require drilled shafts in the abutments, the embankment at the bridge ends shall be made to grade as shown and thoroughly compacted, as provided in the governing specifications, prior to drilling for abutment shafts.

702.8.3.2. Reinforcing Steel. The reinforcing steel cage for the shaft, consisting of longitudinal bars and spiral hooping or lateral ties, shall be completely assembled and placed into the shaft as a unit. Generally, the reinforcing steel unit shall not be placed until immediately before concreting operations are to be started. The longitudinal bars shall be tied to the spiral hooping at intervals not to exceed 12-in. on centers to provide a rigid unit. For cased shafts where the reinforcing steel cage is over 30-ft. in length, the longitudinal bars shall be tied at each intersection of the spiral hooping for a distance of $\frac{1}{5}$ the depth of shaft from the bottom of the cage. The cage of reinforcing steel shall be supported from the top by some positive method to prevent slumping downward during extracting of the casing.

In uncased shafts, side spacer blocks of concrete shall be used at intervals along the shaft to insure concentric spacing for the entire length of shaft. In cased shafts, concrete spacer blocks shall not be used, but instead metal "chair" type spacers shall be placed vertically at intervals around the steel cage to insure concentric spacing inside the casing.

702.8.3.3. Concrete. The work shall be performed in accordance with the provisions of [Item 702.5. Constructing Concrete Structures](#), and in conformance with the requirements herein.

Preferably concrete shall be placed immediately after all excavation is complete and reinforcing steel placed.

Concrete placing shall be continuous from the beginning of placement in the shaft or footing bell to the top of shaft or to a construction joint as may be indicated on the plans. Time intervals shall be

allowed for pulling casings, placing forms and other operations necessarily carried on in sequence with the placing operations. The reinforcing steel cage shall be held vertically in some manner to restrain the steel from slumping during the concrete placement operation. Concrete shall be placed through a suitable tube to prevent segregation of concrete materials and unnecessary splashing on the reinforcing steel cage. The tube shall be made in sections to permit the discharge and raising as the placement progresses. A non-jointed pipe may be used if sufficient openings of the proper size are provided to allow for the flow of concrete into the shaft.

Whenever a casing is used, the casing shall be smooth and well-oiled and shall extend sufficiently above the grade of the finished shaft to provide excess concrete to be placed for the anticipated slump due to the casing removal.

Where a casing is to be pulled, the concrete placed in casing shall be of such workability as to require no vibrating or rodding. Where a cap block or ground line strut is shown on the plans to be placed at the top of the drilled shaft, and the cap or strut is shown to be placed monolithic with the drilled shaft, a time interval shall be allowed for placing the required form and reinforcing after any necessary casing removal.

After a placement is completed, the top surface shall be cured and any construction joint area shall be treated as prescribed in [Item 702.5](#), Constructing Concrete Structures.

702.8.4. Test Holes. When shown on the plans, or when ordered by the OWNER in writing, test holes shall be required to establish elevation for "belling" to determine elevation of ground water or to determine other soil characteristics. The diameter and depth of test hole or holes shall be as shown on the plans or as directed by the OWNER.

702.8.5. Test Bells. When shown on the plan, or when ordered by the OWNER in writing, the under-reaming of bells on specified test holes shall be required to establish the ability to under-ream in the soil strata present. The diameter and shape of the test bell shall be as shown on the plans or as directed by the OWNER.

702.8.6. Measurement and Payment. Acceptable drilled shafts in place of the specified diameter shall be measured by the linear foot. At interior bents and piers, shafts shall be measured from 1-ft. below ground for drill shafts at stream crossings, and measured from a point of 6-in. below the ground elevation for grade crossings at the center of shaft unless otherwise indicated on the plans. At street grade separations and at railroad underpasses, the ground elevation shall be the completed roadway section under the structure. At stream crossings and at railroad overpasses, the ground elevation shall be considered as the elevation existing at the time drilling begins. At abutment bents, the length of shaft shall be measured from the bottom of cap elevation.

Footing bells, constructed to the specified dimensions or to the altered dimensions as authorized by the OWNER, shall be measured by the cubic yard of concrete in the acceptable footings placed. The bell shall consist of the authorized footing volume outside the dimensions of the drilled shaft, which for the purpose of measurement shall be considered as extending to the bottom of the bell.

Test holes of the specified diameter shall be measured from the elevation of the ground at the time drilling begins, by the linear foot of acceptable test hole drilled.

Test bells of the specified diameter and shape shall be measured by each test bell acceptably under-reamed.

Drilled shafts shall be paid for at the unit price bid per linear foot of the specified diameter of "drilled shafts," measurements being made as hereinbefore outlined. Where vertical and spiral reinforcing bars from the shaft extend into footings, caps, columns or other concrete members, the cost of such reinforcing shall be included with and paid for as part of "drilled shafts."

Payment shall include the following:

- (1) payment for individual completed shaft lengths, up to and including 5-ft. in excess of the maximum plan length shaft as defined herein, shall be made at the unit price bid per linear foot (m) of the specified diameter of "drilled shafts."

- (2) payment for that portion of individual completed shaft length in excess of 5-ft. and up to and including 15-ft. more than the maximum plan length shaft as defined herein shall be made at a unit price equal to 115-percent of the unit price bid per linear foot of the specified diameter of “drilled shafts.”
- (3) payment for individual completed shaft lengths, over 15-ft. in excess of the maximum plan length shafts as defined herein, shall be in accordance with one of the following methods as determined by the OWNER:
 - (a) Method “A.” By unit prices agreed to in writing by the OWNER before said extra work is commenced, subject to all other conditions of the contract.
 - (b) Method “B.” By lump sum price agreed to in writing by the OWNER and the CONTRACTOR before said extra work is commenced, subject to all other conditions of the contract.

Footing bells, constructed to the specified dimensions or to the altered dimensions as authorized by the OWNER, shall be paid for at the contract unit price bid per cubic yard for “bell footing.”

Test holes, of the specified diameter, shall be paid for at the contract unit price bid per linear foot for “test hole.”

Test bells, of the specified diameter, shall be paid for at the contract unit price for each “test bell.”

The foregoing unit prices shall be full compensation for making all excavations; drilling all test holes and test bells; pumping, placing and removing any required casings; furnishing and placing all concrete and reinforcing steel; all backfilling; and furnishing all tools, labor, equipment, materials and incidentals necessary to complete the work. No extra payment shall be made for casings left in place.

702.9. PRECAST AND CAST-IN-PLACE CONCRETE UNITS

702.9.1. Description. This item shall govern the materials used and for constructing, furnishing and placing precast and cast-in-place concrete units at the locations shown and in accordance with the details shown on the plans. Unless otherwise shown on the plans, the CONTRACTOR shall have the option of furnishing cast-in-place, precast (formed) or precast (machine-made) concrete units.

702.9.2. General. Cast-in-place and precast (formed) concrete units shall conform to the requirements of [Item 702.2](#), Concrete Structure Materials, [Item 702.3](#), Mix Design and Mixing Concrete for Structures, [Item 702.5](#), Constructing Concrete Structures, and ASTM Designations C857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures, and C858 Underground Precast Concrete Utility Structures, as applicable. Concrete units shall be of the various types shown on the plans and designated by letters or numbers to indicate the particular design of each. Each type shall be constructed in accordance with the details shown on the plans or approved by the OWNER, to the depth required by the profiles and schedules given.

702.9.3. Materials.

702.9.3.1. Concrete. Unless otherwise shown on the plans, concrete for cast-in-place and precast formed concrete units shall be Class A or Class PA (as specified by the OWNER) conforming to the requirements of [Item 702.3](#), Mix Design and Mixing Concrete for Structures except that Class C or Class PC concrete (as specified by the OWNER) shall be required when a unit is used with monolithic pipe sewer construction.

Concrete for precast machine-made units shall meet the requirements of ASTM C76 Sections: Reinforced Concrete, Cement, Aggregate, Mixture and Concrete Test Requirements for Concrete and shall have a minimum 28-day compressive strength of 4,000-psi. Vibrating equipment used in making concrete test cylinders must be approved by the OWNER. Testing shall be conducted in accordance with [Item 702.3.4.5](#), Tests.

702.9.3.2. Steel Reinforcement. Steel reinforcement shall conform to the requirements of [Item 303.2.9](#), Steel Reinforcement and the details shown on the plans. A positive means of holding the steel cages in place throughout production of the concrete units shall be provided and shall be subject to approval of the OWNER. Welding of steel reinforcement will not be permitted unless specifically shown on the plan details and shall conform to the requirements of [Item 703.3.7](#), Welding. The maximum variation in the position of the reinforcement shall be plus or minus 10-percent of the wall thickness or plus or minus ½-in., whichever is lesser. In no case, however, shall the cover over the reinforcement be less than shown on the plans.

702.9.4. Forms, Precast Machine-Made Concrete Units. Forms for precast machine-made concrete units shall be made of steel and shall comply with the requirements of [Item 702.5.6](#). Forms.

The thickness of form metal shall be as required to maintain the true shape without warping or bulging. All bolt heads on the facing sides shall be countersunk. 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 which line up improperly shall not be used. Metal shall be kept free from rust, grease or other foreign materials. Metal forms shall be welded except that these will not require lining unless specifically noted on the plan.

702.9.5. Casting Tolerances. Allowable casting tolerances for concrete units shall not vary more than plus or minus 1/4-in. from the dimensions and configuration shown on the plans. Thickness in excess of that required shall not be cause for rejection, provided that such excess thickness does not interfere with proper jointing or operation as determined by the OWNER.

702.9.6. Marking. The following information shall be clearly marked on each section of precast unit prior to leaving the casting yard.

- (1) The date of manufacture.
- (2) The name or trademark of the manufacturer.

702.9.7. Storage and Shipment. Precast units shall be stored on level blocking in a manner acceptable to the OWNER. No loads shall be placed on them until design strength is reached. Shipment of acceptable units may be made when the 28-day strength requirements have been met.

702.9.8. Rejection. Precast units may be rejected for nonconformity with any part of these specifications and also for any of the following reasons:

- (1) Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint.
 - (2) Surface defects indicating honeycombed or open texture.
 - (3) Damaged or misshapen ends, where such damage would prevent making a satisfactory joint.
- All rejected units shall be so marked by the OWNER and shall be replaced by the CONTRACTOR with acceptable ones meeting the requirements herein. Rejected units shall be removed immediately from the site of work.

702.9.9. Repairs. Occasional imperfections in manufacture or accidental injury during handling may be repaired and will be acceptable if, in the opinion of the OWNER, the repairs are sound, properly finished and cured, and the repaired units conform to the requirements of this specification.

702.9.10. Construction Methods. All excavation shall be in accordance with the requirements of [Item 701.2](#). Structural Removal, Excavation, and Backfill or with excavation in [Item 203](#). Site Preparation.

Precast concrete units shall be bedded on foundations of firm and stable material accurately shaped to conform to their bases.

The CONTRACTOR shall provide adequate means to lift and place the concrete units. Lifting holes may be formed during production, or punched through the fresh concrete immediately after stripping forms; however, care shall be taken not to damage the unit by spalling large areas. All lifting holes shall be repaired in accordance with [Item 702.9.9](#). Repairs.

Connections to new or existing structures shall be made in accordance with details shown on the plans. Jointing material shall be in accordance with [Item 501.6](#). Reinforced Concrete Culvert, Storm Drain, Pipe and Box Section, or as specified in the plans.

Frames, grates, rings and covers, when required by the plans for use in a concrete unit, shall be installed in accordance with [Item 806](#). Metal Materials or [Item 502](#). Appurtenances, as applicable.

702.9.11. Measurement and Payment. Precast and cast-in-place units of each size and type, satisfactorily complete in accordance with the plans and specifications, will be measured by each concrete unit completed to the stage of construction required by the plans.

Excavations and backfill, unless otherwise noted on the plans, will be measured as required by [Item 701.2](#). Structural Removal, Excavation, and Backfill with excavation in [Item 203](#). Site Preparation, or [Item 504](#). Open Cut – Backfill, as appropriate.

Payment for precast concrete units of the types shown on the plans, complete, in place, and in accordance with this specification as measured above, shall be made at the unit bid price for each type

specified. Unless otherwise provided for in the proposal, payment for work performed under this specification shall be full compensation for furnishing, transporting, and placing all concrete, steel reinforcement, brick, mortar, castings for shaping of bed, jointing to new or existing structures, and all other materials, tools, equipment, labor, and incidentals necessary to perform the work prescribed above.

Excavation and backfill, unless otherwise provided in the proposals, shall be paid for as appropriate under [Item 701.2](#). Structural Removal, Excavation, and Backfill with excavation in [Item 203](#). Site Preparation, or [Item 504](#). Open Cut – Backfill.

ITEM 801. BARRIERS, WARNINGS AND DETOUR SIGNS, AND FENCES

801.1. BARRIERS AND WARNING AND DETOUR SIGNS

801.1.1. Description. This item shall consist of the basic requirements which the CONTRACTOR must comply with in order to assure the safety of the public, the OWNER and the CONTRACTOR's employees. The type and location of signs and barriers shall be provided as required in [Item 107.19](#), Public Convenience and Safety and [Item 107.20](#), Protection Work and of Persons and Property. Additional signs and/or barriers shall be erected if so directed by the OWNER in writing.

801.1.2. General. The amount of street space taken up by construction and maintenance work should be not more than is absolutely necessary, though this does not justify any failure to use such signs, warning devices and channelization as may be required in the roadway for public protection and guidance. The CONTRACTOR shall be held responsible for all damage to the work due to failure of barricades, signs, lights and watchmen to protect it. Whenever evidence is found of such damage, the OWNER may order the damaged portion immediately removed and replaced by the CONTRACTOR at its cost and expense. The CONTRACTOR's responsibility for the maintenance of barricades, signs and lights and for providing watchmen shall not cease until the project is finally accepted by the OWNER.

801.1.3. Payment. The furnishing, placing and maintaining of barriers, warning devices, detour devices, lights, signs, or other precautionary measures required by law or by the OWNER for the protection of persons or property shall be paid for at the contract unit price for the time they are maintained by the CONTRACTOR until the project is finally accepted by the OWNER.

801.2. METAL BEAM GUARD FENCE

Metal beam guard fence shall conform to TxDOT Item 540. Metal Beam Guard Fence and current version of TxDOT CAD Standard Drawing Metal Beam Guard Fence (MBGF).

801.3. RAILING

801.3.1. Description. This item shall govern for the construction of steel, aluminum, cast iron or pipe railing, including necessary anchorages on bridges, walls or incidental structures as designated on the plans. For concrete railing, refer to TxDOT Item 450.3. Construction, Section B. Concrete Railing.

801.3.2. Materials. All materials shall conform to the requirements of [Item 806](#), Metal Materials.

Railing materials shall be stored above the ground on platforms, skids or other supports. The materials shall be kept free from grease, dirt and contact with dissimilar metals. Care shall be taken at all times to avoid scratching, marring, denting, discoloring or otherwise damaging the railing. Unpacking and storing of rail members, upon arrival at the job site, shall be in accordance with manufacturer's recommendations.

801.3.3. Construction Methods. Railing shall be of size and type shown on the plans and constructed in accordance with details shown on the plans and in conformance with the requirements herein. It shall be constructed to the alignment, grade and camber as designated on the plans. Shop fabricated railing shall be of such uniformity as to insure good joints and continuous lines after erection. Any appreciable amount of cutting, bending or filling required on erection to produce a reasonable fit shall be cause for rejection of the rail. Unless otherwise shown on the plans, rail posts shall be erected plumb, with the top rails parallel to the roadway grade indicated on the plans or to the surface of the structure on which the rail is mounted. The fabrication and erection of metal for railing shall conform to the pertinent provisions of [Item 703.3](#), Steel Structure Construction, and to the requirements of this specification.

Shop drawings shall be prepared and forwarded for approval in accordance with the requirements of [Item 703.3](#), Steel Structure Construction. Splicing of members shall be permitted only as provided by the contract plans.

Splices shall be at rail posts only. All splice locations and details shall be shown on the shop drawings.

The vertical members of the railing may be placed in the correct position and alignment at the time of placing the concrete, or oversize sleeves may be embedded in the proper location and position for subsequent installation of the railing in the sleeves. If sleeves are used, the railing shall be placed in the sleeves and set with molten sulfur compound.

Unless otherwise indicated, aluminum members shall be separated from concrete or steel by a bearing pad conforming to the requirements for preformed rubber fabric pads as described in [Item 703.3](#), Steel Structure Construction. The material shall be 1/8-in. in thickness, unless otherwise specified. All welding shall conform with the recommendations of the American Welding Society. Welding of aluminum material shall be done by an inert gas shielded electric arc welding process in which no flux is used. Torch or flame cutting of aluminum shall not be permitted.

After erection, the railing shall be painted with one prime coat of the type of paint specified on the plans and two field coats of aluminum paint conforming to the requirements of [Item 804.2](#), Painting and Marking. Aluminum railings shall not require field painting. Prior to acceptance, all extrusion marks, grease, dirt and grime shall be cleaned from aluminum railing.

Steel railing shall be given a top coat of the type of paint specified on the plans. This coating shall be of sufficient quality and coverage to protect the metal from corrosion. After erection, the railing shall be cleaned, spot painted and painted in accordance with [Item 804.2](#), Painting and Marking.

If galvanized rail is used, all parts of the rail on which the galvanizing has become scratched, chipped or otherwise damaged shall be thoroughly cleaned painted according to the requirements of [Item 804.3.5](#), Repair of Damaged Zinc Coating. No compensation shall be made for repairing damaged coatings.

Unless otherwise provided, railing shall not be placed until after the false-work for the span has been released. During the construction of railing, care shall be exercised to insure proper functioning of expansion joints, if any.

801.3.4. Measurement and Payment. Railing shall be measured as the number of linear feet of satisfactorily completed railing. Payment shall be made at the contract price bid per linear foot for "railing," which price shall be full compensation for all pipe structural shapes, paint, labor, tools and equipment, and all incidentals necessary for completing the railing in conformity with the plans and these specifications.

801.4. CHAIN LINK FENCE

801.4.1. Description. This item shall consist of one line of chain link fabric supported on posts and constructed as prescribed by this specification at such places as shown on the plans or as designated by the OWNER. The fence overall height and the fabric height shall be as shown on the plans.

801.4.2. Materials. This item covers materials used to construct chain link fencing in accordance with the plans and any typical details which may be shown on the plans. All fence materials furnished shall be in accordance with these specifications, unless otherwise shown on the plans. Failure to meet any of the specifications contained in this section or on the plans shall be cause for rejection and materials shall be replaced at no cost to the OWNER.

801.4.2.1. Chain Link Fencing Fabric. The base metal of the fabric shall be a good commercial quality of steel wire. The wire shall be woven throughout in the form of approximately uniform square mesh, having parallel sides and horizontal and vertical diagonals of approximately uniform dimensions. The top and bottom of the fabric shall be knuckled or barbed as specified. The sizes of wire and mesh shall be as specified. The entire fabric shall be one of the following types:

- (1) zinc coated in accordance with ASTM A392 Zinc-Coated Steel Chain-Link Fence Fabric and [Item 804.3](#), Galvanizing;
- (2) aluminum coated in accordance with ASTM A491 Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric; or
- (3) PVC vinyl coated in accordance with ASTM F668 Standard Specification for Poly (Vinyl Chloride) (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric and colored in accordance with ASTM F934 Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.

801.4.2.2. Posts. Posts may be rolled, formed or tubular in cross section and shall be in accordance with ASTM F1043 Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework. All posts shall meet the weight and length requirements as shown on the plans.

801.4.2.3. Rails, Gates, Braces and Fittings. Rails, gates and braces may be rolled, formed or tubular in cross section and shall be in accordance with ASTM F1083 Standard Specification for Pipe, Steel,

Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures. Colored rails, gates, and braces shall be in accordance with ASTM F1043 Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework. Fittings and appurtenances shall be in accordance with ASTM F626 Standard Specification for Fence Fittings.

801.4.2.4. Concrete. Concrete footings shall be Class B or Class PB, as specified by the OWNER, in accordance with [Item 702](#), Concrete Structures.

801.4.3. Construction Methods.

801.4.3.1. General. The chain link fence shall be constructed in accordance with the details on the plans and ASTM F567 Standard Practice for Installation of Chain-Link Fence, and as specified herein, with new materials unless specified otherwise. Chain Link Fence for Tennis Courts shall be constructed in accordance with ASTM F969 Standard Practice for Construction of Chain-Link Tennis Court Fence. Chain link fence for ballfields and other sports facilities shall be constructed in accordance with ASTM F2000 Standard Guide for Fences for Ballfields and Other Sports Facilities. All work shall be performed in a workmanlike manner satisfactory to the OWNER. Prior to the beginning of the work, the CONTRACTOR shall locate the position of the work by establishing and marking the line and grade for the fences according to the plans.

801.4.3.2. Clearing Fence Line. The site of the fence shall be sufficiently cleared of obstructions, and surface irregularities shall be graded so that the fence shall conform to the general contour of the ground. The fence line shall be cleared to a minimum width of 2-ft on each side of the centerline of the fence. This cleaning shall consist of the removal of all stumps, brush, rocks, trees or other obstructions which shall interfere with proper construction of the fence. Stumps within the cleared area of the fence line shall be grubbed or excavated.

The bottom of the fence shall be placed a uniform distance above the ground and as specified on the plans. When shown on the plans, or as directed by the OWNER, the existing fences which coincide with or are in a position to interfere with the new fence location shall be removed by the CONTRACTOR as a part of the construction work, unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel or other material acceptable to the OWNER and shall be compacted properly with tampers. The work shall include the handling and disposal of all material cleared, excavated or removed, regardless of the type, character, composition or condition of such material encountered.

801.4.3.3. Installing Posts. All posts shall be spaced not more than 10-ft. apart and as shown on the plans. Terminal (end, corner, and pull) posts, gate posts and line posts shall be set in concrete footings of the diameter and depth as shown on the plans. The concrete footings for the posts shall be of sufficient depth to provide a minimum of 2-in. of concrete below the bottom of the posts. The top of the concrete footings shall be slightly above the ground and sloped to drain away from the posts. Holes of full depth and size for the concrete footings for posts shall be dug to the size and depth as shown on the plans. All post settings shall be made carefully so that all posts shall be vertical, in true alignment, centered in the footing, and rigidly secured in position. On terminal (end, corner, and pull) posts and gate posts, the post tops and brace rail clamps around the posts shall be placed before setting the posts in the concrete footings or at such a time that heavy clamps can be installed without spreading them to accommodate the post.

In setting the gate posts, great care must be taken to make sure that gate posts are set apart by the distance shown on the plans. A line drawn across from the top of one gate post to the other must be level regardless of the grade of the groundline. If the ground is not level, the upgrade posts shall be set first to get the proper height for the downgrade gate post. The concrete for post setting shall be allowed to cure for 3-days. Stretcher bar bands and truss bands shall be spread and slipped on end, corner, pull, brace and gate posts as the next operation. Post tops are then inserted on all other posts. Pull posts shall be placed not over 500 ft. apart in straight runs and at each vertical angle point, all as directed by the OWNER. Corner posts shall be placed at each horizontal angle point. Corner and pull posts shall have horizontal braces and truss rods as shown on the plans or as specified. Posts to be

placed in concrete structures shall be placed in previously embedded oversize pipe sleeves and then packed with sulfur compound.

801.4.3.4. Installing Fabric. The fabric shall be placed on the outward facing side of the posts and shall be installed so that the top edge projects over the top rail of the fence. The fabric shall be stretched taut and securely fastened to the post, the top rail and the bottom tension wire. The tension wire shall be installed parallel to the line of the fabric. The bottom of the fabric shall extend to within 2-in. of the natural ground or paved surface. However, over irregular ground, this distance may vary between 1-in. and 6-in. for a distance not to exceed 8-ft. High points of ground shall be excavated to clear the bottom of the fabric; depressions shall be filled and compacted to within 2-in. of the bottom fabric; both shall be considered as incidental work. In locations where chain link fence is installed as a guard or barrier in or on concrete structures such as retaining walls and headwalls, the fabric shall extend to within 6-in. above the concrete surface for structures.

The fabric shall be fastened to end, corner, slope and gate posts with high carbon steel tension bars and steel tension bar bands spaced at 16-in. intervals; and to line posts, top rail and tension wire with tie wires or metal bands. Tie wires or metal bands shall be placed on line posts at intervals of approximately 16-in. and top rail and tension wire at intervals of approximately 24-in.

801.4.3.5. Installing Gates. The widths of any gates to be installed shall be indicated on the plans or in the special provisions.

Gates with fabric 7-ft or more in height shall have a horizontal stiffener. Vertical stiffeners shall be installed at a maximum of 8-ft. centers. A $\frac{3}{8}$ -in. adjustable tension rod shall be installed on all gates over 4-ft. in width. The corners of gate frames shall be fastened together and reinforced with a fitting designed for the purpose or by welding. All welds shall be ground smooth.

Chain link fence fabric shall be attached to the gate frame by the use of tension bars and tie wires as specified and by suitable tension connectors spaced at approximately 16-in. intervals. The swing gates shall be hung up by at least two (2) steel or malleable iron hinges, so designed as to securely clamp to the gate post and permit the gate to be swung back 180° from the closed position. Gates shall be provided with a combination steel or malleable iron catch and locking attachment of approved design. Stops to hold gates open and a center rest with catch shall be provide where required.

801.4.3.6. Existing Fence Connections. Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, a corner post with a brace post shall be set at the junction and braced the same as for corner posts. If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.

801.4.3.7. Repair of Damaged Coating. On all galvanized parts where zinc coating has been omitted, chipped off or removed, the steel or iron left exposed shall be repaired. Damaged zinc coating shall be repaired by cleaning and coating according to the requirements of [Item 804.3.5](#). Repair of Damaged Zinc Coating. No compensation shall be made for repairing damaged coatings.

801.4.4. Measurement and Payment. Chain link fence shall be measured in place from center to center of end posts or corner post and shall be the length of fence actually constructed, except the space occupied by the gates. Gates shall be measured in units for each gate installed and accepted.

Payment shall be made at the contract price per linear foot for chain or guard-link fences. This price shall be full compensation for furnishing all material; for all preparation, erection and installation of these materials; and for all labor, equipment, tools and incidentals necessary to complete the work.

Payment shall be made at the contract unit price per each for gates. This price shall be full compensation for furnishing all materials; for all preparation, erection and installation of these materials; and for all labor, equipment, tools and incidentals necessary to complete the work.

Gates measured as provided in this item shall be paid for at the unit price bid for "gate" of the type, height and opening shown on the plans, which price shall be full compensation for furnishing all materials; fabricating; all preparation, hauling, and erection; and for all labor tools, equipment and incidentals necessary for a complete in- place gate installation.

801.5. WIRE FENCE

801.5.1. Description. “Wire fence” shall consist of constructing fence supported on metal or wood posts in accordance with the details and at the locations shown on the plans. The fence shall consist of woven wire fence fabric with or without barbs as specified on the plans.

801.5.2. Materials. This item covers materials used to construct wire fencing in accordance with the plans and any typical details which may be shown on the plans. All materials furnished shall be in accordance with these specifications unless otherwise shown on the plans. Failure to meet all of the specifications contained in this section shall be cause for rejection and materials shall be replaced at no cost to the OWNER.

801.5.2.1. Wire Fencing Fabric. The base metal of the fabric shall be of a good commercial quality of steel or iron as specified. The wire shall be the height and design shown on the plans. The top and bottom wires shall be a minimum No. 10 AWS gauge, and the intermediate wires and vertical stays shall be No. 12½ AWS gauge. The entire fabric shall be zinc coated in accordance with ASTM A116 Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric and [Item 804.3](#). Galvanizing.

801.5.2.2. Posts.

801.5.2.2.1. Metal. Metal posts may be rolled, formed or tubular in cross section and shall be in accordance with ASTM A702 Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought. All posts shall meet the weight and length requirements as shown on the plans. All posts not galvanized shall be painted with an anti-corrosive paint approved by the OWNER.

801.5.2.2.2. Wood. Wood posts shall be the length and dimensions shown on the plans. The timbers shall be sound and free from all decay, shakes, splits, unsound or excessive knots or any other defects that might impair their strength or durability. Knots shall not exceed one-third of the small dimension or diameter of the post. A line drawn between the center of each end shall not fall outside the center of the post at any point more than by 2-in. Knots shall be trimmed flush and the ends cut square. Untreated posts may be cedar, redwood, cypress or live oak. Treated posts may be pine, spruce or fir. Posts shall be preservative treated according to American Wood-Preservers' Association (AWPA) Standards.

801.5.2.3. Rails, Gates, Braces and Fittings. Rails, gates, and braces may be rolled, formed or tubular in cross section and shall be in accordance with ASTM F669 Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence. Fittings and appurtenances shall be in accordance with ASTM F626 Fence Fittings. All rails, braces and fittings not galvanized shall be painted with an anti-corrosive paint approved by the OWNER.

801.5.2.4. Barbed Wire. Barbed wire shall be two strand twisted No. 12½ AWS gauge galvanized steel wire with two-point barbs of No. 14 AWS gauge galvanized steel wire and conforming to Class 1 ASTM A121 Metallic Coated Steel Barbed Wire.

801.5.3. Construction Methods. Fence posts shall be spaced at intervals as shown on the plans and set to a minimum depth of 2-ft for wood posts and 2½-ft. for metal posts. Posts shall be set in a vertical position. Corner and pull posts shall be braced in two (2) directions. End and gate posts shall be braced in one (1) direction. Where alignment changes 30° or more, a corner post shall be installed. At alignment angles varying from 15° to less than 30°, the angle post shall be braced to adjacent line posts by diagonal tension wires. Where steel posts are specified, a pull post assembly shall be installed at approximately 500-ft. intervals; where wooden posts are specified, the spacing of pull-post assemblies shall be approximately 1,000-ft. Metal line posts may be driven in place, provided such driving does not damage the posts. Metal corner, end, pull post and braces shall be set in portland cement concrete footings crowned at the top to shed water. All posts shall be placed the minimum depth below ground. Posts shall be set plumb and firm to the line shown on the plans. Backfill shall be thoroughly tamped in 4-in. layers. The timber post braces shall be notched.

The corner, end angle post assembly shall be installed before stretching the wire between the posts. At all grade depressions where stress tends to pull the posts out of the ground, the fencing shall be snubbed or guyed at the critical point by means of a double No. 9-gauge galvanized wire connected to each horizontal line of barbed wire or to the top and bottom wire or wire mesh fabric and to a deadman weighing not less

than 100-lb., buried in the ground. The fencing shall be stretched before being snubbed and guyed. Existing cross fences shall be connected to the new fences and corner posts with braces which shall be placed at junctions with existing fences. The barbed wire and wire fabric shall be drawn taut and fastened to posts with galvanized ties or staples.

801.5.4. Measurement and Payment. Fencing shall be measured by the linear foot of wire fence, measured at the bottom of the fabric along the centerline of the fence from center to center of end posts, excluding gates. Gates shall be measured per each gate, complete in place.

The work performed and material furnished as prescribed by this item, measured as provided in this item, shall be paid for at the unit price bid for "wire fence," which price shall each be full compensation for furnishing and installing all fencing materials (except gates); for all preparation, hauling and installing of same; and for all labor, tools, equipment and incidentals necessary to complete the work, including excavation, backfilling and disposal of surplus material.

Gates measured as provided in this item shall be paid for at the unit price bid for "gate" of the type, height and opening shown on the plans, which price shall be full compensation for furnishing all materials; fabricating; all preparation, hauling and erection; and for all labor, tools, equipment and incidentals necessary for a complete in place gate installation.

ITEM 804. PAINTING AND OTHER PROTECTIVE TREATMENTS; PAVEMENT MARKING**804.1. DESCRIPTION**

This item shall govern for the type, quality and application of paint or appropriate coatings or treatments to structures, materials, and pavement surfaces. Such applications include liquid coatings and galvanizing. Items to receive applications may include, but are not limited to, concrete structures, bridges, aerial crossing steel carrier pipes, fences, barriers, concrete pavement, and asphalt pavement. Water tanks and towers are exceptions to these specifications; material specifications and instructions for preparation, cleaning, coating/painting water tanks and towers shall be specified by the OWNER. Painting, coating and other protective treatments shall include, unless otherwise provided in the contract, the preparation and testing of the surfaces; the application, protection and drying of the paint, coating(s) or treatments; the protection of all traffic upon, underneath, or near the structure, material or pavement; the protection of all parts of the structure, material or pavement against disfigurement by any and all painting operations; and the supplying of all tools, tackle, scaffolding, labor, workmanship, paint, coating and/or other materials necessary for the completion of the entire work in accordance with the plans and these specifications.

The intent of the design herein specified is to procure the paints, coatings or treatments in and on structures, materials and surfaces so that the durability and protective value of these designs shall be realized in service. Accordingly, the best quality materials and workmanship are implied throughout. Surface conditions and application requirements are specified with the intent to obtain full adhesion of paint, coatings or treatments to clean, dry, firm surfaces. This shall require careful attention to preparation of surface, to the prevention of contamination and marring of the coating during and after drying, and to uniform, skilled application.

804.2. PAINTING AND MARKING

804.2.1. Safety. Some paints are harmful to the health. All paints shall be handled according to the information contained on the paint safety data sheet. The CONTRACTOR shall be responsible for safety during all cleaning and painting operations.

Unless shown otherwise on the plans, the CONTRACTOR shall be responsible for necessary precautions to contain refuse, dust and paint overspray generated during cleaning and painting operations. Containment shall be such that all falling material is contained and collected for disposal. Noncontainment of airborne particles is permissible provided they are not visible over 100-feet from the actual cleaning or painting operation. A skimmer shall be used when cleaning and painting is over bodies of water. Disposal of collected refuse shall be in accordance with Federal, State and Local rules and regulations.

If spray application is used, workers shall be adequately protected with respirators, and provisions shall be made to prevent infliction of harm upon all other humans and/or animals that might be exposed to the fumes or might eat food upon which the fumes have deposited. This warning shall absolve the OWNER from blame in the event of harm to persons or property from the named cause, and full responsibility for any such harm shall rest upon the CONTRACTOR.

804.2.2. Paint and Marking Materials. All materials used in the painting and marking herein specified shall conform to the material and composition requirements of the applicable TxDOT Material Specification:

- DMS-8100 Structural Paints - Formula
- DMS-8101 Structural Steel Paints- Performance
- DMS-8200 Traffic Paint
- DMS-8220 Hot Applied Thermoplastic
- DMS-8240, Permanent Prefabricated Pavement Markings
- DMS-8241, Temporary Removable, Prefabricated Pavement Markings
- DMS-8242, Temporary Flexible, Reflective Roadway Marker Tabs
- DMS-8290, Glass Traffic Beads,

including any official TxDOT amendment or modification of these specifications, where reference to TxDOT or its representatives shall mean the OWNER. The CONTRACTOR shall certify to the OWNER that paint or coatings provided meet TxDOT material requirements.

804.2.2.1. Testing. All paint and paint materials shall be sampled and tested prior to use. All tests shall be conducted in accordance with the methods specified by ASTM or methods set forth in Federal

Standard FED-STD-141C/GEN Paint, Varnish, Lacquer, and Related Materials: Methods of Inspection, Sampling, and Testing. In the absence of any such methods, other suitable methods may be designated and utilized by the OWNER.

804.2.2.2. Rejection. Raw materials and finished products that fail to meet any requirements of these specifications shall be subject to rejection. Final acceptance or rejection shall be based on results of tests on samples of raw materials and finishes as soon as practicable after their arrival at the shipping destination. Approval of materials, as a result of preliminary testing prior to manufacture into finished coatings, shall not be binding upon final approval or rejection. The judgment of the OWNER shall be final in all questions relative to conformance with the provisions of these specifications.

804.2.3. Preparing Structures for Paint.

804.2.3.1. Descaling, Cleaning and Preparation of Surface. Throughout paint application, including shop and field painting, no paint shall be applied over a surface that evidences a loose or scaly condition. Every effort shall be made by means of the most effective and practical methods to remove all loose mill scale, rust, dirt, oil and grease, as well as all other foreign surfaces which would be deleterious to the procurement of the firm paint coating. The original cleaning and preparation of the surface necessarily must be done at the fabricating plant before application of the shop coat, but the same general requirements for painting over a clean, firm surface shall be applicable to all coats.

The OWNER shall look for evidence of faulty surface preparation preceding the shop coat by close inspection of the surface directly prior to application of first field coat, likewise, between first and second field coats. This careful inspection directly in advance of paint application may disclose not only loose, scaly conditions on the surface as a result of faulty preparation but also failure of the paint to harden because of contamination and changes which might have taken place beneath the paint film as a result of rusting and loosening of mill scale after paint has been applied.

The OWNER will test and make determination of the presence of lead or asbestos in the coatings of existing structures. These findings will be addressed via specifications set by the OWNER. Refer to [Item 603](#). Abatement of Coatings Containing Certain Heavy Metals for additional information for information regarding heavy metals.

Therefore, whenever the OWNER has the slightest doubt as to the firm condition of the surface at any time throughout the application of any coats, OWNER shall be expected to explore underneath the surface of any paint coats already applied so as to uncover evidence of infirmity and to direct remedial measures. Any effective methods for removal of rust, scale and dirt, such as through the use of sandblast, hand or rotating metal brushes, scrapers, chisels, hammers or other effective means, shall be acceptable. Undesirable contaminants, which are not allowed to be present on the surface directly prior to paint application and which shall prevent proper hardening and adhesion of the paint film, are grease, oil, oily grime and moisture. Condensed moisture shall be avoided, and other grease-like contaminants shall be removed with solvents, applied with clean rags in such a manner that the oily substance is actually removed and not simply diluted or spread out over a greater area. Particular attention shall be given to the cleaning of fillets, riveted areas, rivet-heads, bolt heads, nuts, washers, drilled or punched holes and welds where loose mill scale, rust, oil and flux are likely to be present.

Unless cleaning is to be done by sandblasting, all weld areas shall be flushed thoroughly with clean water before painting so as to remove any alkaline residue. The flushed surface shall be allowed to thoroughly dry before paint application.

804.2.3.2. Weather Conditions and Dryness of Surface. Paint shall not be applied to any surface where moisture is present and discernible to the eye. Paint shall not be applied at air temperatures below 40°F nor when there is a likelihood of change in weather conditions within 2-hrs after application which would result in air temperatures below 40°F or depositing of moisture in the form of rain. Paint shall not be applied when, in the OWNER'S opinion, impending weather conditions might result in injury to the fresh paint. Weather condition requirements may be waived if the OWNER approves dehumidification or other climate control methods to successfully control the painting environment so as to ensure an equal or improved product.

804.2.3.3. Protecting Surrounding Features. The CONTRACTOR shall protect pedestrian, vehicular and other traffic in the vicinity, and also all portions of the structures not intended to receive paint, against damage or disfigurement by spatters or splashes of paint or paint materials.

804.2.4. Paint Handling and Application.

804.2.4.1. Stirring, Mixing and Care of Paints. All mixed paints shall be made ready for use through reincorporating settled pigment by means of thorough stirring, boxing and straining so that the paint is in its original homogeneous form, free from large agglomerates and skins greater than 9.8-mil in diameter. Paint in mixing pots shall be kept tightly covered when not in use so as to reduce volatile losses and skinning. Paint always shall be in a complete mixed condition when filled into painter's pots, and this filling always shall be through a strainer of 20 mesh cloth or wire or finer. Paint from the painter's pots shall be concentrated into tightly covered mixing pots at the end of the day and shall at no time during application contain skins or large agglomerates, and the interior sides of pots shall be periodically cleaned free of soft skins which might cling to brushes.

804.2.4.2. Thinning. At temperatures above 70°F, all of the paints herein specified for use, when freshly opened from sealed containers and thoroughly stirred, are of normal consistency suitable for good brush application without thinning. At temperatures below 70°F, the consistency may be heavy enough to require some thinning for proper brush application. Adjustments of paint consistency shall be accomplished by heating in hot water or on steam radiators. Adjustments of paint consistency by thinning so as to meet any and all conditions shall be done only at the discretion of the OWNER and with the OWNER's specific permission. The general rule which shall be applied for thinning paints shall be that the full hiding coat can be applied so as to thoroughly obscure the surface being painted, whether bare metal or undercoat, without sags and runs. Proper use of paints should remove the necessity for thinning because of evaporated volatiles as a result of allowing the paints to stand in uncovered containers.

804.2.4.3. Brush Application. Painting shall be done by workers skilled in the craft of structural metal painting. Good workmanship by skilled workers is evidenced by the following outstanding features: all crevices, sharp angles, etc., are first traced; the entire surface is then coated without attempt to "layoff" the paint in one direction; lastly, runs from crevices are picked up and the paint is laid off in one direction so as to leave a uniform film free from runs, sags or brush marks caused by not "feathering" or blending one lap into another. Brushes preferably shall be round or oval in shape, but if flat brushes are used, they shall not exceed 4-in in width; brushes should be springy and not flabby. Brushes shall not be permitted to become seedy from skins.

804.2.4.4. Spray Application. The equipment used for spray painting shall meet the approval of the OWNER and shall have adequate provisions for separation of moisture from the air stream in contact with the paint. Before thinning for spray application is permitted by the OWNER, at least 50-psi air pressure shall be present at the gun, the gun is not clogged with dried or semi-dried paint, and the spray gun is adequate for the work and has a proper spray head for application of paints used. A spray gun correctly held is approximately 8-in from and always perpendicular to the surface being painted. The painter shall steadily move the gun through a deliberate pattern that permits overlapping of the previous pass by 50-percent and at a speed that shall produce a full uniform coat. Over spray shall be held at a minimum.

804.2.5. Painting New Structures.

804.2.5.1. Number of Coats and Color. Except for surfaces specified herein or otherwise provided for on the plans, all structural steel shall be painted with one (1) shop coat of primer, one (1) field coat primer and two (2) field coats of paint as specified on plans. The paint shall be omitted from the surface of structural steel which shall be in contact with concrete in the finished structure. At the time concrete is placed, such surfaces of structural steel shall be free from dirt, scale, rust, paint, oil or other foreign material.

804.2.5.2. Shop Coat. It shall be mandatory to apply the shop coat by brushing or rolling, unless the surfaces to be painted are cleaned by sandblasting, in which case spray application of the shop coat shall be permitted. When all fabrication work is completed and has been tentatively accepted as such,

all surfaces not painted before assembling shall be cleaned as provided in [Item 804.2.3.1](#). Descaling, Cleaning and Preparation of Surface and painted with one coat of primer. Pieces shall not be loaded for shipment until thoroughly dry. No painting shall be done after loading material on cars. Erection marks for the field identification of members shall be painted on previously painted surfaces. The top of the top flange of stringers shall not be painted. Machine finished surfaces shall be coated as soon as practicable after being accepted.

Surfaces of iron and steel castings milled for the purpose of removing scale, scabs, fins, blisters or other surface deformations shall generally be given the shop coat of paint.

All metal surfaces which shall be within 2-in of field welds shall be coated with linseed oil in advance of the application of shop coat paint and left bare of paint until field welding has been completed. The shop coat shall be applied as uniformly as possible by brushing with the intent of securing an average wet film thickness of 3.5-mils or 468-sq.ft.-of-surface-per-gallon of paint. The corresponding dry film thickness shall be 2.1-mils.

Portions of structures entailing difficult application of the field coats after erection may be completely painted before assembling or erection at the discretion of the OWNER.

804.2.5.3. Field Cleaning and Spot Painting. When the erection work is complete, including straightening of bent metal, etc., the shop-coated surface shall be restored to a serviceable condition acceptable to the OWNER by means of preparation of surface as outlined in [Item 804.2.3.1](#). Descaling, Cleaning and Preparation of Surface and smoothing and touching up marred places in the shop coat film with primer. Field welds, heads of field rivets and bolts and any other surfaces to be painted which have not yet been shop coated shall be painted with primer.

The coating of linseed oil specified in [Item 804.2.5.2](#). Shop Coat shall be thoroughly removed, as directed for removal of grease and oil in [Item 804.2.3.1](#). Descaling, Cleaning and Preparation of Surface, immediately prior to erection.

804.2.5.4. First Field Coat. When field cleaning and restoration of shop coat has been completed and all shop coat is thoroughly dry, the first field coat of primer may be applied. Finished surfaces intended for sliding contact shall be given a coat of approved graphite grease immediately prior to being placed in the structure. Graphite grease shall be composed of dry graphite flakes mixed with sufficient light grease or heavy oil so as to form a thick paste suitable for the purpose. Field coats shall not be required on the bottom surface of shoe castings or bearing plates in direct contact with concrete nor on the top surfaces of beams, girders, etc. on which a concrete slab is to be placed in direct contact. The first field coat shall be applied as uniformly as possible, either by spraying, rolling, brushing, or a combination of these with the intent of securing an average wet film thickness of 3.5-mils.

804.2.5.5. Finish Coats. When the first field coat, including all touched-up marred places, has thoroughly hardened, the finishing field coats of finish paint may be applied. Cracks and cavities which have not been sealed in a watertight manner by the first field coat shall be suitably corrected. This correction shall be allowed to sufficiently surface dry before the second field coat is applied so as not to work up into finish paint. After application of the finishing field coat, the painted portion of the structure shall present a uniform color and appearance throughout.

The finish paint coat shall be applied as uniformly as possible by spraying, rolling, or brushing, with the intent of securing an average dry film thickness of 1.5-mils for each coat of paint applied.

804.2.6. Cleaning and Painting Existing Structures. All structures to be painted shall be cleaned thoroughly in accordance with [Item 804.2.3.1](#). Descaling, Cleaning and Preparation of Surface to prepare the surfaces to receive new paint. Rust spots shall be cleaned to bare metal. Structures shall be spot painted with primer in accordance with [Item 804.2.5.3](#). Field Cleaning and Spot Painting prior to application of paint to the entire surface unless otherwise specified. After the cleaning and spot-paint have dried thoroughly, the application of two (2) field coats of paint shall be applied. The application of paints shall conform to the pertinent articles of this specification.

804.2.7. Removal of Paint Improperly Applied. All paint which has been improperly applied and fails to dry and harden properly, or to adhere tightly to underlying metal or other paint film, or does not evidence a normal, workmanlike appearance in conformance with the intent of these specifications, shall be remedied or

thoroughly removed and replaced at the expense of the CONTRACTOR. When the final field coat does not have a uniform color and appearance throughout the structure, it shall be corrected by the use of whatever additional coats are necessary. Removal of freshly applied paint which has not yet set shall be effected with the use of appropriate solvents. Removal of dried paint films shall be effected either by means of sandblasting or scraping, meeting the approval of the OWNER.

804.2.8. Cleaning and Marking Pavements. When the CONTRACTOR is responsible for marking pavements, as identified in the plans, cleaning and marking shall conform to these specifications and the Texas Manual on Uniform Traffic Control Devices.

Markings shall be applied only when the pavement surface is dry and clean, which may be accomplished with machinery specialized to prepare pavement in front of the marking operation. The CONTRACTOR shall be comply with all environmental condition restrictions recommended by the manufacturer of pavement paints or other markings. Glass beads or other refractive material and application rates shall be as identified on the plans.

Temporary markings shall be thoroughly removed to the satisfaction of the OWNER using an approved method prior to the application of permanent markings.

804.3. GALVANIZING

804.3.1. General. Zinc used for galvanizing shall be grade Prime Western conforming to ASTM B6 Zinc (Slab Zinc). Except as otherwise specified, materials shall be galvanized by the hot-dip or electro-depositing process.

804.3.2. Coating Requirements. The minimum weight of coating and other requirements shall be as shown in Table 804.3.2.(a) Galvanizing Minimum Weight. The weight shown is ounces per square foot of the surface area. All surfaces, when tested separately, shall meet the minimum requirement.

804.3.3. Workmanship. The zinc coating shall adhere tenaciously to the surface of the base metal. The finished product shall be free from blisters and excess zinc, and the coating shall be even, smooth and uniform throughout. Machine work, die work, cutting, punching, bending, welding, drilling, thread cutting, straightening and other fabricating shall be done as far as is practicable before the galvanizing. All members, nuts, bolts, washers, etc. shall be galvanized before a structural unit is assembled. All uncoated spots or damaged coatings shall be cause for rejection.

Products that are warped or distorted to the extent of impairment for the use intended shall be rejected.

804.3.4. Testing. Test coupons for determining the quantity and quality of galvanizing shall be of such size and shall be wired to the materials to be galvanized before immersion so as to represent the amount of coating deposited on the finished product.

The weight of coating shall be determined in accordance with ASTM A90 Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings, modified to determine the coating of each surface separately.

Nondestructive tests for uniformity of coating may be made by the OWNER with a magnetic instrument in accordance with ASTM E376 Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods.

Table 804.3.2.(a) Galvanizing Minimum Weight

Material	ASTM Designation	Min. Weight of Coating oz./sq.ft.
Steel product including structural shapes, tie rods, handrails, and miscellaneous items	A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products	2.00
Hardware including casting, rolled, pressed, and forged articles	A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware	2.00
Bolts, screws, nuts, and washers	A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware	1.25
Chain link fence fabric (galvanized after fabrication)	A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric	1.20
Chain link fence fittings & accessories	F626 Standard Specification for Fence Fittings	1.20
Chain link fence post, gates, rails, and braces	F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures	1.80
CMP culverts and underdrains	A929 Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe	1.00
Steel pipe	A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless	1.80
Iron or steel wire fencing	A116, Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric	0.80
Steel or iron sheets	A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process	0.63
Barbed wire	A121 Standard Specification for Metallic-Coated Carbon Steel Barbed Wire	0.80
Electroliter standards, 7-gauge steel and over	A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products	2.00
Electroliter standards, under 7-gauge steel	A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products	1.50

804.3.5. Repair of Damaged Zinc Coating. Zinc coating, which has been field or shop cut, burned by welding, abraded, or otherwise damaged to such extent as to expose the base metal, shall be repaired and recoated by one of the following methods:

804.3.5.1. Hot-Dip Process. The damaged areas shall be thoroughly stripped and cleaned, and a coating of zinc shall then be applied by the hot-dip process.

804.3.5.2. Metalizing Process. The damaged area shall be thoroughly cleaned by blasting with sharp sand or steel grit. The blasted area shall lap the undamaged zinc coating at least ½-in.

Zinc wire containing not less than 99.98-percent zinc shall be used in the metalizing operation. A zinc coating shall be applied to the damaged area with a metalizing gun to a thickness of not less than 0.005-in. on the damaged area and shall taper to zero thickness at the edge of the blasted undamaged section.

804.3.5.3. Zinc Rich Paint. The damaged area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint. The coating thickness shall be 50-percent

greater than the surrounding coating thickness, but not more than 4.0-mils. Zinc-rich paints shall be based on organic binders, premixed and formulated specifically for use on steel surfaces and shall provide a dried film containing a minimum of 92-percent zinc dust, by weight.

804.3.6. Rejection. Raw materials and finished products that fail to meet any requirements of these specifications shall be subject to rejection. Final acceptance or rejection shall be based on results of tests on samples of raw materials and finishes as soon as practicable after their arrival at the shipping destination. Approval of materials, as a result of preliminary testing prior to manufacture into finished coatings, shall not be binding upon final approval or rejection. The judgment of the OWNER shall be final in all questions relative to conformance with the provisions of these specifications.

804.4. MEASUREMENT AND PAYMENT

Unless otherwise provided in the plans and special provisions, painting, coating, marking, or other treatments such as galvanizing shall not be measured for payment, nor shall payment be made as a separate contract item. The cost thereof shall be included in the contract pay items as are provided for the item to be painted, treated or marked, which prices shall be the total compensation for cleaning, spot painting or treatment, application of paint, coating, marking or treatment, and for furnishing all labor, equipment, material, scaffolding, protection of traffic, tools and incidentals necessary to complete the work, all in accordance with the plans and these specifications.

804.5. SPECIALTY COATINGS

Manufacturer's specifications shall be followed when applying specialty coatings, such as shown in the contract documents.

TS-2 PROTECTION OF PLANT MATERIALS

It is the intention of this specification that all native plant material at this project site not specifically indicated on the plans for removal be protected and preserved. Take all necessary precautions to avoid damage or removal of trees, shrubs and other plant materials that are to remain following construction. Specimen trees and other plants within and closely adjacent to construction sites shall be adequately protected by the Contractor, according to plans and specifications. Additional protective measures may be installed by the Contractor at his option to preclude damage by his workmen and equipment.

PART 2 - PRODUCTS

2.1 PLANT PROTECTION DEVICES

Install protective plastic construction fencing in locations indicated on the drawings prior to beginning construction operations. Maintain protective devices in good order for the duration of the construction period. Additional protective devices or barriers, required by the Owner during the course of construction, will be added to the work by change order. Protective devices so added are to be installed immediately and shall be maintained in good condition until construction is concluded. Protective devices are further defined to include references in the specifications, or notes on the drawings as to construction limits, clearing limits, work limits or other such notes which indicate the area or right-of-way in which the Contractor must work.

PART 3 - EXECUTION

3.1 EQUIPMENT AND MATERIAL STORAGE

Do not store, stack or place equipment, material, chemicals or supplies within 25-feet from edge of canopy of any plant materials that are to remain. Material storage areas are either indicated on the plans or will be designated and approved by the Owner as required. Care shall be exercised in the storage of chemicals to preclude spillage and translocation into protected area. No disposal of material or chemical wastes will be permitted on the site unless specifically allowed by Owner.

3.2 REPARATION FOR DAMAGES

A. Unwarranted damages to plant material shall be evaluated by a member of the Owner's staff and instructions issued for the necessary repairs. The Contractor shall accomplish the corrective work as ordered, or may, at his option, provide monetary reimbursement by change order reduction to the contract. The value established by the Owner will be final and shall be based on repairs by a qualified technician approved by the Owner. Plant material destroyed or removed by the Contractor or damaged beyond corrective repair will be evaluated and assessed as outlined above for reparable damage. In the event large irreplaceable plants are destroyed, the Owner will establish a fair value and may, at his discretion, require replacement by installation of several trees or other plants equaling the fair value of the tree(s) or plant(s) destroyed.

B. The value of plant materials will be determined utilizing \$15.00 per square inch of trunk cross-sectional area taken 4-feet 6-inches above grade.

C. Plants considered to be of special value to the completed project are noted on the plans and their values cited. Noted plant values will supersede values obtained through the abovereferenced formula calculation. Source for determination of value on plant materials: Shade Tree Evaluation - International Arborists Association.

3.3 PLANT PRUNING AND LIMB REMOVAL

Plant protection requirements cited above include authorized pruning and cutting of limbs and major roots. The Contractor is cautioned not to cut, prune or otherwise remove plant parts without prior approval and guidance by the Owner. Major limb removal, which may be required by construction shall be as noted on the plans, approved prior to such removal and shall be accomplished by technicians trained and skilled in the work.

3.4 BURNING

Fires and/or burning are prohibited, unless approved and permitted through the Owner.

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TS-3 Topsoil

PART 1 - GENERAL

Drawings, Standard General Conditions of Contract, Supplementary Conditions and Division 100 of NCTCOG Specification sections, apply to work of this section.

1.1 DESCRIPTION

This section governs the preparation of the ground surface for topsoil application, removal of topsoil from designated stockpiles or areas to be stripped from approved sources off the site, and placement of the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth or hazardous to humans and animals, and it shall be free from subsoil and stumps, roots, brush, stones 2 inches or more in diameter, clay lumps or similar objects. Brush and other vegetation which will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sods and herbaceous growth such as grass and weeds are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH when tested in accordance with the methods of testing of the Association of Official Agricultural Chemists in effect on the date of invitation of bids. The organic content shall be not less than 2% nor more than 20% as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20% nor more than 80% of the material passing the 200 mesh sieve as determined by the wash test in accordance with AASHTO T 11.

All topsoil to be imported by the Contractor shall conform to the above specifications.

B. Inspection and Tests: Ten days prior to stripping topsoil for use on site, the Owner's representative shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths for testing purposes as specified in 2.1 A.

PART 3 - EXECUTION

3.1 GENERAL

A. Areas to receive topsoil include all areas disturbed by construction which are to be revegetated, as indicated on the Drawings, or as instructed by the Owner in writing.

B. Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the Owner before the various operations are started.

3.2 PREPARING THE GROUND SURFACE

A. Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the Owner, to a minimum depth of 2 inches to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 1 inch in any dimension and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as shown on the plans, which are too compact to respond to these operations shall receive scarification by the use of small tillers or hand tools.

B. Grades on the areas to be topsoiled which have been established by others, as shown on the plans, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and properly compacted condition to prevent, insofar as practical, the formation of low places or pockets where water will stand.

3.3 OBTAINING TOPSOIL

A. Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas which may interfere with subsequent operations shall be removed using methods approved by the Owner. Heavy sod or other cover which cannot be incorporated into the topsoil by discing or other means shall be removed.

B. When suitable topsoil is secured off the site, the Contractor shall locate and obtain the supply, subject to the approval of the Owner. The Contractor shall notify the Owner sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the work and placed for spreading, or spread as required. Any topsoil hauled to the site of the work and stockpiled shall be rehandled and placed without additional compensation.

3.4 PLACING TOPSOIL

A. The topsoil shall be evenly spread on the prepared areas to a uniform depth of 4 inches after compaction, unless otherwise shown on the plans. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that turfing operations can proceed with a minimum of soil preparation or tilling.

B. After spreading, any large stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks 1 inch or more in diameter, roots, litter or any foreign matter shall be raked up and disposed of by the Contractor. After spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Owner. The compacted topsoil surface shall conform to the required lines, grades and cross sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

TS-4 SODDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide materials, labor to install and maintain for the guarantee period all areas sodded.

1.2 RELATED SECTIONS

- A. TS-5 - Trees, Shrubs and Ground Cover

1.3 DEFINITIONS

- A. Sod: Thick matting of growing and living grass on a smooth bed free of foreign material, rocks larger than 1" in diameter and weeds.

1.4 QUALITY ASSURANCE

- A. Reference Standards:

- 1. Official Method of Analysis of the Association of Official Analytical Chemists.
 - 2. American Sod Producers Association (ASPA), latest edition.

- B. Source Quality Control:

- 1. Owner reserves right to inspect and approve the sod before it is cut at the source of the sod.
 - 2. Inspection of sod at the source does not preclude the right of rejection at the job site.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements:

- 1. Sodding shall be performed between April 1 and August 1 or as approved by Owner.
 - 2. Frozen sod may not be used nor shall sod be placed on frozen ground.
 - 3. In times of drought, special provisions must be made to prevent the drying of the sod. All provisions shall be approved by the Owner.
 - 4. Do not sod when soil is excessively wet or dry.

- B. Protection: Restrict foot and vehicular traffic from sodded areas after lying until final inspection and acceptance.

1.6 GUARANTEE

- A. Substantial Completion: Sod shall be approved as being in accordance with specifications upon completion of the installation.

- B. Guarantee Period: A stand of grass for 90 days after substantial completion shall

be guaranteed.

C. Maintenance Period:

1. Maintain newly laid sod until entire project is accepted by the Owner.
2. Any sodded areas that become eroded, damaged or any areas of sod that fail to become established satisfactorily, according to the Owner, shall be repaired and/or replaced at no additional expense to the Owner.
3. Repair construction related damage to other plants or lawns during the maintenance period at no additional expense to the Owner.
4. Maintenance shall consist of, but not be limited to:
 - a. Weeding.
 - b. Watering.
 - c. Mowing and Edging.
 - d. Spraying.
 - e. Fertilizing.
 - f. Repair of Erosion Damage.

D. Final Acceptance will be provided by the Owner only upon completion of the entire project and the establishment of a stand of grass as defined herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sod:

1. Species: Tifway 419 Bermuda Grass (*Cynodon dactylon* 'Tif 419').
2. The sod shall be free of weeds or undesirable foreign plants, large stones, roots or other materials which might be detrimental to the development of the sod or to future maintenance.
3. Sod shall be cut with approved sod cutters so that after it is placed, but before it is compacted, it shall have a uniform thickness of not less than 3/4". The sod sections shall be cut in uniform widths, not less than 10" and in lengths of not less than 18".
4. Sod shall be uniform in color, leaf texture and shoot density.

B. Fertilizer:

1. Uniform composition.
2. Pelletized.
3. Containing following minimum percentage of plant food by weight:
 - a. Nitrogen: 8 percent.
 - b. Phosphoric Acid: 4 percent.
 - c. Potash: 24 percent.
4. The fertilizer shall be delivered to the site in bags or other sealed containers, each fully labeled, conforming to the applicable state fertilizer laws, and bearing the name, trade name or trademark and warranty of the producer.

C. Water: Potable, available on site. Contractor shall furnish temporary piping, hoses and connections as required.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Check that preceding work affecting ground surface is completed, properly graded and drains well.
- B. Verify that soil is within allowable range of moisture content.
- C. See that the soil is free of weeds and foreign material immediately before sodding. Remove rocks and stones which are larger than 1" in diameter, remove from the site and dispose of in an approved location.
- D. Do not start work until conditions are satisfactory. To begin work indicates acceptance of conditions.

3.2 PREPARATION

- A. All areas to be sodded are to be bladed and graded smooth. All clods shall be removed or be incorporated into existing soil. All debris shall be disposed of off the site at an approved location.
- B. Till fertilizer into top 2" of soil at rate of 125 pounds per acre.

3.3 APPLICATION

- A. The sod shall be moist and shall be placed on a moist soil bed.
- B. Sod shall be harvested, delivered and laid within a period of 24 hours, unless a suitable preservation method is approved prior to delivery. Sod not transplanted within this period shall be inspected for acceptance by the Owner prior to its installation.
- C. The sod shall be carefully placed by hand, edge to edge (with no gaps), and with staggered joints in rows parallel with the contours. Do not stretch or overlap sod.
- D. The sod shall immediately be pressed firmly into contact with the sod bed by rolling with approved equipment to provide a true and even surface.
- E. Screened soil of acceptable quality shall be used to fill all cracks between pads of sod; however, the quantity of the top dressing soil shall not smother the grass.
- F. The surface of the soil in the sod after compaction shall be flush with or just below adjacent paving.
- G. Water sodded areas to a minimum depth of 2" after planting.

3.4 PROTECTION

- A. Immediately after sodding, erect barricades and warning signs as required to protect the areas from traffic until sod is established.

3.5 SOD ESTABLISHMENT

- A. Watering:
 - 1. The sod shall be kept moist from the time of its placement until it has become established and its continued growth assured.
 - 2. Watering shall be done at a rate which will avoid erosion and excessive runoff.
- B. Mowing:
 - 1. When grass reaches approximately 4" in height, mow to 2" in height.
 - 2. Do not cut off more than 40% of grass leaf in single mowing.
 - 3. Do not remove grass clippings.
- C. Repairing: Any areas that become eroded, damaged or any areas of sod that fails to become established satisfactorily, according to the Owner, shall be repaired and/or replaced at no expense to the Owner.

3.6 RESTORATION

- A. Repair damages done to site caused by the Contractor at no additional expense to Owner.

3.7 CLEANING

- A. Remove trash and excess materials from site.
- B. Maintain paved areas in clean condition.
- C. Remove barriers and signs from site at termination of the maintenance period.

TS-5 REHAB OF EXISTING WATER LINE MAIN BY PIPE BURSTING

PART 1: GENERAL

1.1 Scope of Work

Furnish all materials, labor, equipment, tools, and required incidentals for the replacement of water mains by Pipe Bursting method. The Pipe Bursting process is defined as the trenchless reconstruction of existing water mains by the simultaneous insertion of liner pipe within the bore of the existing pipe, by breaking and expanding the existing pipe. The scope includes reconnection of existing water service connections, television inspection of the newly rehabilitated pipe, and complete installation in accordance with the contract documents. Only hydraulically and pneumatically operated equipment will be allowed for this method.

1.2 Liner Pipe Description

Unless otherwise specified in the plans and/or specifications, one of the following pipes or approved equal can be considered for horizontal directional drilling contingent upon approval by the Owner:

- Fusible Polyvinylchloride (PVC) Water Pipe as manufactured by Underground Solutions, Inc.,
- C900 Certa-Lok Restrained Joint Integral Bell PVC Water Pipe as manufactured by NAPCO
- Approved equal

The pipe to be used must be certified for use as a pressure-rated water delivery system and fire protection piping applications conforming to all standards and procedures, and meeting all testing and material properties as described in applicable pipe specifications and/or plans.

1.3 Related Works

- Technical Specification TS-2 FUSIBLE POLYVINYLCHLORIDE PIPE

PART 2: QUALITY ASSURANCE

2.1 Reference Standards

This section below contains references to the following documents. They are a part of this section as specified and modified.

ANSI/AWWA
C110/A21.10

American National Standard for Ductile-Iron and Gray-Iron
Fittings, 3-inch through 48-inch, for Water and Other Liquids

ANSI/AWWA C111/A21.11	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C153/A21.53	AWWA Standard for Ductile-Iron Compact Fittings for Water Service
ANSI/TAC 61/290.44	American National Standard for Water Distribution
AWWA C600	Installation of Ductile- Iron Water Mains and Their Appurtenances
AWWA C605	Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	Standard for Disinfecting Water Mains
AWWA C900	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 60 in. (100mm Through 1500mm), for Water Distribution
AWWA M23	AWWA Manual of Supply Practices PVC Pipe—Design and Installation, Second Edition
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D2152	Test Method for Degree of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F1057	Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique
UNI-PUB-08	Tapping Guide for PVC Pressure Pipe
NSF-14	Plastics Piping System Components and Related

2.2 Qualification Requirements

- The Contractor shall be certified by the manufacturer of the pipe bursting system that it is a fully trained, licensed installer of their pipe bursting system. Contractor must provide a letter to the Owner documenting this requirement.
- The Contractor shall have at minimum of at least three (3) years verifiable experience using the pipe bursting method while meeting the following criteria:
 - A minimum total of 25,000 LF of completed pipe bursting footage.
 - A minimum total of 10,000 LF of upsizing where similar sized diameter increases have been successfully completed in pipe diameters of 8-inch to 12- inch range.
- Personnel performing pipe bursting must be certified by manufacturer of pipe bursting system having successfully completed training in:
 - Operating bursting equipment to be used
 - Installing proposed replacement pipe.
 - Operation and maintenance of all equipment to be used
- Personnel performing fusing of liner pipe and fittings must be certified by manufacturer of fusing equipment having successfully completed training in:
 - Handling replacement pipe materials.
 - Butt fusion of pipe joints, saddle fusion of fittings for water services
 - Operation and maintenance of all equipment to be used.

2.3 Warranty

- A one-year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the pipe bursting Contractor shall provide in writing a warranty for a period of one year for all the pipe bursting work including material, installation, and pressure testing at no additional cost to the owner.
- Unless otherwise specified, the warranty period shall begin after the Certificate of Acceptance is issued for the Contract.

2.4 Submittals

The Contractor shall furnish the following documents made in a timely manner so that project schedule can be met

2.4.1 Material Data

- Shop drawings, catalog data and manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe and fittings.
- Manufacturer's recommendation for handling, storage, and repair of pipe and fittings damaged.

2.4.2 Process Demonstration

- Detailed installation procedure including pipe bursting method to be used.
- Method of construction and restoration of existing water service connections. This shall include detail drawings and the written description of the entire construction procedure to install pipe.

2.4.3 Testing Documentations

Television inspection reports along with video made after new pipe installation.

2.4.4 Reference

Provide a list of at least three projects completed in the last three years by the contractor/installer where a water main was successfully rehabilitated using the pipe bursting method. Include contact names, addresses and phone numbers of agencies involved.

2.4.5 Pre-Construction Submittals

The following Product Data is required from the pipe supplier and/or fusion provider:

- Pipe Size
- Dimensionality
- Pressure Class per applicable standard
- Color
- Recommended Minimum Bending Radius
- Recommended Maximum Safe Pull Force
- Fusion technician qualification indicating conformance with this specification

The following work plan and information is required from the Contractor and/or pipe bursting Contractor, if requested. This work plan and information shall also be supplied to the pipe supplier, should it be requested:

- Pipe bursting equipment information and certification indicating the applicability of equipment, operator, and methods commensurate with the size and scope of the project, including any proposed lubricants to be used in the operation.
- Contingency plan, including the following:
 - Unforeseen obstructions that stop or delay the operation

- Unforeseen deflections that would over bend the fusible polyvinylchloride pipe
- Excessive surface heaving or subsidence
- Damage to existing utility installations
- Required spot repairs of the existing line
- Shop drawings shall include for each pipe bursting operation all excavation locations, interfering utilities, excavation dimensions, temporary water and traffic control schematics.
 - Work schedule identifying construction sequencing, daily work hours and working dates for each installation.

2.4.6 Post-Construction Submittals

The following as recorded data is required from the contractor and/or fusion provider (if applicable) to the owner or pipe supplier upon request:

- Approved data logger device reports
- Fusion joint documentation containing the following information:
 - Pipe Size and Thickness
 - Machine Size
 - Fusion Technician Identification
 - Job Identification
 - Fusion Joint Number
 - Fusion, Heating, and Drag Pressure Settings
 - Heat Plate Temperature
 - Time Stamp
 - Heating and Cool Down Time of Fusion
 - Ambient Temperature

PART 3: PRODUCT

3.1 Liner Pipe

As specified in Section 1.2 of this specification.

3.2 Pipe Bursting Equipment

3.2.1 General

The pipe bursting system shall be designed and manufactured to force its way through the existing line by fragmenting the pipe and compressing the broken pieces into the surrounding soil as it progresses. The bursting unit shall generate sufficient force to burst and expand the existing pipeline and allow for the insertion of the liner pipe.

3.2.2 Allowable Types of Pipe Bursting System

3.2.2.1 Static Pipe Bursting Systems

- Static pipe bursting systems shall be characterized by a tapered or blunt nosed bursting head being pulled through the host pipe and breaking the host pipe by applying radial pressure to the host pipe. The host pipe fails by 'hoop' tensile stress applied by the bursting head, and is fragmented and pushed into the surrounding bedding and soil as the bursting head progresses.
- The bursting head shall be followed by an expansion head which shall further push the fragmented pipe into the surrounding soil and bedding to a diameter that allows the insertion of the liner pipe behind it. Under no circumstances shall the pipe pull head, which is attached directly to the liner pipe, be used to expand or otherwise increase the diameter of the host pipe, or fragmented host pipe.
- The pull head may be advanced by a hydraulic or winching mechanism, and may be connected by means of a cable, chain, or rod.

3.2.2.2 Hydraulic Pipe Bursting Systems

- Hydraulic pipe bursting systems shall be characterized by a pull head that is equipped with hydraulically actuated 'petals' that break the host pipe by applying radial pressure to the host pipe. The host pipe fails by 'hoop' tensile stress applied by the head, and is fragmented and pushed into the surrounding bedding and soil as the pull head progresses.
- The pull head shall be followed by an expansion head which shall further push the fragmented pipe into the surrounding soil and bedding to a diameter that allows the insertion of the liner pipe behind it. Under no circumstances shall the pipe pull head, which is attached directly to the liner pipe, be used to expand or otherwise increase the diameter of the host pipe, or fragmented host pipe.
- The pull head may be advanced by a hydraulic or winching mechanism, and may be connected by means of a cable, chain, or rod.

3.2.2.3 Pneumatic or Percussion Pipe Bursting System

UNDER NO CIRCUMSTANCES SHALL PNEUMATIC OR PERCUSSIVE BURSTING SYSTEMS BE ALLOWED.

3.2.3 Bursting Lubricants

- Bursting lubricants shall be used at the request of the pipe bursting contractor and at the discretion of the Owner and Engineer.
- Lubricants shall be compatible for long term use with PVC pipe.

3.2.4 Pipe Pull Heads

- Pipe pull heads shall be utilized that employ a positive through-bolt

design assuring a smooth wall against the pipe cross-section at all times.

- Pipe pull heads shall be specifically designed for use with liner pipe, and shall be as recommended by the pipe supplier.

3.2.5 Pipe Rollers

- Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.
- A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and resist excessive sagging of the product pipe.

PART 4: EXECUTION

4.1 Delivery, Storage and Handling

Transport, handle and store pipes and fittings as recommended by manufacturer. If new pipe and fittings become damaged before or during installation, it shall be repaired as recommended by the manufacturer or replaced as required by the Owner, at the Contractor's expense, before proceeding further. Deliver, store and handle other materials as required to prevent damage.

4.2 Cleaning and TV Inspection of Existing Pipeline

- The host pipe shall be cleaned and inspected by TV prior to the bursting operation in accordance with, and if required by the contract documents.
- Cleaning and TV inspection of the host pipe shall indicate condition of host pipe and suitability of host pipe for liner pipe insertion by pipe bursting methods.
- Obstructions considered detrimental to the pipe bursting operation which may include corporation taps, valves and valve bodies, and collapsed piping shall be remedied prior to bursting and liner pipe insertion.
- Spot repairs shall be made in accordance with the drawings and these specifications.

4.3 Obstruction Removal

- Identify any point repairs required, such as dropped joints, intruding service connections, collapsed pipe, sags in main or any other obstructions prior to the pipe bursting process. The Contractor shall remove all obstructions to perform pipe bursting operation, as necessary.
- The contractor shall notify the inspector for approval to make an excavation after having exhausted all other options to remove any obstruction or retrieve any pipe bursting tool or camera from the water main.

4.4 Location and Protection of Underground Utilities

- Correct locations of all underground utilities that may impact the installation is the responsibility of the Contractor.
- Utility location and notification services shall be contacted by the Contractor prior to the start of construction.
- All existing lines and underground utilities shall be positively identified, including exposing those facilities that are located within an envelope of possible impact of the bursting operation as determined for the project specific site conditions. It is the Contractor and pipe burst system operator's responsibilities to determine this envelope of safe burial depth and offset from existing utilities. This will include, but is not limited to soil conditions and layering, utility proximity and material, pipe bursting system and equipment, and foreign subsurface material.

4.5 Excavation and Access Pits

- The location of access pits shall be submitted to the Engineer prior to construction.
- Access pit length shall be such that the minimum bending radius for the liner pipe, per the pipe supplier is maintained. Sheeting, shoring and bracing requirements shall be in accordance with these specifications and applicable jurisdictional standards.
- Access pit excavations shall be performed at all points where the liner pipe will be inserted into the existing pipeline. When possible, access pit excavations shall coincide with host pipe service connection points or other appurtenance installations.
- The liner pipe may be continuously or partially supported on rollers or other Owner and Engineer approved friction decreasing implement during joining and insertion, as long as the pipe is not over-stressed or critically abraded prior to or during installation.

4.6 Pipe Bursting Operation

- Any known pre-existing concrete encasements shall be excavated and broken out prior to the bursting operation to allow the steady and free passage of the pipe bursting head.
- The new pipe shall be inserted immediately behind the bursting head in accordance with the pipe supplier's recommended procedures. The bursting equipment shall be specifically designed and manufactured for the type of insertion process being used.
- Immediately following the completion of a pipe bursting installation, if possible, the pipe should be pushed back into the location of the insertion, at the pulling head, until a small amount of movement is realized at the insertion pit on the other side of the installation from the pulling equipment.

4.7 Preparation Prior To Making Connections Into Existing Piping Systems

- Approximate locations for existing piping systems are shown in the

- construction documents. Prior to making connections into existing piping systems, the contractor shall:
 - Visit the field to verify location, size, piping material, and piping system of the existing pipe.
 - Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.
 - Have installed all temporary pumps and/or pipes in accordance with established connection plans.
- Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

4.8 Pipe System Connection

- Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

4.9 External Service Connections

- In re-connection or reconstruction of existing water services, selected service connection pipe diameter must match existing service.
- All water service connections shall be identified, located and excavated prior to any pipe construction.
- Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C800, ROMAC 202NS or approved equal. Tapping shall be performed only with the use of tap saddles or sleeves. NO DIRECT TAPPING WILL BE PERMITTED. Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per Uni-Pub-8.
- All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.
- Equipment used for tapping shall be made specifically for tapping PVC pipe:
 - Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. 'Hole saws' made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
 - Manually operated or power operated drilling machines may be used.
- Taps may be performed while the pipeline is filled with water and under pressure ('wet' tap,) or when the pipeline is not filled with water and not under pressure ('dry' tap).

4.10 Final Acceptance

Upon completion of installation, testing and inspection, clean and restore project area affected by work of this section.

PART 5: METHOD OF MEASUREMENT AND PAYMENT

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

****END OF SECTION****

**CONSTRUCTION PLANS AND DETAILS
(BOUND SEPERATELY)**

**GEOTECHNICAL REPORT
(BOUND SEPERATELY)**