BID DOCUMENTS

CITY OF COPPERAS COVE

MOUNTAIN TOP NORTH
300,000 GALLON
ELEVATED STORAGE TANK

BID #2016-08-82

Prepared for:
City of Copperas Cove
914 S. Main Street, Suite H
Copperas Cove, Texas, 76522
Phone: 254.547.4221
Fax: 254.547.4301

Prepared by:
River City Engineering, Inc.
3801 So. First Street
Austin, Texas 78704
Phone: 512.442.3008
Fax: 512.442.6522
RCE Job # 5019-95

RIVER CITY ENGINEERING
CIVIL, ENVIRONMENTAL & CONSULTING
TEXAS REGISTERED ENGINEERING FIRM F-1546

TABLE OF CONTENTS

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

SECTION 00100 - ADVERTISEMENT FOR BIDS

City of Copperas Cove
BID #2016-08-82
Mountain Top North 300,000 Gallon Elevated Storage Tank

Notice is hereby given that sealed bids will be received until 2:00 P.M., Thursday, May 12, 2016, and then publicly opened and read aloud at the City of Copperas Cove Community Conference Room at 302 E. Avenue E., Copperas Cove, Texas 76522.

Digital copies of the Plans and Specifications can be obtained beginning Friday, April 22, 2016 by contacting the office of the Engineer, River City Engineering (see contact information below). Hard copies of Plans and Specifications can be obtained on request from the office of the Engineer. Hard copies will be printed once requested. Hard copies may be obtained for a non-refundable fee of $50. Digital copies may be obtained at no cost from the Engineer by either download or on CD. Contact River City Engineering for more information.

This Project generally consists of the construction of a new 300,000 gallon welded steel elevated storage tank, yard piping and associated site and electrical work.

The Mountain Top North 300,000 Gallon Elevated Storage Tank Project shall be substantially complete within 335 calendar days and final completion within 365 calendar days from the Notice to Proceed.

RIVER CITY ENGINEERING, INC.
3801 So. First Street
Austin, TX 78704
PH: (512) 442-3008
FX:(512) 442-6522

SECTION 00110 - NOTICE TO CONTRACTORS

City of Copperas Cove

BID #2016-08-82
Mountain Top North 300,000 Gallon Elevated Storage Tank

Sealed bids in envelopes addressed to City of Copperas Cove, attention Velia Key – Director of Financial Services, will be received until 2:00 P.M., Thursday, May 12, 2016, and then publicly opened and read aloud at the City of Copperas Cove Community Conference Room at 302 E. Avenue E., Copperas Cove, Texas 76522, for furnishing all work required for the construction of the Mountain Top North 300,000 Gallon Elevated Storage Tank.

Any questions or requests for clarification must be submitted to the Finance Department, in writing, prior to **12:00 P.M. May 2, 2016** via email to Velia Key, vkey@copperascovetx.gov, subject line containing bid number and description, or facsimile at 254-542-8941. There will be no exceptions. All responses to the questions will be sent to all bidders.

Digital copies of the Plans and Specifications can be obtained beginning Friday, April 22, 2016 by contacting the office of the Engineer, River City Engineering (see contact information below). Hard copies of Plans and Specifications can be obtained on request from the office of the Engineer. Hard copies will be printed once requested. Hard copies may be obtained for a non-refundable fee of $50. Digital copies may be obtained at no cost from the Engineer by either download or on CD. Contact River City Engineering for more information. The prospective bidder's attention is directed to the bid documents where detailed instruction and provisions are contained concerning bonds, insurance and other performance requirements

This Project generally consists of the construction of a new 300,000 gallon welded steel elevated storage tank, yard piping and associated site and electrical work.

The Mountain Top North 300,000 Gallon Elevated Storage Tank Project shall be substantially complete within 335 calendar days and final completion within 365 calendar days from the Notice to Proceed.

RIVER CITY ENGINEERING, INC.
3801 So. First Street
Austin, TX 78704
PH: (512) 442-3008 / FX: (512) 442-6522

SECTION 00200 - INSTRUCTIONS TO BIDDERS

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

PROPOSAL

The Proposal (or copies of the proposal) shall be submitted on the bidding forms, which are included herein, and shall be enclosed in a sealed envelope addressed to:

CITY OF COPPERAS COVE
Attn: Velia Key
Director of Financial Services
914 S. Main Street, Suite H
Copperas Cove, Texas 76522

and shall be identified as follows:
"Bid #2016-08-82 for Mountain Top North 300,000 Gallon Elevated Storage Tank, to be opened at 2:00 P.M. May 12, 2016."

Any questions or requests for clarification must be submitted to the Finance Department, in writing, prior to **12:00 P.M. May 2, 2016** via email to Velia Key, vkey@copperascovetx.gove subject line containing bid number and description, or facsimile at 254-542-8941. There will be no exceptions. All responses to the questions will be sent to all bidders.

Bidders desiring further interpretation of the Plans or Specifications must make request for such information to the Engineer prior to **12:00 P.M. May 2, 2016**. Any requests received after this date and time will not be responded to. Bidders' information requests shall be directed to:

River City Engineering, Inc.
3801 So. First Street
Austin, Texas 78704
Project Manager: John Muras, P.E.
Ph: 512.442.3008, ext. 108 Fax: 512.442.6522
jmuras@rcetx.com

A Proposal will not be accepted unless prepared on the bidding form provided. The sealed Proposals will be publicly opened and read at the time and place stated in the Notice to Contractors. Bidders or their authorized agents are invited to be present. Unauthorized conditions, limitations or provisions attached to a Proposal will render it informal and may cause its rejection. The complete Proposal forms shall be without additions, alternations or erasures. Alternative proposals will not be considered unless called for. No oral, telegraphic or telephonic proposals or modifications will be considered. The Proposal may be withdrawn upon request by the Bidder without prejudice to himself prior to, but not after, the time fixed for opening of bids, provided that the request is in writing, has been executed by the Bidder or his duly authorized representative, and is filed with the OWNER.

BIDDING FORMS REQUIRED

Bidders shall submit one (1) complete original copies of the Proposal. Complete Proposals shall consist of the following forms:

- Acknowledgement of Addendum Receipt
- Proposal Bidding Sheets
- Bid Bond or Proposal Guarantee
- Information Required of Bidder

DISQUALIFICATION OF BIDDERS

More than one Proposal from an individual, firm, partnership, corporation or association under the same or different names, will not be considered. Reasonable grounds for believing that any Bidder is interested in more than one Proposal for the work contemplated will cause the rejection of all Proposals in which such Bidder is interested. If there is reason for believing that collusion exists among Bidders, all bids will be rejected and none of the participants in such collusion will be considered in future proposals.

RETURN OF PROPOSAL GUARANTEES

Within twenty-five (25) days after an award of the Contract, the OWNER will return the proposal guarantees accompanying each of the proposals as are not considered in making the award. All other proposal guarantees will be held until the contract has been finally executed. They will then be returned to the respective Bidders whose Proposals they accompany.

AWARD OF CONTRACT - RESERVATION OF RIGHTS

The Contract, if awarded, will be awarded to a responsible Bidder if his Proposal complies with all the requirements prescribed. Award, if made, will be made within ninety (90) calendar days after the opening of the Proposals. The OWNER reserves the right to reject any or all bid Proposals, to accept the lowest responsible Bidder's Proposal, and to waive any informality in any Proposal.

EXECUTION OF CONTRACT

A Bidder to whom award is made shall execute a written Contract with the OWNER on the form of Agreement provided. Failure or refusal to enter into a Contract as herein provided, or to conform to any of the stipulated requirements in connection therewith shall be a just cause for the annulment of the award. If the successful Bidder refuses or fails to execute the contract, the OWNER may award the Contract to the second lowest responsible Bidder. If the second lowest responsible Bidder refuses or fails to execute the Contract, the OWNER may award the Contract to the third lowest responsible Bidder. On the failure or refusal of such second and third lowest responsible Bidder to execute the contract, the work may be bid again at a later date.

PROPOSAL GUARANTEE

Each Proposal shall be accompanied by a certified or cashier's check or bid bond in the amount of not less than 5% of the amount named in the Proposal. Said check or bond shall be made payable to the Owner and shall be given as a guarantee that the Bidder, if awarded the work, will enter into a Contract within ten (10) days after the award and will furnish the necessary bonds as hereinafter provided. In case of refusal or failure to enter into said Contract, the check or bond as the case may be, shall be cased as liquidated damages. No Bidder's bond will be accepted unless it conforms substantially to the form furnished by the OWNER, which is bound herein, and is properly filled out and executed.

PROPOSAL SIGNATURE

If the Proposal is made by an individual, it shall be signed and his full name and is address shall be given; if it is made by a firm it shall be signed with the co-partnership name by a member of the firm, who shall sign his own name, and the name and address of each member shall be given; and if it is made by a corporation the name of the corporation shall be signed by its duly authorized officer or officers attested by the corporate seal, and the names and titles of all officers of the corporation shall be given.

COMPETENCY OF BIDDERS

In selecting the lowest responsible Bidder, consideration will be given not only to the financial standing, but also to the general competency of the Bidder for the performance of the work covered by the Proposal. To this end each Proposal shall be supported by a statement of the bidder's experience, on the form entitled "Information Required of Bidder," bound herein. Unsatisfactory safety records or past performance will be grounds for bid rejections.

BIDDER'S EXAMINATION OF SITE

Each Bidder shall examine carefully the site of the proposed work and the Contract Documents therefore. It will be assumed that the Bidder has investigated and is satisfied as to the conditions to be encountered; as to the character, quality and quantity of materials to be furnished and as to the requirements of the Contract, Specifications and Drawings.

CONTRACT TIME

If awarded the Contract, the undersigned agrees that the base bid (Mountain Top North 3 Elevated Storage Tank) shall be substantially complete within 335 calendar days and final completion of the base bid work within 365 calendar days of Notice to Proceed.

ADDENDA

Bidders desiring further information or interpretation of the Plans or Specifications must make request for such information in writing to Engineer prior to the deadline specified in the "Proposals" section on the first page. Answers to all such requests will be given in writing to all Bidders, in Addendum form, and all Addenda will be bound with, and made a part of the Contract Documents. No other explanation of interpretation will be considered official or binding. Should a Bidder find discrepancies in, or omissions from the Plans, Specifications or other Contract Documents, or should he be in doubt as to their meaning, he should at once notify the Engineer in order that a written Addendum may be sent to all Bidders. Any Addenda issued prior to twenty-four (24) hours of the opening of bids will be mailed or delivered to each Contractor contemplating the submission of a proposal on this work. The Proposal as submitted by the Contractor will be so constructed as to include any Addenda if such are issued by the Engineer prior to twenty-four (24) hours of the opening of bids.

Acknowledgment of Addendum Receipt

Addendum No.	Date

SECTION 00400 - PROPOSAL BIDDING SHEETS

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

Job Name: Mountain Top North 300,000 Gallon Elevated Storage Tank
Job Location: COPPERAS COVE, TEXAS
Owner: CITY OF COPPERAS COVE

Gentlemen:

Pursuant to the foregoing Notice to Contractors and Instructions to Bidders, the undersigned BIDDER hereby proposes to do all the work, to furnish all necessary supervision, labor, machinery, equipment, tools, materials, insurance and miscellaneous items, to complete all the work bid as provided by the attached supplemental specifications, and as shown on the base bid MOUNTAIN TOP NORTH 300,000 GALLON ELEVATED STORAGE TANK for the construction of the project and binds himself on acceptance of this proposal to execute a contract and bonds for completing said project within the time slated for the following process, to wit: City of Copperas Cove, Texas.

BASE BID

ITEM NO.	QUANITY UNIT	DESCRIPTION AND UNIT PRICE IN WORDS	TOTAL PRICE
1	1 LS	Bonding, Mobilization and Insurance: Not to exceed 5% of the total Base Bid contract price, at the lump sum cost of _____ _____Dollars	$_____
2	1 LS	Environmental Protection / Storm Water Pollution Prevention Plan (SWPPP): Including preparation, implementation, required inspections, and weekly reports, at the lump sum cost of _____ _____Dollars	$_____
3	1 LS	Construction Staking Including all construction staking and re-staking, complete and in place, at the lump sum cost of _____ _____Dollars	$_____
4	1 LS	Temporary Erosion & Sedimentation Control Including silt fence, stabilized construction entrance, and all materials, installation & maintenance, complete and in place, at the lump sum cost of _____ _____Dollars	$_____

5	1 LS	Trench Safety Including all necessary and required controls for compliance with U.S. Occupation Safety & Health Administration (OSHA) regulations complete and in place, at the lump sum cost of _____ _____Dollars	$_____
6	1 LS	Yard Piping Including all materials, installation, testing, trenching, bedding and backfill, and connection to existing waterlines complete and in place, at the lump sum cost of _____ _____Dollars	$_____
7	1 LS	300,000 Gallon Welded Steel, Single Pedestal Elevated Storage Tank Including design, foundation, concrete floor, splash pad and all related piping and accessories and installation, complete and in place, at the lump sum cost of _____ _____Dollars	$_____
8	1 LS	Site Work Including sidewalk, grading, rip-rap, drainage improvements and all other associated site work complete and in place, at the lump sum cost of_____ _____Dollars	$_____
9	1 LS	Revegetation Including permanent revegetation, soil retention matting, and all materials, installation, watering and maintenance until established, complete and in place, at the lump sum cost of _____ _____Dollars	$_____
10	1 LS	Electrical and Instrumentation Including all materials, electrical, and instrumentation, complete and in place, at the lump sum cost of _____ _____Dollars	$_____

TOTAL BASE BID **(Items 1-10):**	**$**_____

SUBMISSION OF PROPOSAL:

In accordance with the Contract Documents, the above Proposal is hereby respectfully submitted by:

NAME OF CONTRACTOR			DATE
EXECUTED BY			TITLE / POSITION
BUSINESS ADDRESS			TELEPHONE NUMBER
CITY	COUNTY	STATE	ZIP

SECTION 00430 - BID BOND

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

THE STATE OF TEXAS §
§
COUNTY OF_____ §

KNOW ALL MEN BY THESE PRESENTS, that we_____ as PRINCIPAL and _____as SURETY, are held and firmly bound unto CITY OF COPPERAS COVE, hereinafter referred to as the "OWNER," in the penal sum of five percent (5 %) of the total amount of the bid of the PRINCIPAL submitted to the OWNER, for the work described below; for the payment of which sum is lawful money of the United States of America, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents. In no case shall the liability of the SURETY hereunder exceed the sum of THE CONDITIONS OF THIS OBLIGATION ARE SUCH, THAT WHEREAS, said PRINCIPAL has submitted the above-mentioned bid to the OWNER, for construction of the work under the "CONSTRUCTION OF CITY OF COPPERAS COVE MOUNTAIN TOP NORTH 300,000 GALLON ELEVATED STORAGE TANK," for which bids are to be opened on _____, 2016.

NOW THEREFORE, if the PRINCIPAL is awarded the Contract, and within the time and manner required under the heading "Instruction to Bidders," after the prescribed forms are presented to him for signature, enters into a written Agreement, substantially in the form contained in the Specifications, in accordance with the bid and files the two bonds with the OWNER, one to guarantee faithful performance and the other to guarantee payment for labor and material, then this obligation shall be null and void, otherwise, it shall be and remain in full force and effect.

In the event, suit is brought upon this bond by the OWNER and judgment is recovered, said SURETY shall pay all costs incurred by the OWNER in such suit, including a reasonable attorney's fee to be fixed by the court.

IN WITNESS WHEREOF, we have hereunto set our hands and seals this _____ day of _____, 2016.

_____	_____
Principal	Surety
By: _____	By:_____
Title: _____	Title:_____
Address:_____	Address:_____
_____	_____

The name and address of the Resident Agent of Surety is:

_____

_____

_____

SECTION 00450 - INFORMATION REQUIRED OF BIDDER

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

The Prospective Bidder is required to supply the following information. Additional sheets and/or information may be attached if necessary.

(1) Name_____

(2) Address_____

(3) Phone Number_____

(4) Type of firm:

__ Individual, __ Partnership, __ Corporation

(5) Corporation organized under the laws of the State of _____.

(6) Payment of taxes by Bidder is to the State of _____.

(7) List the names and address of all members of the firm or names and titles of all officers of the corporation:

_____ _____

_____ _____

_____ _____

(8) Number of years experience _____

(9) Has the Bidder ever defaulted on a Contract? _____

(10) Are there any currently pending judgments, claims, or lawsuits against the Bidder? _____

(11) Does Bidder currently have any pending judgments, claims, or lawsuits against any prior client? _____

(12) Is the Bidder or its Principals involved in any bankruptcy or reorganization proceedings? _____

(13) Experience with welded steel elevated storage tank projects in particular, valued at $2,000,000 or more is desired. List at least three (3) projects completed by Bidder of comparable scope in the last four (4) years.

Name of Project	
Project Location	
Brief Description or Class of Work	
Owner Name	
Owner Contact Information	
Initial Contract Price	
Final Contract Price	
Date Completed	

Name of Project	
Project Location	
Brief Description or Class of Work	
Owner Name	
Owner Contact Information	
Initial Contract Price	
Final Contract Price	
Date Completed	

Name of Project	
Project Location	
Brief Description or Class of Work	
Owner Name	
Owner Contact Information	
Initial Contract Price	
Final Contract Price	
Date Completed	

(14) List the name and address of each subcontractor who will perform work in or about the work or improvements in excess of one-half (1/2) of one percent (1%) of the total bid price and indicate what part of the work will be done by each such subcontractor.

NAME	ADDRESS	WORK TO BE PERFORMED

(15) If requested by the OWNER, the Bidder shall submit a notarized financial statement, financial data or other information and references sufficiently comprehensive to permit an appraisal of his current financial conditions.

(16) Additional information may be requested after receipt of this completed form in order to complete evaluation.

SECTION 00500 - CONTRACT AGREEMENT

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

THE STATE OF TEXAS §
§
COUNTY OF_____ §

THIS AGREEMENT, made and entered into this ____ day of _____, 2016, by and between CITY OF COPPERAS COVE, COPPERAS COVE, TEXAS hereinafter termed OWNER, and _____ of the City of _____, County of _____, and State of _____, hereinafter termed CONTRACTOR.

WITNESSETH: That for and in consideration of the payments and agreements herein after mentioned, to be made and performed by the OWNER, the CONTRACTOR hereby agrees with the OWNER to commence and complete the construction of certain improvements described as follows:

CITY OF COPPERAS COVE
Mountain Top North 300,000 Gallon Elevated Storage Tank

Further described as the work covered by these Specifications consists of furnishing all the materials, supplies, machinery, equipment, tools, supervision, labor, insurance, and other accessories and services necessary to complete the said construction, in accordance with the conditions and prices stated in the Proposal attached herein, and in accordance with the Notice to Contractors, Instructions to Bidders, General Conditions of the Agreement, Special Conditions of the Agreement, Technical Specifications, Plans and other drawings and printed or written explanatory matter thereof, and the Specifications and addenda therefore, as prepared by River City Engineering, Ltd., 3801 S. First Street, Austin, Texas 78704 herein entitled the ENGINEER, each of which has been identified by the CONTRACTOR'S written Proposal, the General Conditions of the Agreement, and the Performance and Payment Bonds hereof and collectively evidence and constitute the entire Contract.

The CONTRACTOR hereby agrees to commence work within seven (7) calendar days after the date written notice to do so shall have been given to him, and to reach final completion of the base bid (Mountain Top North 300,000 Gallon Elevated Storage Tank) work within 365 calendar days of the written Notice to Proceed, subject to such extensions of time as are provided by the General and Special Conditions.

The OWNER agrees to pay the CONTRACTOR in current funds the price or prices shown in the Proposal, which forms a part of this Contract, such payments to be subject to the General and Special Conditions of the Contract.

IN WITNESS WHEREOF, the parties of these presents have executed this Agreement in the year and day first above written.

ATTEST

CONTRACTOR:	OWNER: CITY OF COPPERAS COVE
_____	_____
Name	Name
_____	_____
Title	Title
_____	_____
Address	Address
WITNESS:	SECRETARY:
_____	_____
Name	Name
_____	_____
Title	Title
_____	_____
Address	Address

SECTION 00610 - PERFORMANCE BOND

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

THE STATE OF TEXAS §
§
COUNTY OF_____ §

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, are held and firmly bound unto CITY OF COPPERAS COVE, COPPERAS COVE, TEXAS in the penal sum of _____ _____ Dollars ($_____) 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 Contract with the OWNER dated the ___ day of _____, 2016 to which Contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH, that if the said PRINCIPAL shall faithfully perform 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 observed and performed, and according to the true intent and meaning of said Contract and the Plans and Specifications thereto annexed, then this obligation shall be void; 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 the said Articles 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 there under, or the Plans, Specifications or drawings accompanying the same, shall in any way 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 hereunder.

IN WITNESS WHEREOF, the said PRINCIPAL and SURETY have signed and sealed this instrument this _____ day of _____, 2016.

_____	_____
Principal	Surety
By:_____	By:_____
Title:_____	Title:_____
Address:_____	Address:_____
_____	_____
_____	_____

The name and address of the Resident Agent of Surety is:

_____

_____

_____

_____

SECTION 00620 - PAYMENT BOND

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

THE STATE OF TEXAS §
§
COUNTY OF_____ §

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, are held and firmly bound unto CITY OF COPPERAS COVE (OWNER) in the penal sum of _____ _____ Dollars ($_____) 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 Contract with the OWNER dated the _____ day of _____, 2016, to which Contract is hereby referred to and made a part hereof a fully and to the same extent as if copied at length herein.

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 any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the term of the Contract, or to the work to be performed thereunder.

IN WITNESS WHEREOF, the said PRINCIPAL and SURETY have signed and sealed this instrument this _____ day of _____, 2016.

_____	_____
Principal	Surety
By:_____	By:_____
Title:_____	Title:_____
Address:_____	Address:_____
_____	_____
_____	_____
_____	_____

The name and address of the Resident Agent of Surety is:

_____

_____

_____

_____

SECTION 00630 - CERTIFICATION OF INSURANCE

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

TO: CITY OF COPPERAS COVE
914 S. Main Street, Suite C
Copperas Cove, TX 76522

Date:_____

THIS IS TO CERTIFY THAT _____
is, at the date of this certificate, insured by this company with respect to the business operations hereinafter described, for the types of insurance and in accordance with the provisions of the standard policies used by this company, and further hereinafter described. Exceptions to standard policies are noted on the reverse side hereof.

TYPE OF INSURANCE	POLICY NO.	EFFECTIVE DATE	EXPIRATION DATE	LIMITS OF LIABILITY
Worker's Compensation				Statutory, State of Texas _____
Employer's Liability				Bodily Injury
Comprehensive General Liability				$_____ each person $_____
_____ Included Contractual Liability Covers Independent _____ Contractors				Property Damage $_____each accident $_____ aggregate
Owner's Protective				Bodily Injury $_____ each person $_____ each person Property Damage $_____ each accident $_____ aggregate
Comprehensive Automobile Liability				Bodily Injury $_____ each person $_____ each accident
____ Owned Vehicles ____ Hired Vehicles ____ Non-owned Vehicles ____ Contractual Liability				Property Damage $_____each accident

The above policies either in the body thereof or by appropriate endorsement provide that they may not be changed or concealed by the insurer in less than ten (10) days after the insured has received written notice of such change or cancellation.

This Certificate of Insurance neither affirmatively or negatively amends, extends or alters the coverage afforded by policy of policies indicated by this certificate.

By:_____
Title:_____
Address:_____
_____

_____
(Name of Insurer)

City of Copperas Cove

"The City Built for Family Living" Finance Department

VENDOR INFORMATION SHEET

COMPANY NAME _____ TAX ID #_____

PRIMARY POC _____ DATE _____
(PLEASE PRINT)

SIGNATURE _____ PHONE NUMBER _____

EMAIL ADDRESS_____

SECONDARY POC _____ DATE _____
(PLEASE PRINT)

SIGNATURE _____ PHONE NUMBER _____

EMAIL ADDRESS_____

LOCAL GOVERNMENT OFFICER CONFLICTS DISCLOSURE STATEMENT

FORM CIS

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

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 person described by Sections 176.002(a) and 176.003(a), Local Government Code

4 Description of the nature and extent of employment or business relationship with person named in item 3

5 List gifts if aggregate value of the gifts received from person named in item 3 exceed $250

Date Gift Received _____ Description of Gift _____ ☐ Did Not Accept Gift

Date Gift Received _____ Description of Gift _____ ☐ Did Not Accept Gift

Date Gift Received _____ Description of Gift _____ ☐ Did Not Accept 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 a family member (as defined by Section 176.001(2), Local Government Code) of a 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

Adopted 11/02/2005

LOCAL GOVERNMENT OFFICER
CONFLICTS DISCLOSURE STATEMENT

Section 176.003 of the Local Government Code requires certain local government officers to file this form. A "local government officer" is defined as a member of a governing body of a local government entity or a director, superintendent, administrator, president, or other person designated as the executive officer of the local government entity. This form is required to be filed with the records administrator of the local governmental entity not later than 5 p.m. on the seventh business day after the date on which the officer becomes aware of the facts that require the filing of this statement.

A local government officer commits an offense if the officer knowingly violates Section 176.003, Local Government Code. An offense under this section is a Class C misdemeanor.

Please refer to chapter 176 of the Local Government Code for detailed information regarding the requirement to file this form.

INSTRUCTIONS FOR COMPLETING THIS FORM

The following numbers correspond to the numbered boxes on the other side.

1. Name of Local Government Officer. Enter the name of local government officer filing this statement.

2. Office Held. Enter the name of the office held by the local government officer filing this statement.

3. Name of person described by Sections 176.002(a) and 176.003(a), Local Government Code. Enter the name of the person described by Section 176.002, Local Government Code with whom the officer has an employment or other business relationship as described by Section 176.003(a), Local Government Code.

4. Description of the nature and extent of employment or business relationship with person named in item 3. Describe the nature and extent of the relationship of the employment or other business relationship with the person in item 3 as described by Section 176.003(a), Local Government Code.

5. List gifts if aggregate value of the gifts received from person named in number 3 exceed $250. List gifts received during the 12-month period (described by Section 176.003(a)(2)(B), Local Government Code) by the local government officer or family member of the officer from the person named in number 3 that in the aggregate exceed $250 in value.

6. Affidavit. Signature of local government officer.

Form **W-9**
(Rev. December 2014)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Give Form to the requester. Do not send to the IRS.

Print or type
See Specific Instructions on page 2.

1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.

2 Business name/disregarded entity name, if different from above

3 Check appropriate box for federal tax classification; check only **one** of the following seven boxes:

☐ Individual/sole proprietor or single-member LLC ☐ C Corporation ☐ S Corporation ☐ Partnership ☐ Trust/estate

☐ Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=partnership) ▶ _____

Note. For a single-member LLC that is disregarded, do not check LLC; check the appropriate box in the line above for the tax classification of the single-member owner.

☐ Other (see instructions) ▶

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):

Exempt payee code (if any) _____

Exemption from FATCA reporting code (if any) _____

(Applies to accounts maintained outside the U.S.)

5 Address (number, street, and apt. or suite no.)

Requester's name and address (optional)

6 City, state, and ZIP code

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN* on page 3.

Note. If the account is in more than one name, see the instructions for line 1 and the chart on page 4 for guidelines on whose number to enter.

Social security number

			–			–				

or

Employer identification number

		–							

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions on page 3.

Sign Here | **Signature of U.S. person ▶** | **Date ▶**

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. Information about developments affecting Form W-9 (such as legislation enacted after we release it) is at *www.irs.gov/fw9*.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following:

- Form 1099-INT (interest earned or paid)
- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See *What is backup withholding?* on page 2.

By signing the filled-out form, you:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),
2. Certify that you are not subject to backup withholding, or
3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income, and
4. Certify that FATCA code(s) entered on this form (if any) indicating that you are exempt from the FATCA reporting, is correct. See *What is FATCA reporting?* on page 2 for further information.

SECTION 00640 - CONTRACTOR'S AFFIDAVIT OF BILLS PAID

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

STATE OF TEXAS §
§
COUNTY OF _____ §

I, _____, being the legal representative of, _____

_____hereby certify that all bill for materials, apparatus, fixtures, machinery, and labor used in connection with the construction of_____

_____, have been fully paid.

Signed: By:

_____ _____
Company Name

Title:_____

STATE OF TEXAS

COUNTY OF _____

Before me, the undersigned, a Notary Public in and for said County and State, personally appeared_____

_____
known to me to be the person whose name is subscribed to the foregoing instrument and acknowledgement to me that he executed the same for the purposes and consideration therein expressed and in the capacity therein stated.

Given under my hand and seal of office this_____day of _____20___.

_____
Notary Public in and for

_____ County, Texas My Commission Expires: _____

GENERAL CONDITIONS OF THE AGREEMENT CONTENTS

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

1. DEFINITIONS

1.01 Calendar Day. A calendar day shall be the 24-hour period from one midnight to the next consecutive midnight.

1.02 Contract Documents. The Contract Documents shall consist of the Notice to contractors; the Instructions to Bidders; the proposal and Bidding Sheets; the executed Agreement; the Performance and Payment Bonds; the General Conditions of the Agreement; the Special Conditions of the Agreement; the Specifications; the Plans; the Standard Drawings; Addenda; and duly authorized Change Orders. The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. In case of conflict between the contract Documents, priority of interpretation shall be in the following order: Signed Agreement, Performance and Payment - Bonds, Addenda, Proposal, Special Conditions of the Agreement, Notice to Addenda, Proposal, Special Conditions of the Agreement, Notice to Contractors, Specifications, Plans, and General Conditions of the Agreement.

1.03 Contractor. "Contractor" shall mean the business organization or individual named and designated in the Contract Agreement as the "party of the Second Part," who has entered into this contract for the performance of the work covered thereby, and its, his, or their duly authorized agents and other legal representatives.

1.04 Engineer. "Engineer" shall mean River City Engineering, Ltd. or such other Engineer, supervisor, or inspector who has been designated, appointed, or otherwise employed or delegated by the OWNER for this work, or their duly authorized agents, such agents acting within the scope of the particular duties entrusted to them in each case.

1.05 Extra Work. The term "extra work" as used in this contract shall be understood to mean and include all work that may be required by the Engineer or OWNER to be done by the Contractor to accomplish any change, alteration, or addition to the work shown on the Plans, or reasonably implied by the Specifications, and not covered by the Contractors Proposal, except as provided under "Changes and Alterations," herein.

1.06 OWNER. "OWNER" shall mean CITY OF COPPERAS COVE, named and designated in the Agreement as the "Party of the First Part" acting through its duly authorized officers and agents.

1.07 Plans. "Plans" shall mean and include (a) all drawings prepared by the OWNER as a basis for proposal, (b) all supplementary drawings furnished by Engineer as and when required to clarify the intent and meaning of the drawings submitted by the OWNER to the Contractor, and (c) drawings submitted by the Contractor to the OWNER when and as approved by the Engineer.

1.08 Specifications. "Specifications" shall mean (a) all written descriptions, methods and instructions prepared by the OWNER as a basis for proposals, (b) all supplementary written material furnished by the Engineer as and when required to clarify the intent or meaning of all written descriptions, methods and instructions submitted by the OWNER to the contractors, and (c) written descriptions submitted by the Contractor to the OWNER when and as approved by the Engineer.

1.09 Subcontractor. "Subcontractor" shall mean and refer only to a business organization or individual having a direct contract with the Contractor for (a) performing a portion of the Contract work, of (b) furnishing material worked to a special design according to the Contract plans or specifications; it does not, however, include one who merely furnishes material not so worked.

1.10 Substantially Completed. The term "substantially completed" shall mean that the structure or facility has been made suitable for use and is in condition to serve its intended purpose, but still may require minor miscellaneous work and adjustments.

1.11 Work. "Work" shall mean the work to be done and the equipment, supplies, material, and services to be furnished under the Contract unless some other meaning is indicated by the context.

1.12 Working Day. A "working day" is defined as any day not including Sundays or legal holidays, in which weather or other conditions, not under the control of the Contractor, will permit construction of the principal units of the work for a continuous period of not less than seven (7) hours between 7:00 a.m. and 6:00 p.m.

1.13 Written Notice. "Written Notice" shall be deemed to have been duly served 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 certified or registered mail to the last business address known to him who gives the notice.

2. GENERAL PROVISIONS

2.01 Engineer's Status and Authority. It is mutually agreed by and between the parties to this Contract that the engineer shall have general supervision and direction of the work included herein. In order to prevent delays and disputes and to discourage litigation it is further agreed by and between the parties of this Contract that the Engineer shall in all cases determine the amounts and quantities of the several kinds of work which are to be paid for under the Contract; that he shall determine all questions in relation to said work and the construction thereof, that he shall in all cases decide every question which may arise relative to the execution of the Contract on the part of the contractor, that his decisions and findings shall be the conditions precedent to the right of the parties hereto to arbitration or to any action on the Contract and to the rights of the Contractor to receive any money under this Contract; provided, however, that should the Engineer render any decision or give any direction which in the opinion of either party hereto is not in accordance with the meaning and intent of this Contract, either party may file with the Engineer within 30 days a written objection to the decision or direction so rendered. It is the intent of this Agreement that there shall be no delay in the execution of the work, and the decision or directions of the Engineer as rendered shall be promptly carried out.

2.02 Right of Engineer to Modify Methods and Equipment. If at any time the methods or equipment used by the Contractor are found to be unsafe or inadequate to secure the quality of the work or the rate of progress required under this Contract, the Engineer may direct the Contractor in writing to increase their safety or improve their character and efficiency and to cease operations under this Contract until such direction is complied with. No claims shall be made against the OWNER for damages caused by any delay resulting from such order.

2.03 Changes and Alterations. The Contractor agrees that the OWNER, through the Engineer, may make such changes and alterations as the OWNER may see fit in the line, grade, form, dimensions, plans, or materials for the work herein contemplated or any part thereof either before or after the beginning of the construction without affecting the validity of this Contract and the accompanying bonds. If such changes or alterations diminish the quantity of the work to be done, they shall not constitute the basis for a claim for damages or anticipated profits on the work that may be dispensed with. If they increase the amount of work and the increased work can fairly be classified under the specifications, such increase shall be paid for according to the quantity actually done and at the unit price established for such work under this contract; otherwise such work shall be paid for as provided under Section 2.12 "Extra Work." In the event the OWNER shall make such changes or alternations which will make useless any work already done or material already furnished or used in said work, then the OWNER shall compensate the Contractor for any materials or labor so used, for any actual loss occasioned by such change, and for the actual expense incurred in preparation for the work as originally planned.

2.04 Damages. The right of general supervision by the OWNER shall not make the Contractor an agent of the OWNER, and the liability of the Contractor for all damages to persons, firms, and corporations arising from the Contractor's execution of the work shall not be lessened because of such general supervision. The Contractor is an independent contractor in regard to work under this Contract, and as such is solely liable for all damages to any persons, firms, corporations, or their property as a result of the execution of the work.

2.05 Losses from Natural Causes. All loss or damage arising out of the nature of the work to be done or from the action of the elements or from any unforeseen circumstances in the prosecution of the work or from unusual obstructions or difficulties which may be encountered in the execution of the work shall be sustained and borne by the Contractor at his own costs and expense.

2.06 Laws and Ordinances. The Contractor shall at all times observe and comply with all Federal, State, and local laws, ordinances, rules and regulations which in any manner affect the Contract or the work and shall indemnify and save harmless the OWNER against any claim arising from the violation of any such laws and ordinances whether by the Contractor or his employees or his subcontractors and their employees.

2.07 Licenses, Permits and Certificates. Except as hereinafter stipulated, all licenses, permits, certificates, etc. required for and in connection with the work to be performed under the provisions of these Contract Documents shall be secured by the Contractor at his own expense. In the event a building permit is required, such permit will be obtained by the OWNER at no cost to the Contractor.

2.08 Royalties and Patents. The Contractor shall protect and save harmless the OWNER from all and every demand for damages, royalties, or fees on any patented invention used by him in connection with the work done or material furnished under this Contract; provided, however, that if any patented material, machinery, application, or invention is clearly specified in this Contract, the cost of procuring the rights of use and the legal release or indemnity shall be borne and paid by the OWNER direct unless such cost is determined and directed to be included in the bid price at the time the Proposal is submitted.

2.09 Keeping of Plans and Specifications Accessible. The Engineer shall furnish the Contractor with three (3) sets of executed Plans and Specifications without expense to him, and the Contractor shall keep one (1) copy of the same constantly accessible on the work, with the latest revisions noted thereon.

2.10 Discrepancies and Omissions. It is further agreed that it is the intent of this Contract that all work must be done and all material must be furnished in accordance with the generally accepted practice, and in the event of any discrepancies between the separate contract documents, the priority of interpretation defined under "Contract Documents" shall govern. In the event that there is still any doubt as to the meaning and intent of any portion of the Contract, Specifications or Drawings, the Engineer shall define which is intended to apply to the work.

2.11 Contractor's Understanding. It is understood and agreed that the Contractor has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of equipment and facilities needed preliminary to and during the execution of the work, the general and local conditions, and all other matters which can in any way affect the work under this Contract. No verbal agreement or conversation with any officer, agent, or employee of the OWNER, either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained.

2.12 Extra Work. There term "extra work" as used in this Contract shall be understood to mean and include all work that may be required by the OWNER through the Engineer to be done by the Contractor to accomplish any change, alteration, or addition to the work shown by the Plans or reasonably implied by the Specifications and not covered by the contractor's Proposal, except as provided in Section 2.03 - "Changes and Alterations."

It is agreed that the Contractor shall perform all extra work under the direction of the Engineer when presented with a written Change Order signed by the OWNER.

No claim for extra work of any kind will be allowed unless ordered in writing by the OWNER. In case any orders or instructions, either oral or written, appear to the contractor to involve extra work for which he should receive compensation, he shall make a written request to the OWNER for a written Change Order authorizing such extra

work. Should a difference of opinion arise as to what does or does not constitute extra work or concerning the payment thereof and the OWNER insists upon its performance, the Contractor shall proceed with the work after making a written request for a written Change Order and shall keep an accurate account of the "actual field cost" thereof as provided under Method "C" below.

2.13 Payment for Extra Work. It is agreed that the compensation to be paid the Contractor for performing extra work shall be determined by one or more of the following methods:

Method "A" - By agreed unit prices;
Method "B" - By agreed lump sum; or
Method "C".If neither Method "A" nor Method "B" can be agreed upon before the extra work is commenced, then the Contractor shall be paid the "actual field cost" of the work plus 15%.

Where extra work is performed under Method "C", the term "actual field cost" of such extra work is hereby defined to be and shall include: (a) the payroll cost for all workman, such as foreman, mechanics, craftsmen, and laborers; (b) the cost of all materials and supplies not furnished by the OWNER; (c) rental for all power-driven equipment at agreed-upon rates for the time actually employed or used in the performance of the extra work; (d) transportation charges necessarily incurred in connection with any equipment authorized by the Engineer for use on said extra work and which is not already on the job; (e) all power, fuel, lubricants, water, and similar operating expenses; (f) all incidental expenses incurred as a direct result of such extra work including sales or use taxes on materials, payroll taxes, and the additional premiums for construction bonds, workmen's compensation, public liability and property damage, and other insurance required by the Contract where the premiums therefore are based on payroll and material costs. The Engineer may direct the form in which accounts of the "actual field costs" shall be kept and may also specify in writing before the work commences the method of doing the work and they type and kind of machinery and equipment to be used; otherwise these matters shall be determined by the Contractor. Unless otherwise agreed upon, the prices for the use of machinery and equipment shall be incorporated in the written extra work Change Order. The 15% of the "actual field cost" to be paid the Contractor shall cover and compensate him for his profit, overhead, and general superintendence.

2.14 Assignment and Subletting. The Contractor shall not assign or sublet the work or any part thereof without the previous written consent of the OWNER, nor shall he assign, by power of attorney or otherwise, any of the money payable under this Contract unless by and with the consent of the OWNER to be signified in like manner. If the Contractor assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to all prior liens of all persons, firms, and corporations for services rendered or materials supplied for the performance of the work called for in this Contract.

2.15 Subcontractors. The Contractor shall be as fully responsible to the OWNER for the acts and omissions of his subcontractors and of persons either directly or indirectly employed by him. Should any subcontractor fail to perform the work undertaken by him in a satisfactory manner, his subcontract shall be immediately terminated by the Contractor upon written notice from the OWNER.

2.16 OWNER's Status. Nothing contained in this Contract shall create any contractual relation between any subcontractor and the OWNER.

2.17 Completed Portions of Work. The OWNER shall have the right to take possession of and to use any completed or partially completed portions of the work prior to completion of the entire work, but such use shall not constitute an acceptance of any of the work not completed in accordance with the Contract Documents. If the Engineer determines that taking possession of and using partially completed work substantially increases the cost of or delays construction, the Contractor shall be entitled to extra compensation, extension of time or both as determined by the Engineer.

2.18 Materials. All materials furnished by the contractor shall be a required by the Plans and Specifications or

as otherwise stipulated. The Contractor shall not start delivery of materials which he is to furnish until the Engineer has approved the source of supply of such materials.

2.19 Receiving and Storage of Materials. The Contractor shall make arrangements for receiving and storing materials. The OWNER will not sign for or receive shipments of materials consigned to the Contractor. The OWNER will not furnish storage space for materials except where the written permission of the Engineer is given.

2.20 "Or Equal" Clause. Whenever a material, product, or article is specified or shown on the Plans by using the name of the proprietary product or of a particular manufacturer or vendor and is followed by the term "or equal," the Contractor may submit a written request to the Engineer requesting approval of the use of a material, product, or article he feels is truly equal to the one specified. The Engineer will evaluate the request to determine if the material, product, or article is of equal substance and function and if it will perform identically the duties imposed by the general design. Written approval of an "or equal" material, product, or article must be obtained from the Engineer before it may be incorporated into the work as a substitute for that specified in the contract Documents.

2.21 Completed Work. The Contractor shall maintain continuous adequate safeguards to protect all completed work from damage, loss, or the intrusion of foreign elements.

2.22 Materials Furnished by the OWNER. The contractor shall assume responsibility for and safeguard against loss or injury, any and all materials supplied by the OWNER. This provision shall extend to the taking of all necessary sanitary precautions to avoid contamination of such materials that must be maintained and incorporated into the work in a sanitary condition.

2.23 Protection of Property. The Contractor shall give reasonable notice to the OWNER or OWNERS of public or private property and utilities when such property is liable to injury or damage through the performance of the work and he shall make all necessary arrangements with such OWNER or OWNERS relative to the removal and replacement or protection of such property or utilities.

The Contractor shall satisfactorily shore, support, and protect any and all structures, and all pipes, sewers, drains, conduits, and the facilities belonging to the OWNER, and he shall be responsible for any damage resulting thereto. The Contractor shall not be entitled to any damages or extra pay as a result of any postponement, interference, or delay caused by any such structures and facilities being on the line of the work whether they are shown on the Plans or not.

2.24 Shelters for Workmen and Materials. The building or structures for housing men or the erection of tents or other forms of protection for workmen or materials will be permitted only as the Engineer shall authorize or direct. The sanitary conditions of the grounds in or about such structures shall at all times be maintained in a manner satisfactory to the Engineer.

2.25 Sanitary Facilities. Necessary sanitary toilet facilities for the use of all employees on the work shall be of a type complying with State and local sanitary regulations and shall be constructed and maintained by the Contractor in such manner and at such points as shall be approved by the Engineer. Their use shall be strictly enforced.

3. CONTRACTOR'S OBLIGATIONS AND RESPONSIBILITIES

3.01 Labor, Equipment, Materials and Construction Plant. The Contractor shall provide all labor, tools, equipment, machinery, supplies, and materials necessary for the execution and completion of this Contract where it is not specifically provided that the OWNER shall furnish them. The OWNER shall not be held responsible for the care, preservation, conservation, or protection of any material, tools, or machinery on any part of the work until it is finally completed and accepted. The contractor shall maintain on the job at all times sufficient labor, material, and equipment to adequately prosecute the work.

3.02 Performance and Payment Bonds. It is further agreed by the Parties to this Contract that the contractor will execute separate performance and payment bonds, each in the sum of 100% of the total Contract price in standard forms for this purpose, guaranteeing faithful performance of the work and the fulfillment of any guarantees required and further guaranteeing payment to all persons supplying labor and materials of furnishing him any equipment in the execution of the Contract. It is agreed that the Contract shall not be in effect until such performance and payment bonds are furnished and approved by the OWNER. The cost of the premium for the performance and payment bonds shall be included in the price bid by the Contractor for the work under thiss Contract, and no extra payment for such bonds will be made by the OWNER.

The surety company or companies underwriting the performance and payment bonds shall be acceptable according to the latest list of companies holding certificates of authority from the secretary of the Treasury of the United States, shall be duly authorized to act under the laws of the State of Texas as SURETY, and shall be approved by the OWNER.

3.03 Contractor's Ability to Perform. Upon receipt by the OWNER the Contractor shall furnish sufficient evidence of his ability to perform the work which is outlined in this document. This shall include an equipment inventory and records showing the satisfactory completion of projects of equal magnitude in the past. It shall be the prerogative of the OWNER to terminate the contract as outlined in Section 7 "Termination of contract," if job progress indicates that the contractor lacks either appropriate experience or ability.

3.04 Superintendence and Inspection. The contractor shall give personal attention to the faithful execution and completion of the contract and shall keep a competent superintendent and any necessary assistants, all of whom are satisfactory to the Engineer, on the work continuously during its progress. The superintendent shall represent the contractor in his absence, and all directions given to him by the OWNER'S representative shall be as binding as if given to the Contractor.

In the event that the Contractor and the superintendent are both absent from the site of the work for prolonged periods of time, the Engineer may order any or all work under this Contract to be stopped until the Contractor provides continuous and proper supervision of the work. Such stoppage shall not constitute a basis for any claim against the OWNER for damages caused by delay for such work stoppage.

3.05 Character of Employees. The Contractor agrees to employ only orderly, competent, and skillful persons to do the work, and whenever the Engineer shall inform him that the work being accomplished is of substandard character by reason of carelessness, incompetence, or inexperience on the part of the workers the installation of such work shall be immediately suspended and shall not be resumed until the Engineer is satisfied that the conditions causing such faulty work have been corrected.

3.06 Contractor's Duty to Protect Persons and Property. In the performance of this Contract, the Contractor shall protect the public and the OWNER fully by taking reasonable precaution to safeguard persons from death or bodily injury and to safeguard property of any nature whatsoever from damage. Where any dangerous condition or nuisance exists in and around construction sites, equipment and supply storage areas, and other areas in anyway connected with the performance of this Contract, the Contractor shall not create excavations, obstructions, or any dangerous condition or nuisance of any nature whatsoever in connection with the performance of this Contract unless necessary to its performance, and in that event the contractor shall provide and maintain at all times reasonable means of warning of any danger or nuisance created. The duties of the Contractor in this paragraph shall be non-delegable, and the Contractor's compliance with the specific recommendations and requirements of the OWNER as to the means of warning shall not excuse the Contractor from the faithful performance of these duties should such recommendations and requirements not be adequate or reasonable under the circumstances.

3.07 Safety Codes. The Contractor shall comply with all applicable provisions of any Federal, State, and Municipal safety laws and building and construction codes. All machinery, equipment, and other physical hazards shall be guarded in accordance with Federal, State, or Municipal laws or regulations.

3.08 Barricades. When barricades are used to satisfy safety requirements, such barricades shall be properly identified with the Contractor's name prominently stenciled on both sides of the barricades with letters at least 2 inches high.

3.09 Minimum Wages. All employees directly employed on the work shall be paid not less than the established prevailing wage scale for work of a similar character in this locality. The Contractor shall pay not less than the general prevailing wages as established by the U.S. Department of Labor and shall keep accurate wage records accessible in accordance with Article 5159 of the Revised Civil Statutes of Texas.

3.10 Unsuitable Work or Materials. It is understood and agreed that if the work or any part thereof or any material furnished by the Contractor for use in the work or selected for the same shall be deemed by the Engineer as unsuitable or not in conformity with the specifications, the Contractor shall, after receipt of written notice thereof from the Contracting Officer, forthwith remove such material and replace, rebuild, or otherwise remedy such work so that it shall be in full accordance with this Contract. Should the Contractor fail to initiate compliance with the above provision within 72 hours or should he fail to properly execute and complete correction of such faulty work, the Engineer may direct that the work be done by others and that the cost of the work be deducted from monies due the Contractor.

3.11 No Waiver of Contractor's Obligations. The Engineer, supervisor, or inspector shall have no power to waive the obligations of this contract for the furnishing by the Contractor of good material and of his performing good work as herein described and in full accordance with the plans and specifications. No failure or omission of the Engineer, supervisor, or inspector to condemn any defective work or material shall release the Contractor from the obligation to at once tear out, remove, and properly replace the same at any time prior to final acceptance upon the discovery of said defective work or material; provided, however that that Engineer, supervisor, or inspector shall upon request of the Contractor inspect and accept or reject any material furnished, and once the material has been accepted by the Engineer, supervisor, or inspector such acceptance shall be binding on the OWNER unless it can be clearly shown that such material furnished was not as represented and does not meet the specifications for the work. Any questioned work may be ordered taken up or removed for re- examination by the Engineer prior to final acceptance, and if found not in accordance with the specifications for the work. Any questioned work may be ordered taken up or removed for re-examination by the Engineer prior to final acceptance, and if found not in accordance with the specifications for said work, all expense of removing, re- examination, and replacement shall be borne by the Contractor; otherwise the expense thus incurred shall be allowed as "Extra Work" and shall be paid for by the OWNER.

3.12 Site Clean-Up. The Contractor shall not allow the site of the work to become littered with trash and waste material but shall maintain the site in a neat and orderly condition throughout the construction period. The Engineer shall have the right to determine what is waste material or rubbish and the manner and place of disposal. On or before the completion of the work the Contractor shall, without charge therefore, carefully clean out all pits, pipes, chambers, or conduits, shall tear down and remove all temporary structures built by him, shall remove all rubbish of every kind from the tracts or grounds which he has occupied, and shall leave them in a condition satisfactory to the Engineer.

3.13 Guarantee. During a period of 12 months from and after the date of the final acceptance by the OWNER of the work embraced by this Contract, the Contractor shall make all needed repairs arising out of defective workmanship, materials, or both, which in the judgment of the OWNER shall became necessary d during such period. If within 10 days after the mailing of a notice in writing to the Contractor or his agent the said Contractor shall neglect to make or to undertake with due diligence the aforesaid repairs, the OWNER is hereby authorized to make such repairs at the Contractor's expense; provided, however, that in case of an emergency where, in the judgment of the OWNER, delay would cause serious loss or damage, repairs may be made without notice being sent to the Contractor, and the contractor shall pay the cost thereof.

4. OWNER'S OBLIGATIONS AND RESPONSIBILITIES

4.01 Lines and Grades. All necessary lines and grade shall be furnished by the Engineer. Whenever necessary, work shall be suspended to permit performance of this work, but such suspension will be as brief as practicable, and the Contractor shall be allowed no extra compensation therefore. The Contractor shall give the Engineer ample notice of the time and place where lines and grades will be needed. All stakes, marks, etc. shall be carefully preserved by the Contractor, and in case of careless destruction or removal by him or his employees such stakes, marks, etc. shall be replaced by the Engineer at the Contractor's expense.

4.02 Right of Entry. The OWNER reserves the right for its personnel or its agents to enter the property or location on which the work herein contracted is being constructed on installed for the purpose of supervising and inspection the work for the purpose of construction or installing such collateral work as the OWNER may desire.

4.03 OWNER's Inspectors. It is agreed by the Contractor that the OWNER shall appoint such Engineer, supervisors, or inspectors as the said OWNER may deem necessary to inspect the material furnished and the work done under this Contract, to see that the said material is furnished, and to see that said work is done in accordance with the plans and specifications therefore. The Contractor shall furnish all reasonable aid and assistance required by the Engineer, supervisors, or inspectors for the proper inspection and examination of the work and all parts thereof. The Contractor shall regard and comply with the directions and instructions of the Engineer, supervisors, or inspectors so appointed when such directions and instructions are consistent with the obligations of this Contract.

4.04 Collateral Work. The OWNER reserves the right to provide all labor and material essential to the completion of work that is not included in this Contract either by a separate contract or otherwise. Any collateral work shall be executed in such a manner that it will not damage the Contractor nor delay the progress of the work being accomplished under this Contract. The respective rights of and operations of the various interests involved shall be established and coordinated by the Engineer.

4.05 Environmental Assessment. The OWNER will provide completed and approved Environmental Information Documents to the Contractor for each job site concurrent with the issuance of the Notice To Proceed. The Contractor may proceed with the preparation of submittal and site design upon receipt of the Notice of Award.

4.06 Right-of-Way. Easements across private property and lands needed for construction under this Contract will be provided by the OWNER.

4.07 Adequacy of Design. It is agreed that the OWNER shall be responsible for the adequacy of the design, sufficiency of the Contract Documents, the safety of the structure and practicability of the operations of the completed project; provided the Contractor has complied with the requirements of the said Contract Documents, all approved modifications thereof, and additions and alterations thereto approved in writing by the OWNER. The burden of proof of such compliance shall be upon the contractor to show that he has complied with said requirements of the Contract Documents, approved modifications thereof and all approved additions and alterations thereto.

5. SCHEDULING AND PROGRESS OF WORK

5.01 Order and Execution of the Work. It is the meaning and intent of this Contract, unless otherwise herein specifically provided, that the Contractor shall be allowed to execute his work at such times and seasons in such order of precedence and in such manner as shall be most conducive to economy of construction; provided however, that the order and time of execution shall be such that the work shall be completed as a whole or in part in accordance with this Contract within the time of completion hereafter designated; provided also that the Engineer may direct the time and manner of constructing any part or parts of the work when in his

opinion such should be given priority to lessen the probability of danger to the public or to anticipate seasonal hazards from the elements or to coordinate with other work being done for or by the OWNER.

5.02 Rate of Progress. The Contractor shall give the Engineer full information in advance as to his plans for carrying on any part of the work. If at any time prior to the start or during the progress of the work any part of the Contractor's plant or equipment or any of his methods of executing the work appear to the Engineer to be unsafe, inefficient, or inadequate to insure the required quality or rate of progress of the work, the Engineer may order the contractor to increase or improve his facilities or methods, and the Contractor shall promptly comply with such orders; failure to comply will result in placing Contractor in abandonment per Section 8 "Abandonment of Contract by Contractor," but neither compliance with such orders nor failure of the Engineer to issue such orders shall release the Contractor from his obligation to secure the degree of safety, the quality of work, and the rate of progress required by this Contract. The Contractor alone shall be responsible for the safety, adequacy, and efficiency of his plant, equipment, and methods.

5.03 Sunday, Holiday and Night Work. Except in connection with the care, maintenance, or protection of equipment or of work already done, no work shall be done between the hours of 6:00 p.m. and 7:00 a.m. or on Sundays or legal holidays without consent of the Engineer.

5.04 Hindrances and Delays. No claims shall be made by the Contractor for damages, hindrances, or delays from any cause during the progress of any portion of the work embraced by this Contract except where the work is stopped by order of the OWNER. If the OWNER stops the work for just cause because the contractor is not complying with the plans and specifications or the intent thereof, the Contractor shall have no claim for damages, hindrances, or delays. However, if the OWNER stops the work for any other reason, the Contractor shall be
entitled to reimbursement paid by the OWNER for such expenses actually incurred which in the judgment of the Engineer occurred as a result of the work
stoppage.

Should delays repeatedly occur due to the Contractor's failure to provide adequate plant, equipment, or personnel, or where the Engineer determines that unreasonable inconvenience to the public is due to such failure, the Contractor's operations shall be suspended until he shall have provided adequate plant, equipment, and personnel to properly resume and continually execute the work.

5.05 Extensions of Time. Should the Contractor be delayed in the final completion of the work by an act or neglect of the OWNER or Engineer, or of any employee of either, or by any other contractor employed by the OWNER, or by strikes, fire or other cause or caused outside of and beyond the control of the Contractor and which the Engineer determines could have been neither anticipated nor avoided, then an extension of time sufficient to compensate for the delay as determined by the Engineer shall be granted by the OWNER; provided, however, that the Contractor shall give the OWNER prompt notice in writing of the cause of delay in each case. Extensions of time will not be granted for delays caused by unfavorable weather, unsuitable ground conditions or inadequate construction force.

5.06 Liquidated Damages for Failure to Complete on Time. The Contractor agrees that time is of the essence on this Contract and that the definite value of damages which would result from delay would be incapable of ascertainment and uncertain, so that for each day of delay beyond the number of days herein agreed upon for the completion of the work herein specified and contracted for, after due allowance for such extension of time as is provided for under the provisions of the preceding paragraph, the OWNER may withhold permanently form the Contractor's total compensation, not a penalty but as liquidated damages, the sum per day given in the following schedule:

Amount of Contract			Amount of Liquidated Damages per Day
Less than		$ 5,000.00	$ 30.00
$ 5,001.00	to	15,000.00	35.00
15,001.00	to	25,000.00	40.00
25,001.00	to	50,000.00	50.00
50,001.00	to	100,000.00	70.00
100,001.00	to	500,000.00	200.00
500,001.00	to	1,000,000.00	300.00
1,000,001.00	to	2,000,000.00	400.00
2,000,001.00	to	5,000,000.00	500.00

6. INDEMNITY

6.01 Contractor's Indemnity Provision. To protect the OWNER from the Contractor's failure to perform any of the foregoing duties or any of the terms of this Contract, the Contractor shall indemnify and save harmless the OWNER and the OWNER's agents and employees from all losses, damages, judgments, decrees, and expenses or costs of any nature whatsoever arising out of or in any way connected with any claims or actions at law or in equity brought against the OWNER and the OWNER'S agents and employees for the death or injury to persons or for damage to property caused, or allegedly caused, by any willful acts, negligence, nuisance, or breach of any term or condition of this Contract by the Contractor, his agents, servants, subcontractors, or employees. The contractor shall furthermore indemnify and save harmless the OWNER and the OWNER'S agents and employees from all demands of subcontractors, workers, material persons, or suppliers of machinery and part thereof, equipment, power tools, and supplies incurred in connection with work to be performed under this Contract. Property of any description, including property of the OWNER, which shall be damaged in the performance of this Contract by the Contractor, his agents, employees, subcontractors or their employees and subcontractors shall be restored to its condition prior to damage by the Contractor at the Contractor's expense.

6.02 Workmen's Compensation Insurance. The Contractor agrees to comply with the Workmen's Compensation Act of the State of Texas, and to pay or cause to be paid all compensation, medical or other benefits, which may become due or payable thereunder, and to protect and indemnify the OWNER and the OWNER'S agents and employees from and against any and all liabilities by reason of accidental injury, disease, or death sustained by subcontractor's employees. The Contractor shall furnish the OWNER with a certificate from the industrial Accident Board evidencing the contractor's and subcontractor's compliance with said statute.

6.03 Comprehensive General Liability Insurance. The Contractor shall provide and maintain during the life of this Contract and until all work under said Contract has been completed and accepted by the OWNER, a Comprehensive General Liability insurance policy, said policy and the issuing carrier approved by the OWNER, which specifically insures the contractual liability of the contractor assumed under Paragraph 6.01 above entitled "Contractor's Indemnity Provision." The Liability limits for the Comprehensive General Liability insurance coverage under this policy shall not be less than the following:

Bodily Injury	$500,000 each person $1,000,000 each accident
Property Damage	$250,000 each accident $250,000 aggregate

A $1,000,000 umbrella coverage shall also be required.

6.04 OWNER'S Protective Insurance. The contractor shall provide and maintain during the life of this Contract and until all work under said Contract has been completed and accepted by the OWNER, and OWNER'S, Engineer's and Contractor's Protective Policy which co-insures the OWNER, Engineer, and the OWNER'S agents and employees with the same comprehensive General Liability coverage as described in Paragraph 6.03 above entitled "Comprehensive General Liability Insurance."

6.05 Comprehensive Automobile Liability Insurance. The Contractor shall provide and maintain during the life of this Contract and until all work under said Contract has been completed and accepted by the OWNER, a Comprehensive Automobile Liability insurance policy, said policy and issuing carrier approved by the OWNER, covering the operation on or off the site of the work of all motor vehicles licensed for highway use, whether they are owned, non-owned, or hired by the Contractor, in which shall specifically insure contractual liability of the Contractor assumed under the above Paragraph 6.1 entitled "Contractor's Indemnity Provision." The liability limits for the comprehensive Automobile Liability insurance coverage shall not be less than the following:

Bodily Injury	$250,000 each person $500,000 each accident
Property Damage	$500,000 each accident

6.06. Insurance Certificate. In connection with the insurance coverage set out in Sections 6.02, 6.03, 6.04, and 6.05 above, the Contractor shall furnish the OWNER with a certificate verifying said insurance. The Owner shall be listed as the Certificate holder, and the Owner and Engineer shall be named as additional insured. Said certificate shall state the OWNER shall be given 10 days advance written notice before any provision of the policies are changed or in the event said policies shall be canceled. This Certificate of Insurance shall be provided the OWNER prior to starting any construction work in connection with this Contract.

7. TERMINATION OF CONTRACT

7.01 Right of OWNER to Terminate. If the Contractor should be guilty of substantial violation of the Contract or any provision thereof, the OWNER, upon certification by the Engineer as to the nature and extent of such violation, may without prejudice to any other resources or remedy give the contractor written notice of termination of the employment of the contractor 10 days subsequent to such notice. Immediately following such date the OWNER may take possession of the site of the work and all material, equipment, tools, and appliances thereon and may finish the work in accordance with the provisions of Section 8 "Abandonment of Contract by Contractor," of these General Conditions.

7.02 Right of Contractor to Terminate. If work should be stopped by order of any public authority or court through no act or fault of the Contractor for a period of three (3) months or if the OWNER should substantially fail to perform the provisions of the Contract with regard to OWNER'S obligations to the contractor, then the contractor may, upon 10 days written notice to the OWNER, terminate this Contract and recover from the OWNER payment for all completed work.

7.03 Removal of Equipment. In the event that the Contract should be terminated for any reason whatsoever, the OWNER may request the contractor in writing to remove any or all of his equipment, tools, and supplies, and the contractor shall comply with the request within 10 days after receipt of the notice. Should he fail to do so within 10 days after receipt of such notice, the OWNER shall have the right to remove such equipment and supplies at the expense of the Contractor and to place such equipment, tools and supplies in storage at the risk and expense of the Contractor.

8. ABANDONMENT OF CONTRACT BY CONTRACTOR

8.01 Notification of Contractor. If the contractor should abandon and fail or refuse to resume work within 10 days after written notification from the OWNER or the Engineer of if the Contractor fails to comply with the orders of the engineer when such orders are consistent with this contract or with the specifications hereto attached, then the Contractor shall be deemed as having abandoned the Contract. In such event the SURETY on the bond shall be notified in writing and directed to complete the work, and a copy of said notice shall be delivered to the Contractor.

8.02 Retention of Contractor's Equipment and Materials by OWNER. After receiving said notice of abandonment the contractor shall not remove from the work any machinery, equipment, tools, materials, or supplies then on the job, but the same together with any materials and equipment under contract for the work may be held for use on the work by the OWNER or the SURETY on the performance bond or another contractor in completion of the work; and the Contractor shall not receive any rental or credit therefore except when used in connection with extra work where credit shall be allowed as provided for under Section 2.12 entitled "Extra Work," it being understood that the use of such equipment and materials will ultimately reduce the cost to complete the work and will be reflected in the final settlement.

8.03 Methods of Completing the Work. If the SURETY should fail to commence in compliance with the notice for completion provided within 10 days after service of such notice, then the OWNER may provide for completion of the work in either of the following elective manners:

a. The OWNER may employ such force of workers and use such machinery, equipment, tools, materials, and supplies as said OWNER may deem necessary to complete the work and charge the expense of such labor, machinery, equipment, tools, material, and supplies to said Contractor, and the expense so charged shall be deducted and paid by the OWNER out of such monies as may be due or that may thereafter at any time become due to the Contractor under and by virtue of this Contract. In case such expense is less than the sum which would have been payable under this Contract if the same had been completed by the Contractor, then said Contractor shall receive the difference. In case such expense is greater than the sum which would have been payable under this contract if the same had been completed by said Contractor, then the Contractor or his SURETY shall pay the amount of such excess to the OWNER.

b. The OWNER under sealed bids, after 14 days' notice published two or more times in a newspaper having a general circulation in the county of location of the work, may let the contract for the completion of the work under substantially the same terms and conditions which are provided in this Contract. In case of any increase in cost to the OWNER under the new contract as compared to what would have been the cost under this Contract, such increase shall be charged to the Contractor, and the SURETY shall be and remain bound therefore. However, should the cost to complete any such new contract prove to be less than what would have been the cost to complete under this Contract, the Contractor or his SURETY shall be credited therewith.

8.04 Final Acceptance. When the work has been completed the Contractor and his SURETY shall be so notified and a Contract Completion Certificate as hereinafter provided shall be issued. A complete itemized statement of the Contract amounts certified by the Engineer as being correct shall then be prepared and delivered to the Contractor and his SURETY, whereupon the contractor, his SURETY, or the OWNER, as the case may be, shall pay the balance due as reflected by said statement within 15 days after the date of such Contract Completion certificate.

8.05 Disposition of Contractor's Equipment. In the event the statement of accounts shows that the cost to complete the work is less than that which would have been the cost to the OWNER had the work been completed by the Contractor under the terms of this Contract or when the Contractor or his SURETY pay the balance shown to be due by them to the OWNER, then all machinery, equipment, tools, materials, or supplies left on the

site of the work shall be turned over to the Contractor or his SURETY. Should the cost to complete the work exceed the contract price, and the contractor or his SURETY fail to pay the amount due the OWNER within the time designated, and there remains any machinery, equipment, tools, materials, or supplies on the site of the work, notice thereof together with an itemized list of such equipment and materials shall be mailed to the Contractor and his SURETY as the respective addresses designated in this Contract; provided, however, that actual written notice given in any manner will satisfy this condition. After mailing or other giving of such notice such property shall be held by the OWNER at the risk of the Contractor or his SURETY subject only to the duty of the OWNER to exercise ordinary care to protect such property. After 15 days from the date of said notice the OWNER may sell such machinery, equipment, tools, equipment, or supplies and apply the sum derived from such sale to the credit of the Contractor and his SURETY. Such sale may be made at either public or private sale, with or without notice, as the OWNER may elect. The OWNER shall release any machinery, equipment, tools, materials, or supplies which remain on the work and belong to persons other than the Contractor or his SURETY to their proper OWNERS.

9. MEASUREMENT AND PAYMENT

9.01 Character of Measurements. No extra or customary measurements of any kind will be allowed, but the actual length, area, solid contents, number, and weight only shall be considered unless otherwise specifically provided.

9.02 Estimates vs. Actual Quantities. Any and all estimated quantities stipulated in the proposal form under unit price items are approximate and are to be used only (a) as a basis for estimating the probable cost of the work and (b) for the purpose of comparing the proposals submitted for the work. It is understood and agreed that the actual amounts of work done and materials furnished under unit price items may differ from such estimated quantities and that the basis of payment for such work and materials shall be for the actual amount of such work done and the actual quantity of materials furnished.

The Contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the amounts estimated therefore in the proposal or other Contract Documents; provided, however, that if the actual quantity of any item should become as much as 25 percent more than or 25 percent less than the estimated or contemplated quality for such items, then either party to this Contract shall be entitled upon demand to a revised consideration on the portion of the work above or below 25 percent of the estimated quantity prior to initiating work or furnishing materials for the overrun or under-run quantities. Such revised consideration shall be determined by agreement between the parties or otherwise by the terms of this Contract as provided under Section 2.12 entitled “Extra Work.”

9.03 Payment. In consideration of the furnishing of all the necessary labor, equipment, and material and the completion of all work by the Contractor, and on the completion of all work and the delivery of all material embraced in this Contract in full conformity with the specifications and stipulations contained herein, the OWNER agrees to pay the Contractor the amounts set forth in the proposal attached hereto which has been made a part of this Contract. The Contractor hereby agrees to receive such amounts in full payment for furnishing all material and all labor required for the aforesaid work, for all expense incurred by him, and for well and truly performing the same and the whole thereof in the manner and according to this Contract, the attached specifications, and requirements of the Engineer.

9.04 Monthly Estimates and Payments. On or about the fifth day of each month the Engineer will make an approximate estimate of the value of work done in conformity with the plans and specifications during the previous calendar month. The Contractor shall furnish to the Engineer such detailed information as he may request to aid him as a guide in the preparation of monthly estimates. After each such estimate shall have been approved by the OWNER, the OWNER shall pay to the Contractor 90 percent of the amount of such estimated sum on or before the 25th day of said month. It is understood, however, that in case the whole work is near to completion and some unexpected or unusual delay occurs due to no fault or neglect on the part of the

Contractor, the OWNER upon written recommendation of the Engineer, pay a reasonable and equitable portion of the retained percentage to the Contractor.

9.05 Certificates of Completion. Within 10 days after the Contractor has given the Engineer notice that the work has been completed, the Engineer shall inspect the work and satisfy himself by examination and test that the work has been finally and fully completed in accordance with the plans, specifications and contract. If so, the Engineer shall issue a Contract Completion Certificate to the OWNER and the Contractor. Such certificate when issued shall constitute final acceptance of the work covered under this Contract.

9.06 Final Estimate and Payment. After the Contract Completion Certificate has been issued, the Engineer shall proceed to make final measurements and to prepare a final estimate of the work done and materials furnished under this Contract and the value thereof. The Engineer shall certify the Final Estimate and submit it to the OWNER within five (5) days from the date of the Contract Completion Certificate.

The OWNER shall pay the Contractor within 15 days from the date of the Contract Completion Certificate the entire sum shown due on the certified Final Estimate prepared by the Engineer after deducting all amounts to be kept and retained under any provision of this Contract. However, it is to be specifically understood that the final payment will not be paid by the OWNER to the Contractor under any circumstances until the Notarized Affidavit required by Section 9.07 entitled "Notarized Affidavit," has been submitted to the Engineer.

All prior estimates and payments shall be subject to correction in the final estimate and payment; but in the absence of error or manifest mistake, it is agreed that all estimates, when approved by the OWNER, shall be conclusive evidence of the work done and materials furnished.

9.07 Notarized Affidavit. Before final payment for the work by the OWNER, the Contractor shall submit to the Engineer a notarized affidavit in duplicate stating under oath that all subcontractors, vendors, and other persons or firms who have furnished or performed labor or furnished materials for the work have been fully paid or satisfactorily secured. Such affidavit shall bear or be accompanied by a statement, signed by the SURETY Company who provided the performance bond for the work, to the effect that said SURETY Company consents to final payment to the contractor being made by the OWNER.

9.08 Release of Liability. The acceptance by the Contractor of the last payment shall operate as and shall be a release to the OWNER and every officer and agent thereof from all claims and liability hereunder for anything done or furnished for or relating to the work or for any act or neglect of the OWNER or of any person relating to or affecting the work.

9.09 Contractor's Obligation. Neither the Contract Completion Certificate nor the final payment nor any provision in the Contract Documents shall relieve the contractor of the obligation for fulfillment of any warranty which may be required in the Contract Documents.

9.10 Payments Withheld. The OWNER may on account of subsequently discovered evidence, withhold or nullify the whole or part of any payment to such extent as may be necessary to protect himself from loss on account of:

a. Defective work not remedied.
b. Claims filed or reasonable evidence indicating probable filing of claims.
c. Failure of the Contractor to make payments properly to subcontractors or for material or labor.
d. Damage to another contractor.

When the above grounds are removed or the Contractor provides a SURETY Bond satisfactory to the OWNER, which will protect the OWNER in the amount withheld, payment shall be made for amounts withheld because of them.

END OF SECTION

SPECIAL CONDITIONS OF THE AGREEMENT

City of Copperas Cove – Mountain Top North 300,000 Gallon Elevated Storage Tank

SECTION 01: INFORMATION

1.01 COPIES OF PLANS AND SPECIFICATIONS FURNISHED

The Agreement will be prepared in not less than seven (7) counterpart (original signed) sets. OWNER will furnish Contractor two (2) sets of conforming Contract Documents, Technical Specifications and Plans free of charge, and additional sets will be obtained from the Engineer at commercial reproduction rates plus 20% for handling.

1.02 GOVERNING CODES

All construction as provided for under these Plans and Specifications shall be governed by any existing Resolutions, Codes and Ordinances, and any subsequent amendments or revisions thereto as set forth by the OWNER.

1.03 ADDITIONAL SPECIFICATIONS

All work shall be performed according to the plans and specifications provided herein. If an item of work is not covered within the specifications, the appropriate City of Copperas Cove Standard Specifications shall prevail.

1.04 PAY ESTIMATES

If pay estimates from the Contractor are not received by the Engineer on or before the time specified in Section 9.04 of the General Conditions, then the pay estimate will not be processed and will be returned to the Contractor.

SECTION 02: SPECIAL CONSIDERATIONS

2.01 CROSSING UTILITIES

Prior to commencing construction, it shall be the Contractor's responsibility to make arrangements with the OWNERs of such utility companies to uncover their particular utility lines or otherwise confirm their location. Certain utility companies perform such services at their own expense, however, where such is not the case, the Contractor will cause such work to be done at this own expense.

2.02 "AS-BUILT" DRAWINGS

The Contractor shall mark all changes and revisions on all of his copies of the working drawings during the course of the Project as they occur. Upon completion of the Project and prior to final acceptance and payment, the Contractor shall show field locations of all above ground appurtenances, including but not limited to, valves, fire hydrants and manholes. Each appurtenance shall be located by at least two horizontal distances measured from existing, easily identifiable, immovable appurtenances such as fire hydrants or valves. Property pins can be used for as-built tie-ins provided no existing utilities as previously described are available. Costs for developing as-built drawings shall be subsidiary to other bid items. Prior to submission of final as-built drawings to the Engineer, the Contractor shall meet with representatives of the OWNER and Engineer on the site to verify the accuracy and completeness of the as-built drawings.

2.03 LANDS FOR WORK

OWNER provides, as indicated on the drawings, land upon which work is to be done, rights-of-way for access to some and such lands which are designated for use of Contractor. Contractor provides, at his expense and without liability of OWNER, any additional land and access thereto that may be required for his construction operations, temporary construction facilities, or for storage of materials.

2.04 UTILITY SERVICES FOR CONSTRUCTION

The Contractor will be responsible for providing his own utility services during construction. No additional payment will be made for this item.

2.05 GUARANTEES

Guarantee work, including equipment installed, to be free from defects due to faulty workmanship or materials for a period of one (1) year from the date of final acceptance by the OWNER. Upon notice from OWNER, repair defects in all construction which develop during specified period at no cost to the OWNER. Neither final acceptance, Certificate of Completion, final payment, nor any provision in Contract Documents relieves the Contractor of above guarantee. Notice of observed defects will be given with reasonable promptness. Failure to repair or replace defect upon notice entitles OWNER to repair or replace same and recover reasonable cost thereof from Contractor.

2.06 DEVIATIONS OCCASIONED BY UTILITY STRUCTURES

Whenever existing utilities, not indicated on the Plans, present obstructions to grade and alignment of pipe, immediately notify Engineer, who without delay, will determine whatever existing improvements are to be relocated, or grade and alignment of pipe changed. Where necessary to move existing services, poles, guywires, pipelines, etc., as determined by the Engineer, the Contractor will make arrangements with the OWNER of the utility to be moved and have it moved. The cost of any utility relocation will be at the Contractor's sole expense. OWNER will not be liable for relocation costs or damages on account of delays due to changes made by OWNER'S of privately owned utilities which hinder progress of the work.

2.07 MINIMUM WAGE SCALE / PREVAILING WAGE RATES

Minimum wage scale as specified and regulated by the State of Texas and the Federal Government.

The Contractor or a subcontractor of the Contractor shall pay not less than the rates as determined by the Davis-Bacon Wage Determinations for Coryell County Heavy construction, General Decision TX160016 and TX160033, or current.

2.08 LIMIT OF FINANCIAL RESOURCES

The OWNER has a limited amount of financial resources committed to this Project; therefore, it shall be understood by all Bidders that the OWNER may be required to change and/or delete any times which OWNER may feel is necessary to accomplish all or part of the scope of work within its limit of financial resources.

Contractor shall be entitled to no claim for damages for anticipated profits on any portion of work that may be omitted. At any time during the duration of this Contract, the OWNER reserves the right to omit any work from this

Contract. Unit prices for all items previously approved in this Contract shall be used to delete or add work per change order.

2.09 CONSTRUCTION REVIEW

The OWNER shall provide a project representative to review the quality of materials and workmanship.

2.10 LIMITS OF WORK AND PAYMENT

It shall be the obligation of the Contractor to complete all work included in this Contract, so authorized by the OWNER, as shown on the drawings or described in the Contract Documents and Technical Specifications. All items of construction not specifically paid for in the bid schedule shall be included in the unit price bids. Any questions arising as to the limits of work shall be left up to the interpretation of the Engineer.

2.11 PAYMENT FOR MATERIALS-ON-HAND

OWNER shall pay for 90% of amount of materials-on-hand in accordance with monthly estimate procedure stipulated in the General Conditions of the Agreement.

2.12 CONSTRUCTION STAKING

The Contractor shall provide construction staking for this Project. The Contractor shall furnish and pay for any re-staking.

Protection of Stakes, Marks, Etc.

All engineering and surveyor's stakes, marks, property corners, etc. shall be carefully preserved by the Contractor, and in case of destruction or removal during the course of this Project, such stakes, marks, property corners, etc. shall be re-staked by the Contractor at the Contractor's sole expense without additional compensation by the OWNER.

The Contractor shall furnish to the OWNER, at the Contractor's expense, the Engineer's certification that all property pins are in place prior to his moving off the job site. Such certification will be expected of each Contractor involved with the time periods specified:

1. Street Contractor - after subgrade, before Utility contractor moves in.
2. Utility Contractor - after utilities are installed, before installation of gas.
3. Gas Contractor -after gas installation, before Street Contractor moves back in.
4. Street Contractor - after streets installed, before final acceptance.

SECTION 03: INSURANCE

Insurance policies must be obtained by the Contractor or separate endorsement obtained by his existing insurance policies on projects that involve special hazards, such as blasting, excavation on public properties, etc.
The principal types of insurance which will be necessary are:

Comprehensive general liability insurance.
The Contractor shall provide and maintain during the life of this Contract, and until all work under said Contract has been completed and accepted by the OWNER, a Comprehensive General Liability insurance policy, said policy and

the issuing carrier approved by the OWNER, which specifically insures the contractual liability of the Contractor assumed under Paragraph 6.01 in the General Conditions entitled "contractor's Indemnity Provision." The liability coverage under this policy shall cover Independent Contractors. Liability limits for the Comprehensive General Liability insurance coverage under this policy shall not be less than the following:

Bodily Injury	$300,000 each person $300,000 each accident
Property Damage	$100,000 each accident $100,000 aggregate

A $500,000 umbrella coverage shall also be required.

Public Liability and Property Damage to protect the Contractor, any of his subcontractors, the OWNER, and the Engineer against claims arising from personal injury, including accidental death, as well as claims for property damage.

The amount for liability is $250,000/$500,000. The amount for property damage is $100,000 per accident.

Automobile and Truck Public Liability and Property Damage to protect the same individuals as indicated under Public Liability and Property Damage above, and in the same amount of liability.

Worker's Compensation and Employer's Liability.

Builder's Risk Insurance is necessary to cover loss of or damage to the building materials while the Project is under construction.

The contractor shall supply to the OWNER a Certificate of Insurance, on a form supplied by the insurance companies or a form similar to the attached sample from the Contractor prior to the start of work.

Owner's Protective as required by the General Conditions of the Agreement.

END OF SECTION

ABBREVIATIONS

City of Copperas Cove – Mountain Top North 0.3-MG Elevated Storage Tank

PART 1. GENERAL

1.01 SCOPE OF WORK

A. Whenever in these Contract Documents the following abbreviations are used, the intent and meaning shall be Interpreted as follows:

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturers' Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGMA	American Gear Manufacturers' Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Associations
API	American Petroleum Institute
AREA	American Railway Engineering Association
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers' Association
AWPB	American Wood Preservers' Bureau
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builder's Hardware Manufacturers' Association
CBMA	Certified Ballast Manufacturers' Association
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers' Association of America
CRSI	Concrete Reinforcing Steel Institute
Fed. Spec.	Federal Specialist
HI	Hydraulic Institute
HMI	Hoist Manufacturers' Institute
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IPCEA	Insulated Power Cable Engineer's Association
MMA	Monorail Manufacturers' Association
NACE	National Association of Coatings Engineers
NBMA	National Builders' Hardware Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NLMA	National Lumber Manufacturers' Association
NWMA	National Woodwork Manufacturers' Association
OECI	Overhead Electrical Crane Institute
OSHA	Occupational Safety and Health Act (both Federal & State)
PS	Product Standards Sections – U.S. Department of Commerce
RMA	Rubber Manufacturers' Association
SAE	Society of Automotive Engineers
SSPC	Steel Structures Painting Council
TCA	Tile Council of America
TEMA	Tubular Exchanger Manufacturers' Association
UBC	Uniform Building Code
UL	Underwriter's Laboratories, Inc.
WWPA	Western Wood Product Association

STANDARD

CONSTRUCTION SPECIFICATIONS

OF THE

CITY OF COPPERAS COVE, TEXAS

FEBRUARY 1980 - REVISED 1990

AN ORDINANCE

AN ORDINANCE AMENDING THE CODE OF ORDINANCES OF THE CITY OF COPPERAS COVE, TEXAS, BY AMENDING SECTION 8-2 ADOPTING THE STANDARD CONSTRUCTION SPECIFICATIONS OF THE CITY OF COPPERAS COVE DATED FEBRUARY 1980 AND ANY SUBSEQUENT REVISIONS THERETO:

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF COPPERAS COVE, TEXAS, That the Code of Ordinances, City of Copperas Cove, Texas, Section 8-2 be amended to read as follows:

SECTION 1: The attached Standard Construction Specifications of the City of Copperas Cove dated February 1980 and any subsequent revisions thereto are included as a part of this ordinance. All facilities constructed within the existing public right-of-way or newly dedicated right-of-way shall conform to the applicable provisions of these Standard Construction Specifications of the City of Copperas Cove, including any subsequent revisions, or to the Standard Construction Specifications in effect when the work is accomplished.

SECTION 2: Considering the fact that the existing City of Copperas Cove plumbing ordinance of April 15, 1956, now covers construction operations as performed by Plumbers in the City limits, this ordinance shall not be construed to include plumbing operations when such operations are being conducted from a point two (2) feet behind the curb line, or future curb line, to and including the plumbing for the building to be served. However, when a plumbing contractor exceeds these limits, his operations shall be deemed those of a contractor and in this case, shall be governed by these specifications and this ordinance.

SECTION 3: This ordinance shall not be construed to include a person, individual partnership, corporation which constructs or contracts to construct a building which will receive service from City owned utility lines and appurtenances, said persons being included under existing ordinances.

SECTION 4: In the event any section, sub-section, sentence, clause or phrase of this ordinance shall be declared or adjudged invalid or unconstitutional, such adjudication shall in no means affect any other sections, sub-sections, sentences, clauses or phrase of this ordinance, but all the rest hereof shall be in full force and effect just as though the section, sub-section, sentence, clause or phrase so declared are adjudged invalid or unconstitutional was not originally a part hereof.

SECTION 5: All ordinances or part of ordinances inconsistent or in conflict with the provisions of this ordinance shall be void and the same are hereby repealed.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF COPPERAS COVE, TEXAS this 19th day of FEBRUARY, 1980, at which meeting a quorum was present.

/s/ R.D. Mitchell
MAYOR
City of Copperas Cove, Texas

ATTEST:
/s/ Rose E. Mansfield
Rose E. Mansfield, City Secretary

TABLE OF CONTENTS

GENERAL PROVISIONS

1. DEFINITIONS: The following definitions of terms as used in the Technical Specifications and elsewhere shall apply:

   City shall refer to the governing body of the City of Copperas Cove or to the office or employees to which or to whom appropriate authority has been delegated.

   City Manager shall refer to the City Manager or to his designated representative.

   City Engineer, or Engineer shall refer to the staff City Engineer or to a representative designated by the City Manager.

   Approved - where the word "approved" or the phrase "as approved" appears in the Standard Specifications, it shall be construed to refer to approval by the City Engineer or the City Manager.

   City Inspector or Inspector shall refer to the City Engineer or any duly authorized representative of the Engineer who is performing field inspection of the work.

   Developer, Sub-Divider, or Contractor - these terms shall be construed as referring to the individual(s) or firm(s) alike who are responsible for the work within the public right-of-way and is not intended to differentiate between the individuals or firms for the purpose of settling responsibility.

   Public Right-of-Way for the purpose of these specifications shall include all publicly owned or controlled property within the property lines established by approved plats, deeds, or easements.

2. APPLICABILITY: These standards are intended to apply primarily to the design and construction of new developments, subdivisions, or additions to the City of Copperas Cove. However, they may be used also for contract work directly with the City for work within previously developed areas, as applicable and as stipulated in the Contract.

3. PLANS AND PROCEDURES: Prior to initiation of any construction work in connection with any planned development, subdivision or addition within the City or proposed for annexation, the developer shall submit plats, plans, drainage studies, and other data for approval as required by the current Subdivision Ordinance, these specifications and any current revisions thereto, and any other applicable Ordinances or Standards in effect at the time of application. Prior to final approval and acceptance of the plat, plans shall be sufficiently complete to permit engineering review and approval of the proposed work, and shall include as a minimum plans and profiles of streets, drainage facilities, and gravity sewer lines. Plans shall also include locations, sizes, and other pertinent data for water lines, force mains, lift stations, and off-site work required to connect to existing facilities. The amount of detail required shall be commensurate with the size and complexity of the project. However, all plans will be required to conform to all applicable provisions of these Standard Specifications.

4. CONSTRUCTION PROCEDURES:

   A. Contractor's Public Responsibility:

(1) The Contractor shall at all times conduct the work in such manner as to insure the least possible obstruction to public traffic and protect the safety of the public. Public safety and convenience and provisions therefore made necessary by the work shall be the direct responsibility of the Contractor and shall be performed at his entire expense. Materials placed on the site, or materials excavated and the construction materials or equipment used shall be located so as to cause as little obstruction to the public as possible. The Contractor shall at all times conduct his operations and the use of construction machinery, so as not to damage or destroy improvements, trees and shrubs located adjacent to the site of the work. Whenever any such damage may be done, the Contractor shall immediately satisfy all claims of the property owners.

(2) The Contractor shall at all times conduct the work in such manner as to insure no damage to existing utilities or other facilities. However, in the event that damage is done to existing utilities, the Contractor shall repair and replace them immediately and at his entire expense. In the event public facilities are damaged which cannot be replaced or repaired by the Contractor, the Contractor shall inform the City or the Utility Company involved and will reimburse them for the replacing or repairing of the item damaged. This reimbursement shall be a prerequisite to any acceptance of the construction which was responsible for the damage.

(3) The Contractor shall save harmless the City from his operations, shall provide bonds, insurance, etc., as required by law.

(4) Contractor shall be an Equal Opportunity Employer and comply with all applicable regulations.

B. QUALITY CONTROL:

(1) Materials - The Contractor shall furnish such evidence as may be requested by the City Engineer that materials furnished for incorporation in the work comply with the requirements of these Standard Specifications. Manufacturer's Certifications, certified copies of independent laboratory tests, shop drawings, catalog literature, or similar data will normally be considered sufficient. Any materials not meeting specification requirements shall be removed from the site.

(2) Construction:

(a) If work is being performed as a part of a new subdivision the City shall determine the need for laboratory and field testing to assure that materials and construction complies with the requirements of the plans and specifications. Generally, laboratory and field testing requirements will not exceed those set out below for other than new subdivisions. All costs shall be paid by the subdivider. Should test results indicate failure to comply, the subdivider shall also pay for additional tests required to assure compliance.

(b) If work being performed is not a part of a new subdivision, the Contractor shall be responsible for the cost of tests required to assure compliance with the specifications on the following basis:

1) A modified Proctor Density test for each type of material to be used in all types of construction where density requirements are specified.

2) One field density test for each type of material in each section, however short that section may be; in the case of a street more than four-hundred (400) linear feet in length, there shall be

required one (1) for each four-hundred (400) linear feet of street constructed. All locations for tests shall be determined by the City inspector. Areas where failures occurred will be retested.

3) Where materials such as flexible base, sub-base, portland cement concrete and hot-mix asphaltic concrete are used, sufficient tests as determined by the City inspector will be made to assure compliance to specification requirements. Other materials may be accepted on the basis of manufacturers literature and grade markings at the option of the City Engineer.

4) All tests required by these specifications will be conducted by a commercial testing laboratory operating under the supervision of a registered professional engineer.

(3) Supervision and Inspection: The Developer or Contractor is responsible for compliance with the approved plans and the applicable provisions of these Standard Construction Specifications and shall furnish sufficient supervision to insure that the work is accomplished in a satisfactory manner. The City Engineer will inspect the work sufficiently to satisfy himself that the work does comply with all requirements. It shall be the Contractor's responsibility to keep the Engineer advised of scheduled work and to notify the Engineer when work is ready for inspection or acceptance, and no work or increments thereof will be accepted without inspection unless the requirement for inspection is waived by the Engineer.

(4) Reference Specifications and Standards : When specifications and standards such as ASTM, AASHO, AWWA, ASA, and other association standards are referenced in the specifications, it shall be interpreted to refer to the latest or current issue of the standard or specification.

(5) Standard Details: The Standard and Typical details and drawings bound in the back of these specifications shall be considered an extension of the plans and these specifications and any reference to the plans, specifications, and/or details shall be construed as including these details and drawings.

(6) Warranty: Notwithstanding any certificate or other indication of acceptance which may have been given by the City Engineer, if any materials, equipment or any workmanship which does not comply with the requirements of this contract shall be discovered within one (1) year after final completion of construction of the project, and acceptance by the Owner, the Contractor shall replace such defective materials or remedy any such defective workmanship within ten (10) days after notice in writing of the existence thereof shall have been given by the City or Engineer. In the event of failure by the Contractor to replace any such defective materials or equipment or to remedy defective workmanship as herein provided, the City may replace such defective materials or equipment or remedy such workmanship as the case may be and in such event the Contractor shall pay to the City the cost and expense thereof.

(7) Bridges, Culverts, and Special Drainage Structures: Requirements for design and construction of bridges, culverts, and special drainage structures are not included herein, and shall be subject to the approval of the City Engineer in all instances.

(8) Protection of Existing Utilities: Existing utilities are indicated on the City maps from available information. The Contractor is advised that any reference to or indication of existing utilities on these maps is solely for the City's general information and is not to be construed as indicating the exact location or number of said utilities. The locations shown on the maps relative to existing

utilities are based upon the best record and/or field information available. It shall be the Contractor's responsibility to verify the location of adjacent and conflicting utilities and to take all necessary precautions in order to protect all utilities encountered.

(9) Order of Work: Unless otherwise approved by the City Engineer, all rough grading for streets shall be accomplished prior to the installation of any underground utility systems. All utilities shall be completed prior to the subgrade preparation, construction of curb and gutter, and construction of the base course for the streets.

TECHNICAL SPECIFICATIONS

ITEM 1

TRENCHING AND BACKFILLING

1. General: All excavation, trenching and backfilling for utility lines and appurtenant structures shall conform to the requirements of this specification and to the applicable typical details attached to these specifications. The inspector shall have the right to limit the amount of trench opened in advance or left open after pipe laying.

2. Excavation: Trench excavation shall be to the lines and grades shown on the plans or standard details or as required by the specifications for the line work to be installed therein. The City inspector may direct or authorize deviations where appropriate at his discretion. Excavation for structures shall be sufficient to accommodate forms, where required. Overdepth excavation shall be avoided. All excavation, regardless of the materials encountered, shall be unclassified so far as payment is concerned.

3. Methods of Excavation: Excavation may be performed with any type of trenching or excavating equipment which is capable of cutting properly aligned trenches in whatever materials are encountered. All excavation shall be by open cut unless specifically required to be bored. Blasting will be permitted only when or where specifically approved by the City Manager in writing, and only in the manner specifically approved. Blasting shall conform to all Federal and State laws and Municipal Ordinances. When necessary to prevent caving or unduly hazardous working conditions, trench walls shall be sheathed and braced or shall be layed back from a point six (6) inches above the pipe. Where sheathing and bracing are used, sheathing shall remain in place until the pipe has been installed, tested for leaks and defects, repaired if necessary, and the earth backfill completed to a depth of two (2) feet unless ordered by the City Engineer to be left in place. (see also section on Trench Safety) If trenching for utilities indicates seepage of ground water into the area under the road bed subsurface drainage as approved by the City Engineer shall be installed.

4. Excavated Materials: All excavated material shall be piled in such a manner that it will not endanger the work in progress and will avoid blocking sidewalks and driveways or obstructing traffic. Driveways must be immediately cleared to permit free access. Gutters and drainage channels shall be kept clear, or other means of securing proper drainage shall be provided.

5. Dewatering: Where ground water is encountered, the water table shall be lowered so that all necessary work may be carried on in the dry. The water shall be kept down until the unit or section under construction is completed. No water shall be allowed to flow through or over unset concrete or through the completed line.

6. Use of Washed Gravel: Where ground water is encountered, four (4) inches of washed gravel will be placed the full width of the trench in lieu of the granular embedment upon which the pipe will rest. The City Engineer will direct the Contractor when and where to place washed gravel.

7. Existing Structures: At the expense of the Contractor, all existing structures, improvements and utilities shall be adequately protected from damage that may occur due to construction operations. Where construction comes in close proximity to existing structures or utilities, or if it becomes necessary to

move services, poles, guy wires, pipelines or other obstructions, the Contractor shall notify and cooperate with the utility or structure owner.

8. Backfill: Backfill shall be of three types: Granular embedment, Select Backfill, and Trench Backfill.

A. Granular Embedment shall be used under, around, and over all utility lines in accordance with the standard details for utility trenches, except that service lines in soil not containing rock may be installed wthout embedment. Granular embedment shall be defined as free flowing sand or mixed sand and pea gravel that is free of stone, organic material or clay and which material shall not form mud or muck when wet. This material may be an inferior grade or "pit-run" sand not normally considered satisfactory for construction purposes, and it may be used directly from pits without processing. No fine granular material will be installed by the Contractor without the Engineer's approval.

Granular embedment shall be replaced to a grade slightly higher than required for the grade. Wedging or blocking up of pipe will not be permitted. Each pipe section shall have a uniform bearing on the embedment for the length of the pipe, except for immediately at the joint. Embedment under either water or sewer lines shall amount to at least four (4) inches in earth cut and six (6) inches in rock cut. Ganular embedment over the pipe shall be at least six (6) inches.

Where sand of a quality meeting the requirements for granular embedment material is encountered in the trench excavation, it may be stockpiled and used in lieu of material from other sources. Compaction of granular embedment by flooding will not be permitted.

"Crusherfines" do not constitute approved embedment material.

B. Select Backfill: Select backfill shall be used for a depth of twelve (12) inches immediately below the base material of streets or other areas to be paved. Select backfill shall be of generally granular type material such as base material, road gravel, sand or sandy gravel, and shall have a Plasticity Index of not more than ten (10). Select backfill shall contain no rock larger than three (3) inches in its greatest dimension. Not more than fifty (50) percent of the material shall be rock, and not more than ten (10) percent shall be as large as three (3) inches. Not more than twenty-five (25) percent shall be clay or clay lumps. Select backfill shall be compacted to not less than ninety-five (95) percent of Modified Proctor Density, ASTM Designation D1667, in layers of not over four (4) inches in thickness. Compaction method shall be approved by City Engineer.

C. Other Trench Backfill: In areas outside of streets, drives, and in treets below select backfill material, etc., trench backfill above embedment material may be accomplished by the use of excavated material if the material is suitable for compaction and contains only an occasional rock up to eight (8) inches in greatest dimension.

Trench backfill in areas outside of streets, drives, etc., will not be tested for density, but the material shall be compacted and the entire area left in a neat and orderly condition with excess material mounding over the trench. After a suitable length of time to permit settling, the trench surface shall be brought to a smooth grade.

Trench backfill in streets below select backfill shall be compacted to ninety (90) percent modified Proctor Density.

9. Pavement Repair: Existing pavement shall be precut, sawed or scored so as to result in an event, straight cut. After completion of the trench backfill, and upon approval of the Engineer, on all paved streets other than gravel streets, the Contractor shall cut and excavate the surface and base of the streets back on each side of the trench to form a shoulder for the new base and surfacing. The base, if stone, shall then be replaced in three (3) inch layers tamped in place. On gravel streets, six (6) inches of road gravel shall be rolled in place to serve as a wearing surface. All cutbacks shall be to a neat, straight line, and the paving cut shall be made with a concrete saw and shall be parallel to the center line of the pipe. Where excess surfacing has been removed beyond the nominal limits of the ditch, such areas shall be kept to a minimum, and where excess of such areas shall be cut parallel to the pipe. All stone or gravel base or surface course shall be compacted to ninety-five (95) percent Modified Proctor Density, ASTM Designation D1557.

In all paved streets the trench shall be finished in a workmanlike manner with the same type of roadway which was removed so that the underlying courses, as well as the wearing surface, shall conform to the remainder of the roadway and shall be equal in every respect to the improvements existing prior to excavation.

TECHNICAL SPECIFICATIONS

ITEM 2

CONCRETE

1. Description: The requirements of this item shall govern for all concrete for structures, curb and gutter, and incidentals or miscellaneous construction.

   Concrete shall be composed of Normal Portland Cement or High Early Strength Cement, coarse aggregate, fine aggregate and water proportioned and mixed as hereinafter provided in these specifications.

2. Materials:

   A. Cement: Only one brand of cement shall be used in any one (1) structure, except by written permission of the City Engineer. When such permission is granted and more than one (1) brand is used in one (1) structure, the resulting concrete shall be uniform in color.

      Portland Cement shall meet the requirements of the current Standard Specifications for Portland Cement of the ASTM Designation C-150, Type I, for Normal Portland Cement, Type III for High Early Strength Portland Cement and Type II will have a maximum of five (5) percent tricalcium aluminate for exposure to sewage.

      All cement shall be sampled and tested in accordance with the current Standard Methods of Sampling and Testing Portland Cement of the ASTM Designation C-183, C-184, C-188, C-190 and C-191.

   B. Mixing Water: Water for use with cement shall be clean and free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances. Water from doubtful sources shall not be used until tested and approved.

      Water which is suitable for drinking or for ordinary household use may be accepted for use without being tested.

   C. Coarse Aggregate: Coarse aggregate shall consist of gravel or crushed stone meeting the requirements of the current ASTM Specifications C-33.

      When tested by the Standard Method for Testing for Abrasion of Coarse Aggregate by use of the Los Angeles Testing Machine, ASTM Designation C-131, coarse aggregate shall have a percentage of wear of not more than forty (40).

      Coarse aggregate for Class F concrete shall have a minimum of fifty (50) percent calcium carbonate equivalent.

      When tested by approved methods, the coarse aggregate shall conform to the following grading requirements:

Maximum Size Aggregate

1-1/2"

Retained on 1 1/2" screen	0 to 5%
Retained on 3/4" screen	25 to 60%
Retained on 1/4" screen	95 to 100%

1"

Retained on 1" screen	0 to 5%
Retained on 1/2" screen	25 to 60%
Retained on 1/4" screen	95 to 100%

D. Fine Aggregate: Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof, conforming to the current ASTM Specification C-33.

When tested in accordance with the Standard Method of Test of Organic Impurities in Sands for Concrete, ASTM Designation C-40, the fine aggregate shall not show a color darker than the standard color.

When tested by approved methods, the fine aggregate shall conform to the following grading requirements:

Retained on 3/8" screen	0%
Retained on 1/4" screen	0 to 5%
Retained on 20 mesh sieve	15 to 50%
Retained on 100 mesh sieve	85 to 100%

E. Concrete Admixtures:

(1) Water Reducing Agent shall conform to ASTM C-494 Type A, and shall have a dosage as recommended by the manufacturer. Admix shall be Pozzolith by Master Builders Co.; WRDA by W.R. Grace; PSI by Gifford Hill & Company or approved equal.

(2) Set Retarding Agent: When, in the opinion of the Engineer, the ambient or concrete temperature requires the use of a set retarding admixture, such admix shall conform to ASTM C-494, Type D. Admixtures shall be PSI-R by Gifford Hill; Daratard by W.R. Grace, or approved equal.

(3) Air Entaining Admixture shall be used where specified or directed to improve workability and increase resistance to freeze and thawing, and scaling. The admix shall comply with ASTM C 260 and shall be used in accordance with manufacturer's recommendations. Products shall be Air-Tite by Gifford Hill; Daravair by W.R. Grace; MB-VR by Master Builders, or approved equal.

The total air content of the concrete shall be three (3) percent to six (6) percent.

F. Curing and Sealing Compound: All concrete shall be cured and sealed with a continuous acrylic membrane forming compound meeting the requirements of ASTM C-309. Curing compound shall be applied as soon as practical after placement of concrete and shall be used in accordance with the manufacturer's recommendations. Products shall be Sealco 309 by Gifford-Hill; Horn Clear Seal by W.R. Grace and Company, or an approved equal.

G. Bonding Agent: Bonding agent shall be a liquid polymer latex compound such as Daraweld-C manufactured by W.R. Grace and Company or an approved equal.

H. Reinforcing Steel:

(1) Bar Steel: All bar reinforcement shall be open hearth new billet steel of structural, intermediate, or hard grade. New billet steel shall conform to the requirements of the latest Standard Specification for Billet-Steel Concrete Reinforcement Bars, ASTM Designation A-15.

Unless otherwise shown on the plans, all reinforcing bars shall be deformed bars. Twisted bars are not considered as deformed bars and will not be used. The form of deformed bars shall be such as to provide a net sectional area at all points equivalent to that of the plain round bars of equal nominal size.

(2) Wire Fabric: Wire for fabric reinforcement shall be cold-drawn from rods hot rolled from open hearth billets. Wire shall conform to the requirements of the latest Standard Specification for Drawn Wire for Concrete Reinforcement, ASTM Designation A-82.

I. Premolded Expansion Joint Filler shall conform to the requirements of ASTM Designation D-994 or other as approved by City Engineer.

3. Equipment: The Contractor shall obtain the Inspector's approval of all concrete mixing, handling and transporting equipment before any pour of concrete is commenced. Such approval will not relieve the Contractor of his responsibility for providing adequate equipment to carry on satisfactorily the project operations.

4. Batching and Mixing: All batching and mixing of concrete materials shall conform to ACI 304-73 "Recommended Practice for Measuring, Mixing and Placing Concrete". All materials shall be measured separately and accurately and batches shall be uniform. The coarse and fine aggregate shall be measured or weighed, loose and separately.

When transit mix concrete is used, the delivery of concrete shall be continuous at regular and uniform intervals, without stoppages or interruptions. Transit mix concrete shall not be placed in the job after a period of forty-five (45) minutes after the cement has been placed in the mixer.

5. Consistency: In general, the consistency of concrete mixtures shall be such that:

A. The mortar will cling to the coarse aggregate.

B. The aggregate will not segregate in the concrete when it is transported to the place of deposit.

C. The concrete and mortar will show no free water when removed from the mixer.

D. The surface of the finished concrete will be free from a surface film of "laitance".

Any concrete mix failing to meet the above outlined consistency requirements, although meeting the slump requirements, will be considered unsatisfactory, and the mix shall be changed to correct such unsatisfactory conditions.

6. Classification and Proportions: Concrete shall be proportioned as determined by the Inspector. The total volume of materials in the concrete mixture shall be so regulated that the cement content per cubic yard of concrete shall not be less than the minimum specified for that class of concrete.

A. The concrete shall be uniform and workable and the minimum cement content, maximum water content, and the maximum slump for the various classes of mixes shall conform to the following:

Class	Min. Cement Bags/C.Y.	Max. Size Coarse Ag. (Inches)	Max.Water Gals./Bag (Net)	Max. Slump (Inches)
A	5.5	1.5	6.75	5
B	5.0	1.5	7.00	4
C	6.0	1.0	6.25	5
D	6.5	1.5	6.25	5
E	3.0	1.5	6.25	4
F	6.0	1.5	5.50	4

The maximum amount of coarse aggregate (dry loose volume) per cubic foot of finished concrete shall not exceed zero-point-eighty-two (0.82) cubic feet.

The maximum amount of water, as set forth in the table above, is based upon the assumption that the aggregates are in a saturated, surface dry condition.

B. The concrete mix will be designed with the intention of producing concrete which will have compressive or flexural strength equal to or greater than the following when using current ASTM Designation C-39 and C-293.

Class of Concrete	Compressive Strength (Pounds Per Square Inch)		Flexural Strength (Pounds Per Square Inch)	
	7-Day	28-Day	4-Day	7-Day
A	2,000	3,000	400	500
B	1,700	2,500	350	425
C	2,000	3,000	400	500
D	2,000	3,000	400	500
E	1,000	1,500	150	250
F	2,700	4,000	-	-

C. The following class of concrete will be used as shown, unless otherwise specified:

Class	Use
A	Formed Structures, such as: Walls, Decks, Structural Foundations, Floor Slabs, Paving, Culverts, Storm Sewer Manholes and Inlets, except Water Retaining Walls and Structures exposed to sewage.
B	Unformed Structures, such as: Riprap, Sidewalks, Curb and Gutter, Gutter, Valleys, Exposed Encasement or as noted on Plans.
C	Drilled Shafts and Thin Wall Sections, Formed Septum Walls.
D	Railings, Stairs and Unformed Foundation Seals.
E	Confined Cradling, Blocking, Backfill, unexposed Encasement below grade, or Backfill.
F	Structures exposed to Sewage and Water Retaining Walls.

In order to obtain a more workable mix and denser concrete, there shall be added as a part of the concrete for Class "A" and Class "F" concrete a cement dispersing or water reducing agent conforming to ASTM Specification C-494, Type A. The agent shall be added in accordance with the manufacturer's recommendations.

The quantity of water to be used shall be determined by the Engineer and shall be such as to give a mixture containing the minimum amount of water consistent with the required workability. The quantity of water shall be varied only by the Engineer.

7. Quality of Concrete: During the progress of the work the Inspector may cast test cylinders or beams for testing to maintain a check on the compressive or flexural strength of the concrete actually placed.

Test beams or cylinders shall be required for each fifty (50) cubic yards or portion thereof, placed each day. On small structures, such as manholes, inlets, culverts, wing-walls, etc., the Inspector may vary the number for small placements to tests for each twenty-five (25) cubic yards, placed over a several-day period.

8. General Construction Requirement for Concrete Structures:

A. Prior to starting work the Contractor shall inform the Inspector as to the methods of construction and the amount and character of equipment he proposes to use, the adequacy of which shall be subject to the approval of the Inspector.

B. Forms and falsework to be used in the construction of the various units of a structure shall be in accordance with all governing safety requirements and shall be the responsibility of the Contractor.

C. Approval by the Inspector of construction methods, equipment, or form and falsework plans will not relieve the Contractor of responsibility for the safety or correctness of methods used, adequacy of equipment, or from carrying out the work in full accordance with the contract.

9. Concrete Delivery: The rate of delivery of transit mixed concrete shall be so arranged that a cold joint is not allowed to form between loads. Concrete shall be hauled in vehicles so constructed and operated to provide constant agitation during transportation. Concrete improperly mixed shall not be placed in the structure.

   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 will insure the discharging of the mixed concrete without segregation.

   The mixer drum shall be water-tight when closed and shall be equipped with a locking device which will automatically prevent the discharging of the mixer prior to receiving the required number of revolutions.

   The entire quantity of mixing water shall be accurately measured and controlled. Each batch shall be mixed to the consistency as described in paragraph 5 above. 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.

10. Construction Joints: Construction joints shall be placed as shown on the plans unless otherwise specifically authorized by the Engineer, in which case the joints shall be so placed and formed as to least impair the strength and appearance of the structure. All construction joints shall be made on horizontal and vertical planes and formed with mortises or keys made in the concrete unless shown otherwise on the plans.

11. Forms: Nominal one (1) inch lumber surfaced to a uniform width and thickness will be permitted for general use on the various portions of structures, if backed by a sufficient number of studs and wales.

    Forms shall be mortar tight, and of sufficient strength to prevent bulging between supports. Forms shall be maintained to the lines designated until the concrete is sufficiently hardened to permit form removal and until the minimum time for forms to remain in place has elapsed in accordance with ACI Standard 318-71 "Building Code Requirements for Reinforced Concrete (ASI318-71)".

    Where corners occur, suitable chamfer strips shall be placed at the angle of the forms to round off or level them. All forms shall be constructed so as to permit removal without injuring the concrete. At the time of placing concrete, the forms shall be clean and entirely free of all chips, dirt, sawdust, and other extraneous matter.

    For thin wall sections and other locations where access to the bottom of the forms by other methods would be cumbersome and inadequate, clean-out opening shall be provided.

    Only spreaders approved by the Inspector shall be used.

    Metal form ties of an approved type shall be used to hold forms in place. Such ties shall be of a type especially designed for use in connection with concrete work, and they shall have provision to permit ease of removal of the metal as hereinafter specified. The use of metal form ties of a type that are encased in paper or other materials to allow the removal of the complete tie, leaving a hole through the concrete structure, will not be permitted. Metal ties shall be held in place by devices attached to walls. Each device

shall be capable of developing the strength of the tie.

All cavities produced by the removal of metal ties shall be carefully cleaned and completely filled with retempered sand cement mortar mixed in proportion of one to three, and the concrete shall be left smooth and even.

12. Placing Concrete:

A. General: The Contractor shall give the Inspector at least twenty-four (24) hours advance notice that he intends to pour concrete in any unit of the structure. The mixing of concrete and placing of same in the forms shall not be commenced until the Engineer has given his approval. No concrete shall be placed in any unit prior to completion of the form work and the placement of the reinforcing and other steel.

Where the Contractor's operations involve the placing of concrete from above directly into an excavated area or through the completion of forms, all concrete so placed shall be deposited through a vertical sheet metal or other approved pipe or tremie not less than six (6) inches nor more than ten (10) inches in diameter. The pipe shall be made in sections so that the outlet may be adjusted to proper heights during placing operations.

Concrete shall be placed in continuous horizontal layers approximately twelve (12) inches in thickness. The rate of delivery shall be so arranged that a cold joint is not allowed to form between loads. The Contractor shall avoid unauthorized construction joints by placing required portions of abutments, piers, walls, floors, slabs columns or superstructures in one continuous operation. As a safety precaution, openings in the forms shall be provided for the removal of laitance and other foreign material.

All concrete shall be well compacted and the mortar flushed to the surface of the forms of continuous working with concrete spading implements and mechanical vibrators of an approved type. Vibrators of the type which operate by attachment to forms or reinforcement will not be permitted. The vibrators shall be applied to the concrete immediately after deposit and shall be moved throughout the mass, thoroughly working the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms until it has been reduced to a plastic mass. The mechanical vibrator shall not be operated so that it will penetrate or disturb layers placed previously which have become partially set or hardened. The vibration shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures, but shall not be done to an extent that will cause segregation. Vibration shall be supplemented by hand spading to insure the flushing of mortar to the surface of all forms.

B. Foundation and Footings: Concrete shall not be placed in footings until the depth and character of the foundation has been inspected and permission has been given to proceed.

Concrete in deep foundations shall be placed in a manner that will avoid separation of the aggregates or displacement of the reinforcement. Suitable chutes or vertical pipes shall be provided.

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 Engineer, and the entire excavation filled with concrete to the elevation of the top of the footing.

C. Weather Conditions for Placement: No concrete shall be placed when the atmospheric temperature is

at or below forty (40) degrees F (taken in the shade away from artificial heat) unless permission is given or in cases where the temperature drops below forty (40) degrees F after the concreting operations have been started.

The Contractor shall furnish sufficient canvas and frame work or other type of housing to enclose and protect the structure in such a way that the air around the forms and fresh concrete can be kept at a temperature not less than fifty (50) degrees F for a period of five (5) days after the concrete is placed.

Sufficient heating apparatus such as stoves, salamanders, or steam equipment and fuel to furnish all required heat shall be supplied.

D. Installation of Premolded Expansion Joint Filler shall be made where indicated, and the filler shall extend through the entire section of the structure.

13. Finishing:

A. Slabs, Valve Vault, Tops, Etc.: As soon as concrete placing operations have been completed for a slab section of sufficient width to permit finishing operations, the concrete shall be approximately leveled and then struck, off, tamped, and screeded using a longitudinal screed. The screed shall be of a design adaptable to the use intended, shall have provisions for vertical adjustment, and shall be sufficiently rigid to hold true to shape during use.

The initial strike off shall leave the concrete surface at an elevation slightly above grade so that, when consolidation and finishing operations are completed, the surface of the slab will be at the grade elevation shown on the plans with proper allowance for finished camber when required.

Tamping and screeding operations shall be continued until the concrete is properly consolidated and the surface voids are eliminated. The surface shall then be brought to a smooth true alignment by means of longitudinal screeding, floating, belting, and/or other methods approved by the Engineer. When templates are used, they shall be of such design as to permit early removal in order to avoid construction joints and to permit satisfactory finishing at and adjacent to the site of the template.

While the concrete is still plastic, the surface shall be straightedged by the use of a standard ten (10) foot metal straightedge. Deviations in excess of permissible variations shall be corrected. The final surface finish of the slab shall be done after the initial straightedging, and corrective adjusting, if required, is completed, as specified hereinafter.

B. Formed Surfaces: Immediately after forms are removed, the formed surfaces shall be finished as follows:

(1) Any honeycomb areas shall be chipped out to firm concrete and thoroughly cleaned of chips and particles of broken concrete. A bonding agent shall then be applied to the entire surface of the cavity, and the cavity packed with a relatively dry mortar of the same sand-cement ratio as the concrete mix used in the structure. The mortar shall be thoroughly compacted to insure complete filling of the cavity and the surface struck off to match the surrounding concrete.

(2) Exterior surfaces that will be more than one (1) foot below grade will require no further finish.

(3) Exterior surfaces to be exposed to view and to a point one (1) foot below finish grade, and interior

exposed surfaces, shall be finished as follows.

All fins, form marks or offsets, and other protrusions shall be removed and surface voids shall be filled or pointed with grout. After the pointing has dried sufficiently to permit rubbing, all surfaces shall be wetted and given a surface rubbing with a No. 16 Carborundum stone or an abrasive of equal quality. The rubbing shall be continued sufficiently to bring the surface to a paste, to remove all form marks and projections, and to produce a smooth dense surface without pits or irregularities. The material that has been ground to a paste shall be carefully spread or brushed uniformly over the surface and allowed to take a reset. The use of cement to form a surface will not be permitted.

C. Floor and Slab Finishes: Finish treatment of floors and slabs to be provided after the initial treatment specified under "A" above shall be as follows:

(1) Sidewalks: The sidewalk shall be floated with a steel trowel to provide a smooth, burnished surface. After floating and before the finish has set, the surfaces shall be lightly brushed with a fine brush to remove the surface cement film, leaving a fine grained, smooth but sand texture.

(2) Concrete Valleys, Driveways, Vault Tops and Floors, Etc.: After the initial treatment specified in "A" above, and after the surface has become firm, the surface shall be given a single floating with a wood float to provide a uniform surface.

(3) Other slab surfaces shall be finished with one of the above finishes, or not finished, as otherwise specified or as approved by the City Inspector.

14. Curing Concrete: Immediately after finishing, all upper non-formed surfaces shall be covered with a continuous, uniform, water impermeable coating. Immediately after removal of the side and end forms of non-exposed surfaces, and after required finishing of exposed surfaces, the formed surfaces of all concrete shall receive a like coating. The solution shall be applied under pressure with a spray nozzle in such a manner as to cover the entire exposed surface thoroughly and completely with a uniform film.

The rate of application shall be such as to insure complete coverage, but the area covered shall not exceed two hundred (200) square feet per gallon of curing compound.

The coating shall be sufficiently transparent and free from permanent color to result in no pronounced change in color from that of the natural concrete at the conclusion of the curing period. It shall, however, contain a fugitive dye of color strength to render the film distinctly visible on the concrete for a period of at least four (4) hours after application.

Under normal conditions, the curing compound, after application, shall dry to touch within one (1) hour and shall dry thoroughly and completely within four (4) hours. When thoroughly dry, it shall provide a continuous flexible membrane free from cracks or pinholes and will not disintegrate, check, peel, or crack during the required curing period. If for any reason the seal is broken during the curing period, it shall be immediately repaired with additional sealing solution.

TECHNICAL SPECIFICATIONS

ITEM 3

WATER SYSTEM

1. General: The Contractor shall be responsible for furnishing all materials and accomplishing all work necessary for the construction of new water lines in accordance with approved plans and in conformance with the following requirements. He shall also be responsible for the construction of service lines from the main to the meter box location behind the curb. The Contractor shall make all required connections to existing lines. All plans and specifications shall conform to the current Rules and Regulations for Public Water Systems of the Texas Department of Health and to these Specifications as they may be amended. Water lines shall not be located closer than nine (9) feet from sewer lines. Where water lines cross sewer lines, the water line shall cross over the sewer line, if possible. All work will be subject to inspection by an authorized representative of the City and no work will be accepted until all construction, testing, flushing, and disinfection has been completed in accordance with the applicable plans and these specifications and to the satisfaction of the City Engineer. Any work found not to be acceptable shall be removed and replaced at the Contractor's expense. The Contractor shall notify the City Engineer or City Manager prior to starting work and prior to covering any water lines in place.

2. Materials: Materials for water line construction shall conform to requirements specified below. All materials shall be class 150, or designed for 150 p.s.i. working pressure. All new water lines shall be a minimum of six (6) inches in diameter, except that smaller diameter lines may be installed in designated locations within the existing developed areas of the City for system rehabilitation or for interim supply augmentation.

   A. Pipe: Pipe for lines four (4) inches to twelve (12) inches in diameter shall be Cast Iron or Polyvinyl Chloride (PVC). Lines over twelve (12) inches in diameter shall be Concrete Steel Cylinder type. Lines smaller than four (4) inches in diameter shall be PVC.

      (1) Cast Iron Pipe shall be manufactured in accordance with Federal Specification WW-P-421b lb or in accordance with AWWA C106 (ANSI- A21.6) or AWWA C108 (ANSI-A21.8) Specifications. All pipe shall be designated Class 150. All pipe shall have an inside mortar lining reduced to one-half (1/2) that stipulated in the American Standards Association Specifications for Cement Mortar Lining (ASA-A21.4- 1953). Outside coating shall conform to the current AWWA Specification C106 (ASA-A21.6). Cast iron pipe shall be approved by the Underwriter's Laboratory and shall be accepted by the State Fire Insurance Commission for use in water distribution systems without penalty. All pipe shall be new and made in the United States. All cast iron pipe shall be designed for five (5) feet of cover. Unless otherwise specified on the plans or in the Special Conditions, above ground joints shall be flanged, sub-surface joints shall be compression, and all specials shall be mechanical joint.

         (a) Bell and Spigot: Bell and spigot shall comply with the current Federal Specification WW-P-42lb as Type 11 bell and spigot.

         (b) Mechanical Joint: Mechanical type joints for cast iron pipe and fittings shall comply in all respects with current American Standards Association Specification ASA-A21.11.

         (c) Flanged Joint: Flanged joints for cast iron pipe and fittings shall comply with current American

Standards Association Specification ASA-B16.

(2) Polyvinyl Chloride (PVC) Pipe for four (4) inch through twelve (12) inch size shall be rigid integral bell and spigot type conforming to the requirements of AWWA Standard C-900, "Polyvinyl Chloride (PVC) Pressure Pipe", for class 150 pipe, cast iron pipe O.D., with wall thickness of DR series 18. Pipe shall be suitable for use in a potable water system, and shall be approved by Underwriter's Laboratories for use in fire lines and water mains, and shall have the NSF Seal of Approval. The manufacturer shall furnish an Affidavit of Compliance to the effect that all materials meet the specification requirements. Joints must provide for contraction and expansion of the pipe. Bells shall be designed to be of equal or greater strength than the pipe. Rings and lubricants shall be of the type designed for water service.

Pipe shall meet all physical property requirements of Section 2.2.3 of AWWA Standard C-900. Standard laying lengths shall be twenty (20) feet, plus or minus one (1) inch, with a maximum of 15 (15) percent furnished in shorter lengths of not less than ten (10) feet each.

(3) Concrete Pressure Pipe shall be pretensioned concrete steel cylinder pipe conforming to the requirements of AWWA Standard C303, and shall be furnished in nominal thirty-two (32) foot or thirty- six (36) foot lengths.

The manufacturer shall submit a complete experience record in the design and construction of the type of concrete pressure pipe involved. The manufacturer shall also provide an Affidavit of Compliance as described under Section 1.11 of AWWA Standard C303. Upon the award of the contract, the Contractor shall furnish the City with Shop Drawings, showing the pipe and fittings to be furnished and shall include a tabulated layout schedule with reference to the stationing on the contract drawings with plan and profile drawings. Such drawings shall be subject to the approval of the City Engineer, and fabrication of pipe and fittings shall not be commenced until such drawings have been approved. Such approval will not relieve the Contractor of any responsibility of providing pipe and/or fittings in accordance with the plans and specifications.

The pipe shall be designed for 150 psi working pressure and 225 psi working plus transient pressure.

Chlorine and/or test connections consisting of an installed corporation-stop shall be required when installing a gate valve in concrete pressure mains (one (1) on each side of the gate valve). These connections shall have a bushing of nylon or other approved nonconductor installed by the pipe manufacturer.

Pipe design for external loads shall be based on the following external loading conditions:

(a) Earth Load: Five (5) foot depth of soil using 130 lbs/C.F.

(b) Concentrated Loads:

Within pavement limits - 16,000 lbs.

Outside pavement limits - to accommodate Contractor's equipment, but not less than 8,000 lbs.

(c) Load Factor: 1.90 (Class B bedding)

(d) Impact Factor, Live Loads: 1.0

(e) Factor of Safety: 1.50

(4) Plastic Pipe 3" and under shall meet the requirements for unplasticized Polyvinyl Chloride (PVC) pipe with integral thickened-wall and bells shall meet all requirements of ASTM D1784, ASTM D2241, and Commercial Standard CS256-63. Unless otherwise specified, the pipe shall be pressure rated at 160 psi with a standard dimension ratio (SDR) of 26. All pipe must meet requirements as set forth in Commercial Standard CS256-63, bearing the National Sanitation Foundation seal for potable water pipe. Provisions must be made for contraction and expansion at each joint, with a rubber ring and integral bell as part of each joint. Pipe and fitting must be assembled with a non-toxic lubricant. Pipe shall be made from an NSF-approved Type I, Grade I, PVC compound conforming to ASTM resin specification D1784. Clean, reworked material generated from the manufacturer's own pipe production may be used. All physical and chemical tests shall be method.

B. Fittings and Specials:

(1) Fittings and specials for cast iron and PVC pipe shall be cast iron or ductile iron conforming to the requirements of AWWA Standards C110 and C111 for Class 150 service. Joints shall be integral bell and spigot, mechanical joint, or flanged joints as required by the pipe joint and all fittings shall be cement lined. Flanges shall be Class 125. All fittings shall be short body type.

(2) Fittings and Specials for Concrete pressure pipe shall be provided as necessary for the concrete pressure pipe line and for connection to other types of pipe or fittings. Design of fittings shall conform to the requirements for the design of the pipe with which they and other specials are specified elsewhere in these specifications, but all special adapters necessary for connections to the concrete pressure pipe shall be provided by the concrete pressure pipe manufacturer and shall be shop fabricated.

(3) Accessories: All bolts, nuts, glands, gaskets, and other accessories necessary for the complete installation shall be furnished with the pipe and fittings.

C. Gate Valves two (2) inch thru twelve (12) inch valves shall conform to the requirements of AWWA Standard C500 for double disc type with parallel seats and all valves shall have a non-rising stem with a resilient wedge either Mueller, Clow, Waterous or M & H. Valves shall have mechanical joint ends except that valves used with flanged pipe shall have flanged ends, and end joints shall be specifically designed for the type of pipe or joint to which they will be connected. Valves shall turn counterclockwise to open. All valves shall be for vertical installation in horizontal lines. Operators shall be nut type for underground service and handwheels for above ground service.

Gate valves eighteen (18) inches and larger shall be equipped with spur gears. Gate valves sixteen (16) inches and larger, unless otherwise specified, shall be Mueller, M & H or Waterous.

Geared valves shall be equipped with cut-tooth steel spur gears without gear case where valves are to be installed in a vault or inside a pump station and not to be buried in the ground. Where valves are to be buried in the ground without a vault, cut-tooth spur steel gears having an enclosed gear case of the

"extended" type, oil or grease lubricated, shall be furnished. Removable cast iron plates shall be furnished on valves with gear cases of the extended type, installed on the valve to enclose and keep the packing gland and valve stem free from dirt. All above ground two (2) inch valves shall have bronze bodies with all working parts of bronze. They shall be of the double disc, parallel seat, internal wedging type and shall have screw ends. They shall open by turning to the LEFT. They shall be guaranteed for one hundred fifty (150) pounds per square inch working pressure.

D. Cast Iron Valve Boxes and Covers: Cast iron valve boxes and covers shall be standard three (3) piece box and cover, consisting of base housing, extension hollow shaft and cover. The covers shall have the word "WATER" cast in raised letters in its upper surface on water mains and shall have no designation for other types of mains. Boxes furnished shall be adjustable unless shown otherwise on the plans and the extension hollow shaft shall be of sufficient diameter to admit readily standard valve wrench. Boxes shall be as manufactured by Mueller, Clow or equivalent and will be required for every subsurface gate valve unless otherwise specified.

E. Fire Hydrants shall be either Mueller Centurion (A-423) or a Clow F2500 having a dry barrel and a six (6) inch inlet with a five and one-quarter (5 1/4) inch main valve opening, with one (1) pumper connection and two (2) hose nozzles, and shall conform to the requirements of AWWA Specification C502 except that the barrels shall have a frangible section at the ground level for break off upon impact. Hydrants shall open by turning counterclockwise. Barrels shall be for thirty-six (36) inch bury. Extensions shall be provided where necessary to attain the proper height setting of hydrants. The inlet shall be a mechanical joint.

F. Service Lines: Materials for service lines from mains to the meter box shall be as specified below. Single services shall be a minimum of three-quarter (3/4) inch and double services a minimum of one (1) inch.

(1) Copper tubing shall conform to ASTM Specification B88, Type K.

(2) Polybutylene tubing shall be SDR-9 Class 250, the SDR-11.5, as stated in the current specifications is of iron pipe size, where the SDR-9 is the same size as copper tubing.

(3) Fittings for either copper tubing or polybutylene tubing shall be brass conforming to ASTM B62. Couplings for copper tubing shall be compression type. Couplings for polybutylene tubing shall be compression type. All fittings shall have threads conforming to the following:

Coupling ends to be connected to iron pipe shall have thread dimensions conforming to Table 3 of ASA B2.1, American Standard Pipe Threads.

Coupling nut threads shall conform to the dimensions shown in Table 3 of AWWA Specifications C800.

(4) Corporation Cocks shall be Mueller H-15008 which is a CC thread x compression outlet.

(5) Curb or Meter Stops: For single service connections, curb stops shall be Mueller H-14258 compression inlet with lockwing head.

For double service connections, "U" branch connections shall be Mueller H-15363 with a

compression inlet. Two (2) curb stops, Mueller H-14265 shall be furnished and installed with lockwing head.

3. Excavation, Trenching, and Backfill, including pipe bedding, shall conform to the applicable provisions of Item 1, Trenching and Backfill, and to the applicable trenching and backfilling details. Walls of trenches shall be vertical to a minimum distance of twelve (12) inches above the top of the pipe. Minimum depth of cover shall be three (3) feet over the top of the pipe, except that minimum cover on top of service lines shall be at least eighteen (18) inches below the top of subgrade.

4. Pipe Handling: Handling of pipe during unloading, stockpiling, and distribution along the trench shall be done in such a manner that the pipe or coating is not damaged by handling equipment which may cause cuts or indentations in the pipe or coating. Slings shall be used to handle all pipe and fittings; no hooks will be permitted.

   Plastic pipe shall be stored on flat surfaces to avoid deformation of the pipe. Particular care shall be exercised during cold weather to avoid severe impact which may damage the pipe. Care should be exercised at all times to prevent entrance of dirt and foreign matter into the pipe.

   All pipe, fittings, valves, hydrants and accessories should be carefully lowered into the trench using suitable equipment in such manner as to prevent damage to pipe and accessory items. Pipe and accessories should never be dropped or dumped into the trench.

   Pipe and accessories should be inspected for defects and cleanliness prior to lowering into the trench. Any defective, damaged or unsound material should be repaired or replaced and all foreign matter or dirt should be removed from the interior of the pipe and accessories before lowering into the trench.

   Any unsound or damaged pipe, fittings, or specials shall be rejected and removed from the site unless, in the opinion of the Inspector, it is suitable for repair. Pipe or fittings approved for repair shall be repaired in accordance with the recommendations of the Inspector and the manufacturer of the pipe.

5. Installation: The pipe shall be kept clean during the laying operation and free of all dirt and trash and, at the close of each operating day, the open end of the pipe shall be effectively sealed against the entrance of all objects and, especially, water. Pipe shall be layed to the lines and grades shown on the plans or otherwise approved. Horizontal and vertical curves may be effected by offsetting of the pipe joints where the radius of the curve exceeds the minimum radius recommended by the manufacturer of the pipe. Where the curve radius is less than the acceptable minimum for offsetting the pipe joints, bends shall be installed.

   All pipe and fittings shall be laid on specified bedding so as to be uniformly supported along its entire length. No "blocking up" of pipe or joints will be permitted. Bell holes to allow making the exterior joint shall be provided. Laying and jointing of pipe shall conform to the requirements of the following Manuals and Standards:

Cast Iron Pipe:	AWWA Standard C600
PVC Pipe:	ASTM Standard 2321
Concrete Pressure Pipe:	AWWA Manual M9

If the above listed publications are not available, the pipe shall be installed in accordance with the pipe manufacturer's published recommendations.

6. Setting Fittings: The Contractor shall furnish and install all fittings at the points shown on the drawings, and as directed. Before installing any fittings, care shall be taken to see that all foreign material is removed from the interior. Fittings shall be placed in the lines as shown on the plans or directed by the Engineer and shall be firmly supported and anchored in accordance with the recommendations of the manufacturer of the pipe.

7. Installation of Gate Valves: Valves shall be carefully handled and lowered into position by mechanical equipment 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 the connected piping.

   Valves sixteen (16) inches and larger, which are not housed in structures shall be supported on concrete bases as detailed on the plans. Valves fourteen (14) inches and smaller, not housed in structures shall be supported on the same material as that supporting the connecting pipe. An adjustable cast iron valve box and cover shall be provided for all buried valves fourteen (14) inches and smaller, and all sixteen (16) inch valves installed in streets (including bypass valves), with stem extension when depth exceeds three (3) feet. The valve shall be set with the stem in a truly vertical position with the box correctly centered over the operating nut.

   When the valve box is in position and the top of the box adjusted to the proper elevation, select backfill material shall be firmly tamped around the outside.

8. Setting Fire Hydrants: The hydrant shall set truly vertical and be securely braced and blocked with concrete. It shall be set on a block of concrete at least one (1) foot square and six (6) inches thick placed on well compacted or undisturbed soil surrounded by a minimum of seven (7) cu. ft. of clean gravel or stone to permit free draining of the hydrant.

   The six (6) inch fire hydrant lead shall be of such length as is necessary to reach from the main to the hydrant location, and at such depth as to permit the pipe being installed in a horizontal position, and the barrel of the fire hydrant being in a vertical position. The bury depth may vary, and care must be taken to select and install the proper length of fire hydrant extension as required.

   A six (6) inch gate valve shall be installed in the six (6) inch hydrant lead between the fire hydrant and the main where shown on the plans.

   After installation is complete, the Contractor shall apply two (2) coats of bright red machinery enamel, Pittsburg or approved equal.

9. Installation of Three Inch (3) and Smaller PVC Lines: Fittings for two (2) inch and three (3) inch PVC pipe shall be PVC of the same pressure class. Gate valves shall be cast iron for two (2) inch and three (3) inch diameter pipe and gate valves under two (2) inch shall be bronze body, as hereinbefore specified. All joints shall be compression type. Pipe ends shall be lubricated in accordance with the manufacturer's recommendation and pushed in to the proper depth as indicated by the reference mark on the pipe. Pipe may

be jointed in the trench or above ground prior to placing in the trench. Bedding shall be used where rock is encountered in the trench or when directed by the Engineer. Pipe layed in earth trenches without rock need not have bedding if the backfill material is free of rock. Pipe shall be "snaked" in the trench when temperatures exceed seventy (70) degrees F to allow for contraction due to cooling, and the pipe should preferably be filled with water before backfilling.

10. Sewer Line Crossings: Whenever sanitary sewer mains, laterals or service lines are encountered by trenching operations, the sewer pipe shall be placed with one eighteen (18) inch joint of cast iron pipe centered in the trench. The cast iron pipe shall have solid bearing on undisturbed earth, at least eighteen (18) inches back from the face of the trench. The jointing and connection of the cast iron pipe to clay or concrete pipe shall be done in accordance with City standards. Upon completion of the joints they shall be completely surrounded with thoroughly compacted moist backfill.

11. Concrete Blocking and Cradle: Concrete blocking (Class "E" Concrete) shall be placed at bends, tees, crosses and plugs in the pipe lines. The concrete blocking shall be placed so as to rest against firm, undisturbed trench walls, normal to the thrust. The supporting area for each block shall be at least as great as that indicated on the plans an/or standard details and shall be sufficient to withstand the thrust, including water hammer which may develop. Each block shall rest on a firm, undisturbed foundation or trench bottom. When tie downs are required, concrete shall be Class "A" or "B" and constructed as detailed and/or noted on the plans. Concrete cradle shall be Class "E" concrete and shall be installed where shown on the plans in accordance with the standard details.

12. Pressure Testing: All new water mains shall be tested by the Contractor with a hydraulic test pressure of maximum of one hundred fifty (150) pounds per square inch. The pressure test shall be maintained for a continuous period of not less than four (4) hours on each section of the pipeline under test. All pressure testing will be monitored by the City Engineer prior to acceptance.

    The Contractor shall furnish adequate and satisfactory equipment and supplies necessary to make such hydrostatic tests.

    Materials and labor for the installation of corporation cocks in cast iron mains for this purpose will be furnished by the Contractor. The Contractor shall be responsible for all excavation, etc., in preparation for installation of taps.

    The section of line to be tested shall be gradually filled with water, carefully expelling the air, and the specified pressure applied. The City will furnish water required for the testing at its nearest City line. All air shall be expelled from the pipe before applying the required test pressure.

    All exposed joints shall be examined during the pressure test. All pipe, fittings and valves shall be examined while the test is in progress, and any items found to be defective shall be removed and replaced by the Contractor and retested after repairs are completed.

    In order to determine the quantity of water lost through leakage in a section of pipe under the required test pressure the Contractor will be required to measure all water used in the pressure test through an approved meter. The maximum leakage permitted on the basis of one hundred fifty (150) pounds per square inch pressure shall not exceed the amounts indicated below for each type of pipe per inch of pipe diameter per mile of pipe in twenty-four (24) hours:

Cast Iron Pipe: 25 Gallons

PVC Pipe: 25 Gallons

Concrete Pressure Pipe: 25 Gallons

The Contractor shall correct defects and bring the leakage within the specified limits before the contract is accepted by the City.

Permanent pavement shall not be placed over any pipe until all leakage tests on the section of pipe line involved have been completed.

The cost of testing and finding and repairing the leaks, and retesting, if necessary, shall be at the expense of the Contractor.

13. Chlorination of Water Mains: When the entire pipe line, or selected sections thereof, have been completed, tested and are ready for turning over to the Owner for use, the line or section shall be disinfected according to the following procedure:

    A. The line shall be flushed out and filled with water from a City main.

    B. Chlorine or HTH shall be injected at one end of the line, and water released from the opposite end until chlorine is present at the discharge end in such quantity to indicate a residual of fifty (50) p.p.m.. All valves shall then be closed, and the solution shall remain in the line for at least twenty-four (24) hours.

    C. After twenty-four (24) hours the solution shall be discharged from the line and replaced by water direct from a City main.

    D. A water sample shall be taken from a suitable tap (not through a fire hydrant) under the supervision of the City and submitted to an Independent Laboratory or to the Texas Department of Health Laboratory for analysis. If the tests show a satisfactory quality of water, the line may be placed in service. If the sample shows an unsatisfactory quality of water, the process of disinfection shall be repeated until a satisfactory sample is obtained.

    E. Unless other wise specified or approved, the Contractor will make all necessary taps into pipe to accomplish chlorination of a new line.

14. Installation of Service Lines: Service lines shall be of copper or polybutylene plastic pipe as hereinbefore specified. Connections to water mains shall be made by tapping for cast iron pipe, and by the use of Mueller galvanized or cadmium coated Smith-Blair #313 (formerly Rockwell) or Ford F202 service saddle.

    Corporation stops shall be installed in all taps or service saddles with the lines connected to the corporation stop. Service lines shall be installed a minimum of eighteen (18) inches below subgrade without sharp bends or changes of direction. Particular care shall be taken to avoid kinking or excessive bending of either copper or plastic pipe during installation and the pipe shall be laid from side to side in the trench to provide for expansion and contraction. Lines shall extend to approximately two (2) feet in back of and one (1) foot below the top of the back face of the curb. Curb stops, meter couplings, and "U" branch connections shall be provided on the end of the line for future connection to the meter. Service lines in earth trenches without

rock will not require bedding. Where trenches are partially or entirely in rock, or where the backfill material contains rock, bedding a minimum of four (4) inches under and over the pipe shall be required. The curb shall be marked by an imprinted letter "W", three (3) inches in height, at the point where the service pipe passes under the curb.

Pressure testing and sterilization of service lines is not required, but prior to backfilling, the lines shall be filled under normal working pressure and observed for leaks. Backfill will not be placed over pipe until approved by the City Inspector.

When tapping into the City water main the tapping sleeve shall be a stainless steel wrap-around, either the Smith-Blair #663 (formerly Rockwell) or the Romac SST.

The Contractor shall also furnish the City with the extracated piece of pipe from the tap known as the coupon.

15. Clean-Up: Upon completion of the installation of the water lines, distribution systems and appurtenances, all debris and surplus materials resulting from the work shall be removed.

TECHNICAL SPECIFICATIONS

ITEM 4

SEWER SYSTEM

1. General: This item includes the construction of both gravity sewers and force mains. Insofar as possible sewer systems shall consist of gravity lines and the use of lift stations and force mains shall be avoided. Design of sewer systems shall conform to the requirements of the Texas Department of Health. Design Criteria for Sewer Systems Construction shall conform to the requirements of these specifications. The Developer shall provide with his plat plans and profiles for review of all sewer line work proposed and shall construct the sewer system in accordance with the approved plans.

2. Alignment and Grades: Sewers shall be laid in straight alignment where possible and a uniform grade between manholes where possible. Where horizontal curves are required, curves may be made not to exceed the maximum allowable for type of joint and size of pipe as recommended by the manufacturer of the pipe. The pipe will bend without using extra fittings (45's, 90's). If fittings have to be used a manhole must be placed for access. All lines shall be located a minimum of nine (9) feet horizontally from water lines, and where sewers cross water lines, they shall be constructed of pressure pipe for a distance of nine (9) feet on either side of the water line. Crossings shall be under water lines where possible. Minimum grades, as per Texas Department of Health requirements shall be:

Pipe I.D. in Inches	Fall in Feet Per 100 Ft.
6"	0.50
8"	0.33
10"	0.25
12"	0.20
15"	0.15
18"	0.11

3. Materials:

   A. Gravity Pipe: Gravity sewer pipe shall be one of the following materials. All gravity sewer pipe shall be so manufactured that the completed sewer shall have a maximum infiltration or exfiltration of two hundred (200) gallons per inch of internal diameter, per mile of pipe, per twenty-four (24) hours, where the maximum hydrostatic head at the center line of the pipe does not exceed twenty-five (25) feet.

      (1) SDR 26-P.V.C. Gravity Sewer Pipe: PVC sewer pipe and fittings shall conform to the requirements of current ASTM Specification D- 3034-SDR 26, and shall be equipped with joints meeting the requirements of current ASTM Specification D-3212.

      (2) Ultra-Rib P.V.C. Gravity Sewer Pipe: Ultra-Rib sewer pipe shall conform to ASTM F 79 and Uni-Bell Specification UNI-B-9 when pipe is approved for use by City Engineer.

   B. Pressure Pipe for force mains and water line crossings shall be:

(1) Cast Iron Pipe and fittings shall conform to the requirements for Class 150 pipe for water lines as specified under Item 3, Water System Specifications.

(2) PVC Pressure Pipe and fittings shall be Class 160, SDR 26, pipe conforming to ASTM Designations D1784 and D2241.

C. Concrete shall conform to the requirements of Item 2, Concrete, of these specifications.

D. Manholes shall be forty-eight (48) inch inside diameter reinforced concrete, precast or monolithic cast-in-place, or when so approved, may be preformed fiberglass.

(1) Precast Concrete manholes shall consist of precast riser, concentric cones, and grade rings supported on a cast-in-place concrete base. For water containment construction, precast reinforced concrete manhole sections shall be of the bell and spigot or tongue and groove design meeting the requirements of ASTM C-478, having a wall thickness equal to that of ASTM C-76 wall "B", using a trapped type preformed O-Ring rubber gasket conforming to the requirements of ASTM C-443. Risers shall be in standard lengths of one (1) through six (6) feet in increments of one (1) foot. Manhole steps shall be installed by the pipe manufacturer where attention shall be given to a safe structural tie. Vertical center line of steps shall be marked on the outside of each manhole section.

(2) Monolithic Manholes: Monolithic concrete manholes shall be poured on the job site in forms as approved by the Engineer. These manholes shall be poured from Class "F" (4000#) concrete to provide a formed wall thickness of at least six (6) inches.

(3) Fiberglass Manholes shall consist of a preformed riser with an integral cone supported on a reinforced cast-in-place concrete base. They shall be manufactured in accordance with ASTM Specification X-23.2.10 or the latest draft thereof, and shall be designed for H-20 wheel load.

E. Manhole Frames and Covers: Grey iron manhole frames and covers shall be McKinley Iron Works, Type No. A24AM, Neenah Type B, No. 1415, or approved equal. Covers shall be provided with pick slots for those manholes equipped with twenty-four (24) inch diameter cover. The word "Sewer" shall be cast in each cover.

F. Non-Metal Manhole Steps: Non-metal steps shall be of solid glass fiber or other non-corrosive manhole steps. Only non-metallic manhole steps will be used in sanitary sewer manholes.

G. Cleanouts: Cleanouts shall be standard castings with covers, Bass and Hays Pattern No. 339, McKinley Iron Works, Type SC2, or an approved equal.

4. Excavation, Trenching and Backfilling shall conform to the requirements of Item 1 of these specifications.

5. Pipe Laying: All pipe shall be lowered into the trench by suitable mechanical equipment; no pipe shall be rolled or dumped into the trench. All dirt and trash shall be removed from the pipe while suspended. Previous to being lowered into the trench, each pipe shall be carefully inspected, and those not meeting specifications shall be rejected, and either destroyed or removed from the job. All pipe shall be laid to the line and grade shown on the plans.

A. 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. All pipe shall be carefully adjusted to fit snugly in cradling or embedment so that the entire length bears on cradling or embedment materials. Pipe shall be laid with the bell (or groove) end upgrade, unless otherwise approved by the Engineer.

B. Before laying, the interior of the bell shall be carefully wiped smooth and clean and the annular space shall be kept free from dirt, stones, or water. All water must be kept out of the bell-hole during laying.

C. 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.

D. Pipe shall be installed in accordance with the most current revision of ASTM Specification D-2321, "Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe", available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103. In addition, written recommendations of the pipe manufacturer shall be followed, where these recommendations do not conflict with ASTM D-2321.

E. When work is suspended on the line for any reason, the end of the line shall be properly plugged to prevent water, trash, dirt, or rodents from entering.

6. Service Connections: Unless otherwise shown or approved by the City Engineer, a sewer service connection shall be installed to serve each lot in the area served by the sewer main.

   Standard sewer service connections shall be installed in trenches down to twelve (12) feet deep, and deep-cut service connections shall be installed in trenches greater than twelve (12) feet deep. Installation of sewer service connections will consist of such wyes, bends, etc., as may be required by the Standard Details. The four (4) inch tap on main for service line shall be a ninety (90) degree "T" or wye laid with the line, or it shall be made on pipe in place by installing a tapping saddle on the pipe over a four (4) inch hole cut in the pipe. Pipe saddles shall be completely encased in concrete. Wyes, forty-five (45) degree tapping saddle with direction of flow. No taps in manhole unless approved.

   Service lines shall extend from the sanitary sewer lateral in the street to a point at least two (2) feet behind the curb, unless otherwise shown.

   The end of the services shall be plugged with a precast plug or other suitable means, meeting the approval of the Engineer. The curb shall be marked by an imprinted letter "S", three (3) inches in height, at the point where the service pipe passes under the curb.

   All completed service lines must have a clean-out.

7. Manhole Construction: Sewer line manholes shall be constructed in accordance with the plans, specifications, and standard details and approval of the Engineer. They shall be provided with cast iron manhole ring and covers. Noncorrosive manhole steps shall be installed as shown on the plans or as directed by the Engineer.

   Sewer pipe shall be laid through the manhole where possible, prior to concreting floor slab, so that full depth of pipe is embedded in concrete to form the flow channel. Where pipe cannot be used through manholes due to direction of flow, the flow channel to top of pipe shall be formed with concrete and troweled with a steel

trowel to a smooth even finish. The slab shall be sloped one (1) inch per foot to flow channel and troweled to a smooth even finish. After concrete has set, the top half of the pipe between the walls of the manhole shall be broken out and the edges pointed up.

A. Cast-In-Place Manholes: The walls and base of cast-in-place manholes shall be poured monolithically. The earthen pit shall be widened and deepened at the bottom to allow a sufficient spread of base concrete matching the dimensions shown on the detail in the plans. The walls shall be constructed using form sections which can be disconnected and removed both inside and outside after the concrete has cured.

   Precast cover grade rings shall be used to bring the manhole to finish grade. The grade rings and cast iron frame and cover shall be mortared around the outside flush with the outside wall of the cast-in-place section.

B. Precast Manholes: The Class "B" concrete base shall be poured around the sewer pipe to the shape and dimensions shown on the plans. The first section of reinforced precast concrete pipe shall be set on the base and grouted in place. The required sections of precast pipe shall be placed to bring the manhole up to grade. Precast pipe joints shall be "O" ring. The last section of precast pipe shall be a concentric manhole ring. Precast concrete grade rings shall be used to bring the manhole to finished grade. The grade rings and cast iron frame and cover shall be mortared around the outside flush with the outside wall of the precast manhole cone.

C. Fiberglass Manholes shall be installed in accordance with the manufacturer's recommended procedures as found in Owens-Corning Fiberglass Publication No. 5-PS-6455-C, "Fiberglass Flowtite Manholes".

D. Drop Manholes: Drop manholes shall be constructed with cast iron pipe drops in locations as shown and as shown in the standard details.

8. Connection to Existing Lines: Where possible, connection to an existing line shall be made without interruption of flow of sewage in the existing line.

9. Bypassing of Sewage: Sewage shall not be bypassed from existing lines unless absolutely necessary. Before any sewage may be bypassed from an existing sanitary sewer to accomplish any of the work required on the project, written permission to make such bypass must be obtained from the City's Engineer. A request for permission to effect such bypass shall be made in writing at least two (2) days prior to the time needed. The request shall contain full details as to the manner in which bypassing is to be accomplished, and the minimum and maximum time bypass is to remain in service. In general, bypassing will not be approved unless it is absolutely essential to accomplish the work, and all costs incurred by the City in taking proper health and sanitation precautions as a result of an approved bypass shall be paid by the Contractor.

10. Testing: All PVC sewer pipe shall be tested for deflection. The deflection test for PVC sewer pipe shall consist of passing a prefabricated plug designed for deflection testing through the pipe a minimum of seven (7) days and no later than one (1) year after installation. The prefabricated plug shall have an outside diameter of ninety-five (95) per cent of the inside diameter of the pipe being tested. If during the test, the plug hangs and cannot be pulled completely through a section of the sewer line between two (2) access points, i.e., two (2) manholes, or a manhole and a cleanout, all or a part of that section of pipe shall, at the discretion of the Engineer, be removed and replaced. A deflection test shall be performed on the replaced section of pipe in the prescribed time range as stated above. A completed section of sewer line will not be

accepted until it has passed the deflection test.

When, in the opinion of the City Engineer, an excessive amount of infiltration, or leakage, is indicated in a newly installed line prior to acceptance, an exfiltration test may be required to be performed by the Contractor. This test may be performed by either of the following methods:

A. This method may be used in lieu of B. The influents to the manholes at the upper and lower ends of the new line shall be plugged with an inflatable rubber pipe stopper. The line shall be filled by introducing water into the manhole and filling it to ground level.

   After the water has remained in the line twenty-four (24) hours, the water level is again brought up to ground elevation. After one (1) hour the water level is measured from the starting point and the quantity of leakage computed.

B. This method may be used in lieu of A. The effluents to the manhole at the upper end of the new line and the influent to the manhole at the lower end of the line shall be plugged with a plumber's plug. The plug at the upper end of the new line shall be watertight and shall be so constructed as to permit the introduction of water into the sewer through a hose. The end of the hose shall be connected to a barrel which will permit variation of the hydrostatic pressure by elevating the barrel. The line shall be filled by introducing water through the hose until the line and barrel are full. After the water has remained in the line twenty-four (24) hours, the water level is again brought up to ground elevation. After one (1) hour the water level is measured from the starting point and the quantity of leakage computed. Any line, or segment of line which has exfiltration in excess of two hundred (200) gallons per inch of internal diameter, per mile of pipe, per twenty-four (24) hours, where the maximum hydrostatic head at the center line of the pipe does not exceed twenty-five (25) feet will not be considered to be acceptable.

TECHNICAL SPECIFICATIONS

ITEM 5

STREETS, WALKS, AND DRIVEWAYS

1. General: This item includes the construction of all street, curb and gutter, sidewalk, and driveway construction within public right-of-way. It does not include walk and driveway construction beyond the right-of-way property line. The provisions of these specifications are intended to apply primarily to new developments and to new streets within existing platted or annexed areas, and the developer shall provide complete plans, including profiles, of the proposed work for approval prior to initiating any work in the area. Street design shall conform to the requirements of the current Subdivision Ordinance and to these technical specifications. All streets shall have curb and gutter and bituminous surfacing, and all street construction shall conform to the requirements of this item of the Standard Specifications.

2. Street Classification and Pavement Structure Requirements:

A. All streets shall be classified as either Residential (local, minor, and major), Collector (minor or major), or Others. The classifications shall be as specified in the criteria found in the Subdivision Ordinance and/or as approved by the City. "Others" shall refer to streets shown by the City, City Engineer, or a Registered Professional Engineer, based on acceptable engineering practices, that loading or traffic count requirements exceed those provided for the street classifications.

(1) Residential

ROW	- See Subdivision Ordinance
Asphaltic Surface	- 1 1/2" hot-mix asphaltic concrete
Flexible Base	- See Pavement Thickness Design Chart
Pavement Width	- See Subdivision Ordinance

(2) Collector

ROW	- See Subdivision Ordinance
Asphaltic Surface	- 2" hot-mix asphaltic concrete
Flexible Base	- See Pavement Thickness Design Chart
Pavement Width	- See Subdivision Ordinance

(3) Other

ROW	- As approved by City
Asphaltic Surface	- 2" hot-mix asphaltic concrete
Flexible Base	- See Pavement Thickness Design Chart

Pavement Width	- As approved by City
Axle Frequency	
Loading	- Number of 18,000 pound equivalent axle load repetitions which street will experience if its design life exceeds 150,000.

3. Alignment and Grades:

A. Alignment: Street and curb alignment shall consist of uniform straight line tangents connected by true circular horizontal curves. Compound curves may be used where necessary to achieve the desired alignment. Extensions of existing streets shall match the existing street centerline without abrupt offsets, and any widening shall be accomplished equally on both sides with horizontal curves in the curb line. Requirements of the current Subdivision Ordinance shall also be complied with in establishing the street alignment. At intersections, curbs shall have a minimum radius of fifteen (15) feet to the back of the curb. Larger radii at these points are permissible if desired. Curb returns at driveway approaches shall have five (5) foot radius to the back of the curb.

B. Grades: Streets and curbs shall be on uniform straight line grades with any changes of grade made on a true calculated parabolic vertical curve. Abrupt changes of grade without vertical curves will not be permitted. Vertical curves may be successive without an intervening tangent grade where necessary, but shall not be compounded. Uniform grades shall not be less than zero point thirty (0.30) percent and shall not exceed ten (10) percent without approval. Grades for sidewalks shall be exactly that of the curb which is adjacent. Elevations for sidewalks shall be one (1) inch above the elevation of the adjacent curb, with the sidewalk also having a fall of one quarter (1/4) inch per foot toward the street. Valley gutters shall have a minimum of zero point thirty (0.30) percent grade truly uniform.

C. Standard Details: All streets, curb and gutter, sidewalks, and driveways shall conform to the standard plans and details appended to these Standard Specifications.

D. Construction Tolerances: Maximum allowable deviations from alignments and grades shown on the plans shall be:

(1) Alignment: Variations from the true alignment shall not exceed zero point zero five (0.05) feet combined amount in any one hundred (100) foot distance.

(2) Grade:

(a) Subgrade - + 0.05 feet

(b) Finished Base Course - + 0.03 feet without abrupt changes.

(c) Finished Pavement Surface - + 0.02 feet

(d) Curbs - For grades of:

Over 1.0% - 0.02 ft.
0.5 to 1.0% - 0.01 ft.
Under 0.5% - 0.00

Regardless of the allowable tolerances indicated for curbs, all curb and gutter shall be constructed to proper grade to drain freely and any gutter constructed with water pockets shall be torn out and properly replaced at the Contractor's expense.

Any variation in alignments, grades, plans or sections as herein required shall only be by written consent of the City Engineer.

4. Quality Control: Attention is invited to the Quality Control provisions of the General Provisions of these Standard Specifications. All work under this item will be subject to these quality control requirements.

5. Materials: Materials for the various features of work under this item of these specifications shall meet the following requirements:

A. Concrete shall conform to the requirements of Item 2, Concrete.

B. Lime for subgrade stabilization shall conform to the requirements of Item 264 of the Texas Highway Department Standard Specifications, for Type A or Type B.

C. Flexible Base Material shall be obtained from approved sources and shall be crushed limestone consisting of durable particles mixed with approved binding materials. The material shall be subject to approval of the City Engineer at the source. The processed material when properly slaked and tested by standard laboratory methods shall meet the following requirements:

Retained on 1 3/4 inch sieve . .0%
Retained on No. 4 sieve . . . . 45 to 75%
Retained on No. 40 sieve . . . .60 to 85%

The material when tested by "The Wet Ball Method for Determining the Disintegration of Flexible Base Materials" according to the latest procedures of the Texas Highway Department shall not develop more than fifty (50) percent soil binder prior to rolling.

Materials passing the No. 4 sieve shall be known as "Binder". The portion of material passing the No. 40 sieve shall be known as "Soil Binder" and shall meet the following requirements:

The liquid limit shall not exceed 40 when tested in accordance with AASHO designation T89-49.

The plastic limit shall be determined by testing in accordance with AASHO designation T90-49.

The plasticity index shall not exceed 12 or be less than 4 when calculated in accordance with AASHO designation T91-49.

The preparation of samples for testing according to AASHO designations T89-49, T90-49, and T91-49 shall be according to AASHO designation T146-49 "Wet Preparation of Disturbed Soil Samples for Test".

Materials retained on the No. 4 sieve shall have a per cent wear of not more than 45 when tested according to AASHO designation T96-49 "Abrasion of Coarse Aggregate by use of the Los Angeles Abrasion Machine".

D. Bituminous Materials: All bituminous materials shall conform to the Texas Highway Department Standard Specification Item 300, types and grades as indicated below:

Tack Coat	- RC-2, or a slow or medium setting emulsion.
Prime Coat	- MC-30 or MC-70
Asphalt for Hot-Mix Asphaltic Concrete	- AC-10
Asphalt for 2-Course Surface Treatment	- AC-3 or AC-5

E. Paving Mixes and Aggregates shall conform to the Standard Specification items of the Texas Highway Department as listed below:

Hot Mix Asphaltic Concrete	- Item 340, Type "D"
Aggregate for Surface Treatment	- Item 302, Type B, Grade 3 for first course and Grade 4 for second course.

F. Where more than one (1) type or grade of material is given, the City Engineer shall determine the type of grade to be used for the project.

6. Excavation, Fill, and Grading: All excavation, construction of fills or embankments and grading within the public right-of-way shall conform to the following requirements. All completed work shall conform to the plans and applicable Standard Details and shall be accomplished as specified hereinafter.

A. Excavation shall be in accordance with the lines, grades, and typical sections as shown on the plans or established by the Engineer. Unless otherwise shown on the plans or established by the Engineer, street excavation will be made to the subgrade.

B. Embankments (Fills): Prior to placing fill material, the area on which the fill is to be placed shall be cleared of all trees, brush, stumps, and other obstructions.

Embankments shall be constructed of suitable materials approved by the Engineer and shall be placed in successive horizontal layers of not more than eight (8) inches in depth, loose measurement, for the full width of the embankment and in such lengths as designated. Stumps, trees, rubbish, vegetation or other unsuitable materials shall not be placed in embankments. All construction traffic shall be uniformly distributed over the entire surface of each layer of the embankment.

A "Maintainer", or a "Blade Grader" weighing at least three (3) tons, with a blade at least ten (10) feet in length shall be kept in operation on the embankment for the purpose of uniformly mixing, spreading, pulverizing, and consolidating the embankment material.

After a layer of embankment material has been placed and bladed, it shall be sprinkled, if directed, in the quantity as determined by the Engineer, and rolled-to-compaction with a

tamping roller, of approved type.

Embankment placed over and adjacent to pipes, culverts, and other structures shall be of suitable materials, and shall be placed in successive horizontal layers of not more than eight (8) inches in depth, loose measurement, and each layer uniformly mixed, pulverized and thoroughly compacted to the satisfaction of the Engineer, by the use of rakes, hand tamps, and/or other approved methods.

Special care shall be taken to prevent any wedging action against the structure. This method of consolidation and compaction shall be used for such distances along embankment adjacent to structures as may be necessary and in other areas where blading and rolling would be impractical.

Where a large portion of the materials excavated consist of rock, the rock may be used in the construction of the embankment as hereinafter specified.

The maximum dimension of any rock used shall not exceed fifty (50) percent of the height of the embankment and in no case shall any rock over twenty-four (24) inches in its maximum dimension be placed in the embankment. When the greater portion of the embankment is to compose of materials other than rock, the embankment shall be constructed as required in the preceeding paragraphs, and the rock shall be carefully distributed throughout the embankments and filled around with earth or other approved fine material so that the interstices between the large particles are filled and a dense, compacted, uniform embankment is secured.

The upper eight (8) inches of all embankments shall be composed of soil without objectionable quantities of rock.

All embankments shall be compacted for the full depth to a density of ninety (90) percent of maximum density as determined by the modified Proctor method, ASTM Designation D1557.

7. Provisions for Drainage: If it is necessary in the prosecution of the work to interrupt the natural drainage of the surface, or the flow of artificial drains the Contractor shall provide temporary drainage facilities that will prevent damage to public or private interests, and shall restore the original drains as soon as the work will permit. The Contractor shall be held liable for all damages which may result from neglect to provide for either natural or artificial drainage which his work may have interrupted.

If excavation of road materials indicates seepage of ground water into the area under the road bed subsurface drainage as approved by the City Engineer shall be installed.

If permanent underground drainage facilities or off-street drainage facilities are required, they shall conform to Item 6, Drainage Facilities, of these Standard Specifications.

8. Subgrade Sampling Procedure:

A. Samples shall be obtained of the predominant subgrade materials from the street right-of-way.

B. Sampling locations shall be selected at intervals not to exceed three hundred (300) feet.

C. Each sample shall consist of approximately two (2) pounds of material and should be properly identified as to sampling location and sampling depth interval.

D. The sample shall be representative of the twelve (12) inches below subgrade elevation. It should be cautioned that the top twelve (12) inches of the natural soil profile is not necessarily representative of the subgrade.

E. Notations shall be made of any fill areas, soft ground conditions, groundwater, or other unusual situations which may influence the pavement design. Sampling should not be from previously backfilled trenches.

9. Laboratory Testing Procedure:

A. All samples of subgrade materials shall be visually examined in the laboratory for the initial soil classification and color description.

B. Samples which visually appear to be similar shall be grouped together. This process is very important since subsequent testing is performed on these grouped samples.

C. Representative samples from each of these groups shall be tested for the following properties:

Liquid Limit (LL)
Plastic Limit (PL)
Plasticity Index (PI)
Percentage Passing No. 200 Mesh Sieve
Optimum Moisture Content
Modified Proctor Density

D. All samples shall be stored until the project is complete. These samples may be useful during construction as an aid in identifying the various subgrade groups.

10. Subgrade Group Classification Procedure:

A. Plot the results of the Atterberg Limits tests (LL and PI) on the "Subgrade Classification Chart", Table II, to obtain the subgrade group.

B. The resulting subgrade group may be up-graded one (1) group if less than forty (40) percent of the material passes the No. 200 mesh sieve. This applies only to groups III through VII.

11. Pavement Thickness Design Procedure:

A. Each street must be assigned one of the traffic classifications as indicated below:

Residential Street	(local, minor, and major)
Collector Street	(minor and major)
Others	(approved by City)

The City Engineering Department must be consulted to aid in these traffic classifications.

B. The appropriate "Pavement Thickness Design Chart" (see Tables III through V) selected on the basis of the traffic classification can then be used with the subgrade classification group to determine the total required pavement thickness.

C. The pavement section will consist of hot-mix asphaltic concrete surface (thickness as indicated on "Pavement Thickness Design Chart") overlying a crushed limestone base material.

D. For pavements designed for subgrade groups IV through VII, a select sub-base layer may be substituted for a portion of the base layer. The select sub-base material must be classified using the subgrade classification procedure and a subgrade group assigned to the sub-base material. The pavement thickness required above the sub-base material is determined using the design charts and the group classification.

E. A six (6) inch thickness of lime-stabilized subgrade may be substituted for eight (8) inches of crushed limestone base material for pavements designed in subgrade groups IV through VII. The quantity of hydrated lime may be selected from the table below:

Subgrade Group No.	Pounds of Lime to be Applied per Square Yard: Six (6) inch Compacted Thickness
IV	20 pounds per square yard
V	22 pounds per square yard
VI	25 pounds per square yard
VII	28 pounds per square yard

TABLE I

CITY OF COPPERAS COVE

FLEXIBLE PAVEMENT DESIGN PROCEDURE

SUBGRADE CLASSIFICATION GROUPS

Soil Classification Tests

Group No.	Liquid Limit	Plasticity Index	Typical Material Description
I	< 35	5-15	limestone, weathered limestone, or severely weathered limestone
II	30-40	10-25	sandy clays, silty clays, or severely weathered limestone
III	40-50	15-30	sandy clays, silty clays, or severely weathered limestone
IV	50-60	20-35	clay or silty clay
V	60-70	25-40	clay
VI	70-80	35-50	clay
VII	> 80	40-60	clay

Graphical representation of these subgrade groups are shown on following Table II. Values which plot on the borderline between two (2) groups should be assigned the group number of the poorer soil group. Soils which have less than forty (40) percent passing the No. 200 mesh sieve and which would plot in Groups III through VII may be up-graded to the next better group.

TABLE II

CITY OF COPPERAS COVE

PAVEMENT DESIGN PROCEDURE

SUBGRADE CLASSIFICATION CHART

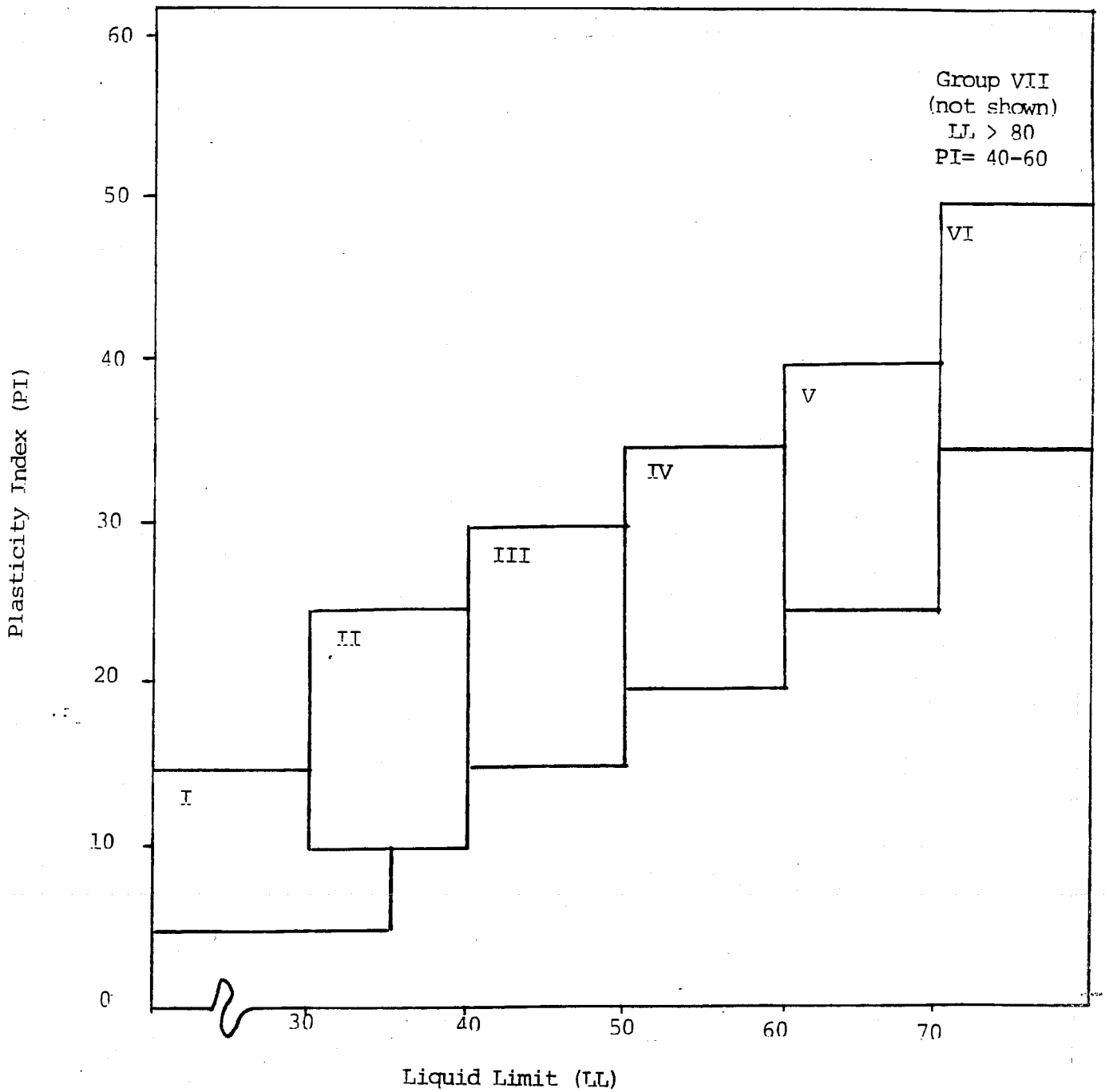


TABLE III

CITY OF COPPERAS COVE

PAVEMENT THICKNESS DESIGN CHART

LOCAL, MINOR, and MAJOR RESIDENTIAL STREET

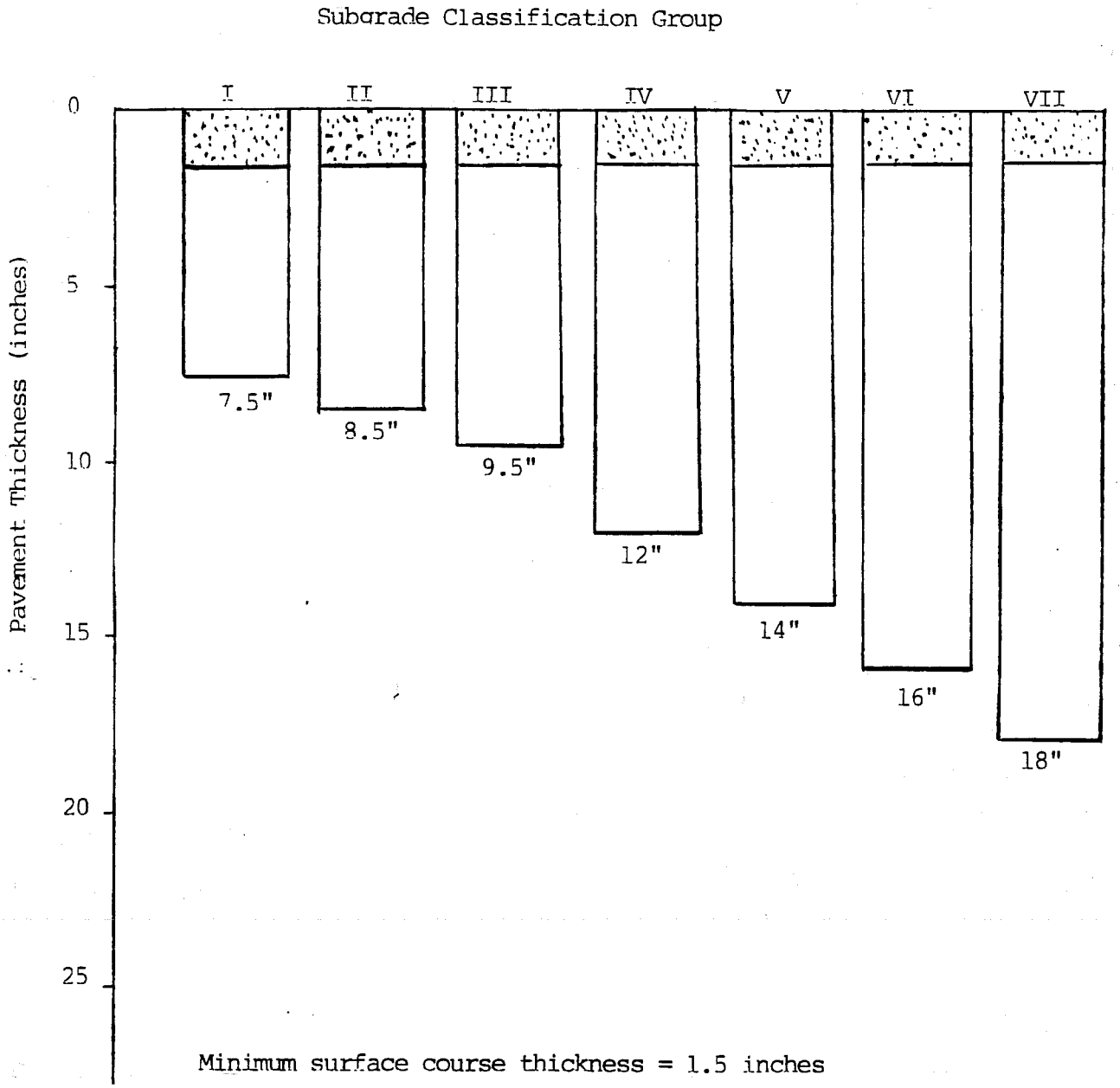


TABLE IV

CITY OF COPPERAS COVE

PAVEMENT THICKNESS DESIGN CHART

MINOR and MAJOR COLLECTOR STREET

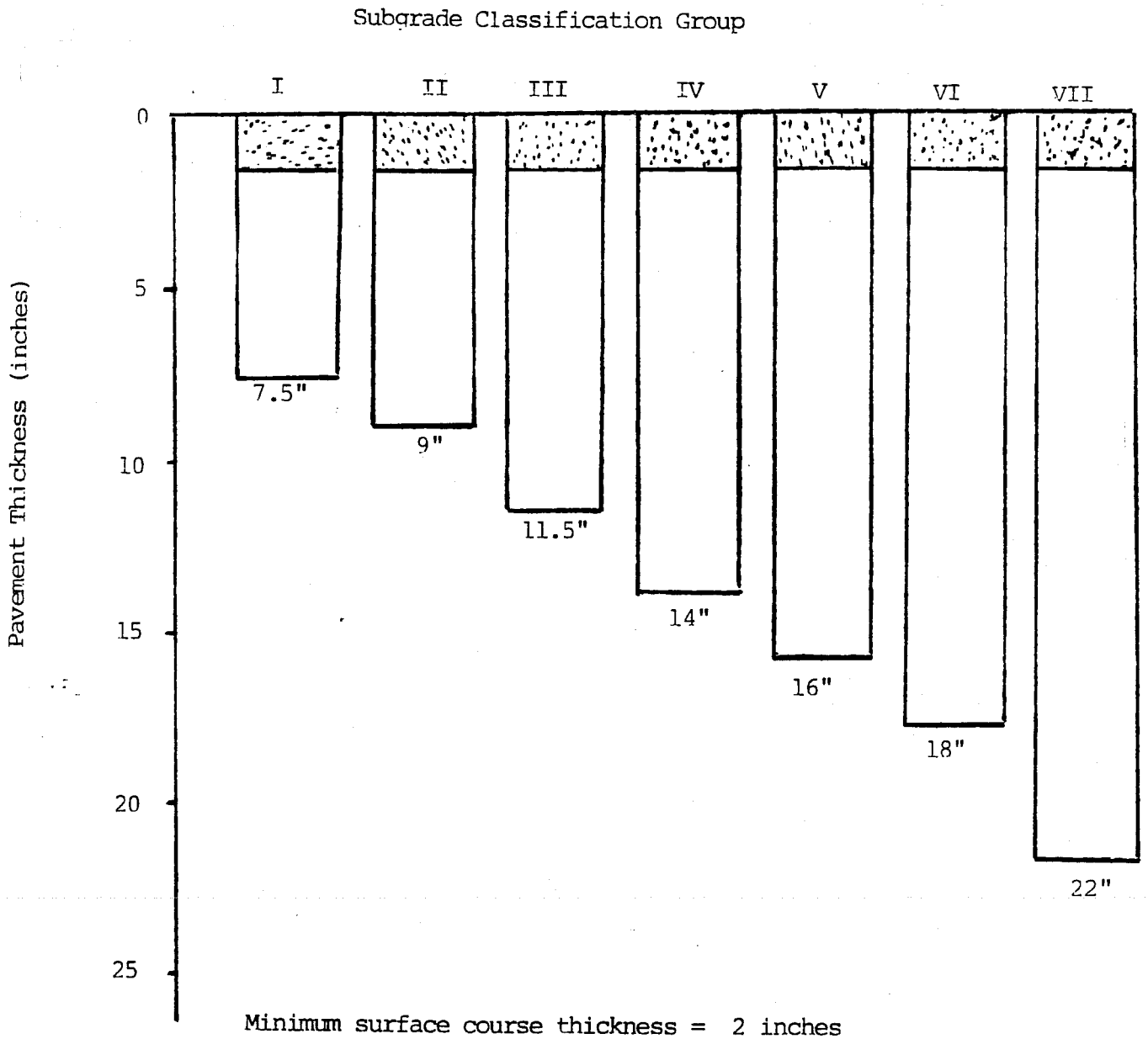
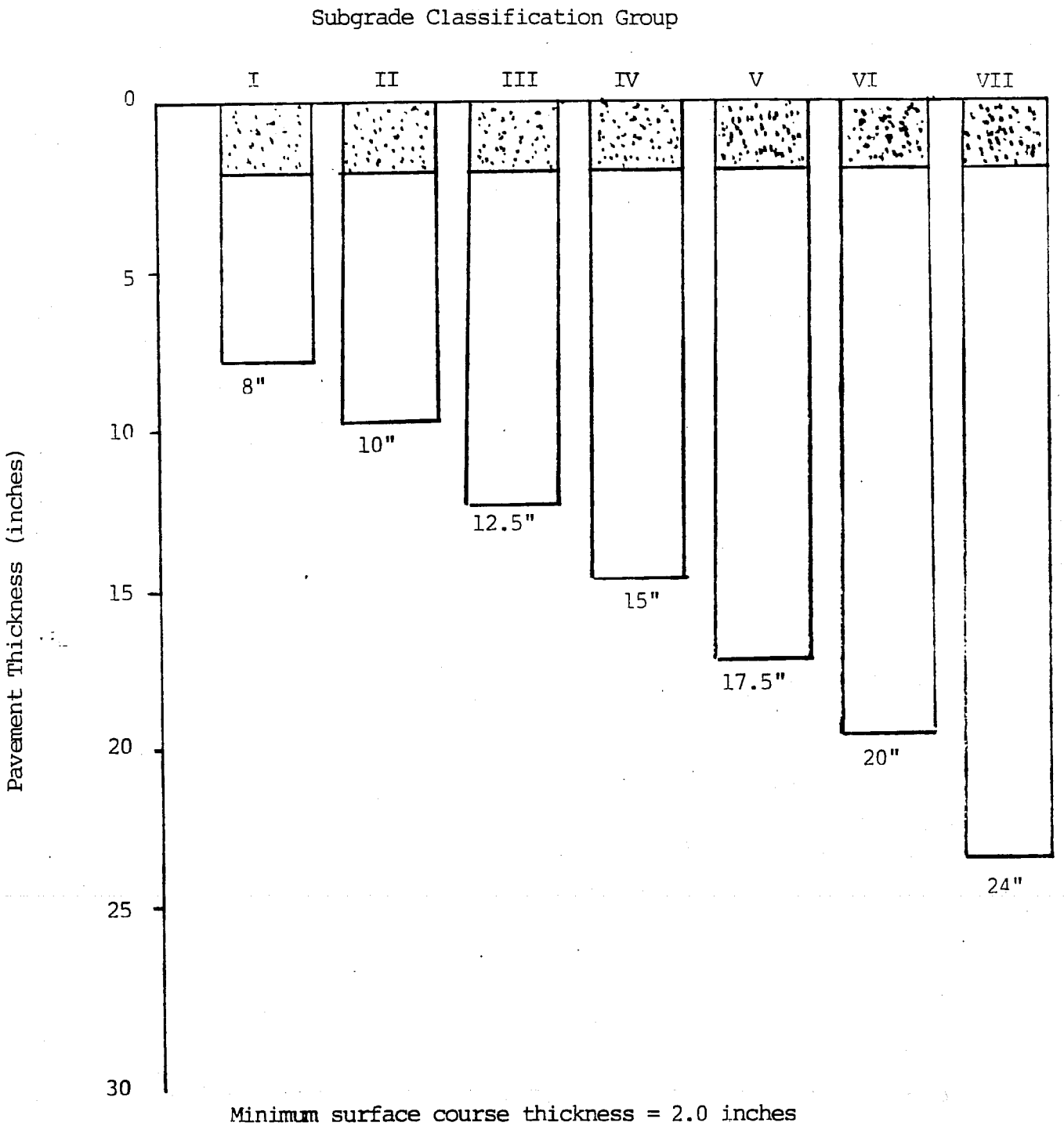


TABLE V

CITY OF COPPERAS COVE

PAVEMENT THICKNESS DESIGN CHART

OTHER STREETS



12. Subgrade Preparation:

A. If subgrade consists of fill material or natural, non-lime-stabilized material the top six (6) inches shall be compacted as required to ninety-five (95) percent modified Proctor Density.

B. Lime Stabilized Subgrade should be constructed in accordance with Texas Highway Department Item 260, Lime Treatment for Materials In-Place using the quantity of hydrated lime required by the design procedure. Hydrated lime should meet the requirements of Texas Highway Department Item 264. The well-mixed and cured soil-lime mixture should be compacted to a minimum of ninety-five (95) percent of ASTM D1557 maximum density at optimum moisture content.

Approved lime-stabilization procedures follow.

The existing subgrade shall be pulverized to a depth of six (6) inches and shall be treated with lime and water either in the form of a slurry or the materials may be applied to the subgrade separately.

The lime and moisture are to be uniformly mixed with the subgrade by the use of an approved pulvi-mixer. The section will then be brought to proper crown and grade. In the event that all clods and lumps are not sufficiently broken up by the pulvi-mixer, the soil-lime mixture shall be allowed to cure from two (2) to four (4) days as directed by the City Engineer. During the curing period, the material shall be kept moist as directed. After the curing is completed, the final mixing shall begin. The mixture (exclusive of all plus half (1/2) inch non-slaking aggregates) when properly mixed shall meet the following requirements when dry screened on a dry weight basis.

Passing 2" Screen	100%
Passing 1/2" Screen, Minimum	60%

Water shall be added during the mixing of soil and lime to attain the optimum moisture content to ninety-five (95) percent maximum density as determined by the modified Proctor method, ASTM Designation D1557.

After compaction is completed, the surface shall be shaped, water added as needed and finish rolled as directed with a pneumatic or other suitable roller sufficiently light to prevent cracking.

The completed section shall be moist cured until such time as the first course of base material is placed and compacted.

13. Flexible Base Course: Prior to placing the flexible base material on the subgrade, the surface of the subgrade shall be bladed and rolled, as necessary and to the extent directed in order to place the subgrade in an acceptable condition to receive the base material. The surface of the subgrade shall be smooth and conform to line and grade as established and in conformity with the typical section as shown on the plans. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of the work.

Where the base course exceeds six (6) inches in thickness, it shall be constructed in two (2) or more courses of equal thickness as indicated on the typical section.

Immediately before placing the base course material, the subgrade shall be checked as to conformity with grade and section. The surface of the subgrade shall not show deviations in excess on one quarter (1/4) inch of five (5) feet, nor one-half (1/2) inch in sixteen (16) feet longitudinally.

The base course material shall be delivered in approved vehicles of a uniform capacity, and the required amount of specified material shall be delivered to secure the proper thickness of completed 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. The material shall be sprinkled, if directed, and shall then be bladed 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 Engineer. If additional binder is considered desirable or necessary after the material is spread and shaped, it shall be furnished and applied in the amount directed by the Engineer. Such binder shall be carefully incorporated with the 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 hereinafter specified. After each section of flexible base is completed, tests as necessary will be made. 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 typical sections shown on the plans and to the established lines and grades. On the surface where pavement is to be placed, any deviation in excess of one-fourth (1/4) inch in cross-section and in length of sixteen (16) feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.

The base material shall be compacted at optimum moisture content to ninety-five (95) percent modified Proctor Density as determined by ASTM Designation D1557.

14. Bituminous Surfaces: All streets shall have a surface treatment of Hot Mix Asphaltic Concrete (HMAC) of the minimum thickness shown on the Standard Details, or, when approved in writing by the City Engineer, a two (2) course penetration type asphalt surface treatment may be applied. If the two (2) course penetration pavement is used, the thickness of the flexible base course must be increased by at least the difference in thickness between the HMAC surface course and the two (2) course penetration pavement in order to provide a combined total thickness of base course and surface treatment equal to or greater than the combined total thickness of the base course and HMAC pavement shown on the Standard Details or otherwise required.

A. Construction of HMAC Pavement: Prime coat, tack coat, and HMAC surface course or courses shall be placed in accordance with the following:

(1) Prime Coat: All base courses to receive asphaltic concrete pavement shall be cleaned and primed with a uniform application of asphaltic material as specified above. The priming material shall be applied with a self-propelled pressure distributor sprayer, except in places impossible to use a sprayer, at a rate of zero point fifteen (0.15) to zero point three (0.3) gallons per square yard of surface as determined by the Engineer. Subsequent application of pavement course shall not be laid until the primed surfaces have cured long enough to evaporate the volatiles. Alternate methods of application at the same coverage rates shall be used where the pressure distributor sprayer cannot be used.

(2) Tack Coat: When required to obtain a satisfactory bond between courses or between the prime coat and surface course, a tack coat shall be applied prior to placing the next course. Tack coat material shall be as specified under "Materials" above. The course to which the tack coat is applied shall be swept clean before the tack is applied. The asphalt tack coat material shall be applied uniformly with a sprayer at a maximum coverage of zero point ten (0.10) gallons per square yard of surface as directed by the Engineer. The surface of curbs, gutters, vertical faces of existing pavements, and all structures in actual contact with asphalt mixes shall be painted with a thin, complete coating of asphaltic tack coat material to provide a closely bonded, water- tight joint.

(3) Hot Mix Asphaltic Concrete construction methods shall conform to the requirements of Item 340 of the Texas Highway Department 1972 Standard Specifications for Construction of Highways, Streets and Bridges. Materials shall be as specified above under "Materials".

The compacted thickness or depth of the asphaltic concrete surface course shall be as shown on the plans or Standard Details. Where the plans require a depth or thickness of the surface course greater than two (2) inches, it shall be accomplished by constructed multiple courses of approximately equal depth.

All asphaltic concrete material shall be placed and rolled during daylight hours. The mixture shall be at a temperature between two-hundred twenty five (225) degrees F and three-hundred twenty five (325) degrees F when placed.

During the application of asphaltic material, care shall be taken to prevent splattering on adjacent pavement, curbs, gutters, and other structures.

(a) Joints: The placing of the mixture shall be as continuous as possible, and the roller shall pass over the unprotected edge of the freshly laid mixture only when the laying is discontinued for such length of time as will permit chilling or cooling of the mixture. In every case when resuming the work, the material previously laid shall be cut back to produce a slightly beveled edge for the full depth of the course. The material cut away shall be removed from the site of the work. Fresh mixture shall be laid against the fresh cut. Construction joints shall be either parallel to or at right angles to the longitudinal axis of the work.

(b) Compaction: The edges of the pavement along curbs, headers, manholes, valve boxes, and similar structures, and all places not accessible to the roller, or such areas where proper compaction cannot be obtained with the roller, shall be compacted with lightly oiled hand operated vibrating rollers, mechanical tamps, or hand tamped.

Each separate course after final compaction shall have a density of not less than ninety-five (95) percent of the density developed in the laboratory test method, ASTM D1188, "Test for Bulk Specific Gravity of Compacted Bituminous Mixtures, Using Paraffin-Coated Specimens".

(c) Testing: The surface of the pavement, after final compaction, shall be

smooth and true to the established line, grade, and cross section, and shall have no deviation in excess of one eighth (1/8) inch per foot from the nearest point of contact when tested with a sixteen (16) foot straight-edge placed parallel to the centering of the roadway. The maximum ordinate measured from the face of the straight-edge shall not exceed one-quarter (1/4) inch at any point. All areas not complying with this requirement shall be corrected. When required by the City Engineer, the completed pavement shall be sampled and tested for thickness and density.

The testing agency will cut cores from the pavement at locations selected by the Engineer in order to determine if the specified thickness, stability, and density have been obtained. If any core indicates a deficient thickness, the Contractor may cut additional cores at his own expense in order to define the area of deficiency. The Contractor shall remove and repair the areas of deficient thickness, stability, or density, designated by the Engineer at no extra cost.

B. Construction of Two Course Surface Treatment: Prime coat shall be required on all base course surfaces, as specified above for HMAC pavement, prior to construction of the two (2) course surface treatment. Materials shall be as specified above under "Materials". Construction methods shall conform to Item 322 of the Texas Highway Department Standard Specifications.

15. Curb and Gutter, Sidewalks, and Driveways: Construction of curb and gutter, concrete valleys, sidewalks, and driveway approaches shall conform to the following requirements. Concrete shall be Class B as specified under Item 2, "Concrete", of these Standard Specifications. No concrete shall be placed until the forms have been checked and approved by the City Inspector. Dimensions and conformation shall comply with the Standard Details appended to these specifications. Grades, alignment, and tolerances shall be as hereinbefore specified.

Forms shall be of wood or metal, of a section satisfactory to the Engineer, straight, free of warp and of a depth equal to the depth of the concrete face. They shall be securely staked to line and grade, and maintained in a true position during the depositing of concrete. Thin plywood, steel, or other similar material may be used to form short radius curb returns at driveways. The reinforcing steel, if required, shall be placed in position as shown on the typical sections. Care shall be exercised to keep all steel in its proper location.

A. Curb and Gutter: The length of curb and gutter placed in any one day shall be limited to the amount which can be furnished in daylight hours. The concrete shall be of sufficiently dry consistency when placed to permit shaping of the curb without a face form. The concrete shall be spaded along the forms to eliminate honeycomb and the gutter section shall be consolidated by tamping. The top section of curb and gutter shall be formed by a template or "mule" fabricated to match the contour of the curb and gutter. The lip of the gutter shall be "turned down" where necessary to match the adjacent grade of valley gutters.

When the concrete has set sufficiently, the top surface shall be finished uniformly with a wood float, and then tooled transversely at five (5) foot intervals and longitudinally at the gutter lip and the back of the curb with a quarter (1/4) inch radius edging tool. Expansion joints with half (1/2) inch thick premolded expansion joint filler shall be installed at ends of curb returns, at cold joints between pours, and at other locations required by the Standard

Details or as directed by the City Engineer.

As an option to the method described above, the concrete may be struck off one-quarter (1/4) inch to half (1/2) inch low, and a mortar topping of the same sand-cement ratio placed to fill the curb and gutter section. Finishing shall then be accomplished as specified above with a full-section mule, wood float, and edging. Topping must be placed while the base concrete is still plastic and prior to initial set. The face of the curb shall be marked where water and sewer service lines cross under the curb with the letters "W" or "S", as appropriate, and as specified under Item 3, Water System, and Item 4, Sewer System, of these specifications. The letters shall be three (3) inches high and shall be imprinted while the concrete is sufficiently plastic to receive a legible impression.

Completed curb and gutter shall be coated immediately with a curing compound as specified under Item 2, "Concrete". Immediately following the removal of forms, the formed surfaces shall have all honeycomb neatly patched and the surface treated with curing compound.

Backfill shall not be placed against the curb face for at least five (5) days, and the backfill shall not be compacted in a manner that will cause lateral displacement of the curb. Care shall also be exercised to prevent scarring or defacing of the exposed surfaces with equipment used for backfilling and grading.

B. Concrete Valleys shall be constructed in accordance with the Standard Details and to the grades indicated on the plans. Transitions to and from the standard curb and gutter sections at each end shall be such that water will not be trapped in the gutter section. The structure shall be monolithic with the curb and gutter at either end. Valleys shall have a wood float finish with transverse tooled joints as shown in the details. Steel reinforcement shall be provided as shown.

C. Sidewalks and Drive Approaches shall conform to the Standard Details appended to these specifications. The subgrade shall be compacted uniformly to the approximate density of the surrounding undisturbed material, and a one (1) inch sand cushion provided on the subgrade. Wire mesh reinforcement shall be provided in both sidewalks and drive approaches. Wire mesh shall be 6 x 6 - 10 / 10 for sidewalks and 6 x 6 - 6 / 6 for driveways. Expansion joints shall be installed at the intersection of drives and walks, where cold joints occur, and where walks or drives abut other concrete structures. Walks and drives shall have a light brush finish as specified under Item 2 / Concrete of these specifications. The edges shall be tooled with a one-quarter (1/4) inch radius edging tool, and walks shall also be tooled transversely at five (5) foot intervals. This pattern shall be continued through the drive approach apron. Curing compound shall be applied to the surface immediately after finishing is completed.

TECHNICAL SPECIFICATIONS

ITEM 6

STORM DRAINAGE

1. General: This item includes the construction of underground storm drainage facilities, particularly for new developments. The use of open channels shall be limited to major drainage facilities in open areas. Storm drainage facilities shall include inlets, manholes, pipe drains, culverts, headwalls, and pipe underdrains. All except underdrains shall be designed to convey the runoff from a one-hundred (100) year storm from the area served by the storm drain, including any contributing areas, without any significant ponding in streets or overflows onto adjacent property. All storm drains shall discharge into larger collector drains or outfall into natural major drainageways or streams within the same drainage area in such a manner as to not endanger downstream property or facilities from increased or concentrated flows caused by the storm drainage facility. Design of all storm drainage facilities must be approved by the City Engineer. Materials and construction methods shall conform to requirements specified hereinafter.

2. Excavation, Trenching, and Backfilling shall conform to the applicable requirements of Item 1 of these specifications except for bedding as specified below.

3. Concrete shall conform to the requirements of Item 2, "Concrete", of these specifications. Concrete for structures such as inlets, manholes, and headwalls shall be Class A.

4. Storm Drain Lines and Culverts materials and construction shall conform to Items 464 and 465 of the Texas Highway Department Standard Specifications except as provided above. Pipe jointing materials shall be rubber gaskets or cold applied preformed plastic gaskets unless otherwise approved by the City Engineer. Bedding shall be Class B. Pipe shall be precast reinforced concrete unless otherwise approved.

5. Manholes and Inlets shall conform to Items 470 and 471 of the Texas Highway Department Standard Specifications.

6. Pipe Underdrains shall conform to Items 510 of the Texas Highway Department Standard Specifications, of the type pipe approved for use.

TECHNICAL SPECIFICATIONS

ITEM 7

TRENCH SAFETY SYSTEMS

1. DESCRIPTION: This item shall govern for the Trench Safety Systems required for all trench excavation and including all additional excavation and backfill necessitated by the safety system. A trench shall be defined as a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than fifteen (15) feet. Trench Safety Systems include, but are not limited to, sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

2. CONSTRUCTION METHODS: Trench safety systems shall be accomplished in accordance with the detailed specifications set out in the provisions of Excavations, Trenching, and Shoring, Federal Occupational Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P, as amended, including Proposed Rules published in the Federal Register (Vol. 52, No. 72) on Wednesday, April 15, 1987. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-653. Legislation that has been enacted by the Texas Legislature (H.B. No. 662 and H.B. 665 and any subsequent) with regard to Trench Safety Systems, is hereby incorporated, by reference, into these specifications.

   If the Contractor elects to use a trench protective system that, in the Proposed Rules, requires "design by a qualified person or a qualified Engineer", (for example see 1926-652 (b) (3) and 1926.652 (c) (4), "a qualified person or a qualified engineer" shall be a Professional Engineer Registered in the State of Texas.

3. SAFETY PROGRAM: The Contractor shall submit a safety program specifically for the construction of trench excavation.

   The trench safety program shall be in accordance with OSHA standards governing the presence and activities of individuals working in and around trench excavation.

4. INSPECTION: The Contractor shall make daily inspections of the Trench Safety Systems to ensure that the systems meet OSHA requirements. Daily inspection is to be made by a competent person provided by the Contractor with actual experience in trench safety systems.

   If evidence of possible cave-ins, or slides, is apparent, all work in the trench shall cease until the necessary precautions have been taken by the Contractor to safeguard personnel entering the trench. It is the sole duty, responsibility and prerogative of the Contractor, not the Owner or the Engineer, to determine the specific applicability of the designed trench safety systems to each field condition encountered on the project. The Contractor shall maintain a permanent record of daily inspections.

5. INDEMNIFICATION: The Contractor shall indemnify and hold harmless the City, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgements or claims by anyone for injury or death of persons resulting from the

collapse or failure of trenches constructed under this contract.

The Contractor acknowledges and agrees that this indemnity provision provides indemnity for the City in case the City is negligent either by act or omission in providing for trench safety, including, but not limited to, inspections, failure to issue stop work orders, and the hiring of the Contractor.

SECTION 01110

TECHNICAL SPECIFICATIONS - SUMMARY OF WORK

PART 1: GENERAL

1.01 LOCATION OF WORK

The work of this Contract is located in the City of Copperas Cove. The exact location of each improvement is shown on the attached Plan Sheets.

1.02 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to construct the CITY OF COPPERAS COVE MOUNTAIN TOP NORTH 300,000 GALLON ELEVATED STORAGE TANK project as shown on the Plans and specified herein.

B. The Work includes, but is not necessarily limited to:

The Project generally consists of the construction of a new 300,000 gallon elevated storage tank, yard piping, and all electrical and related site improvements and appurtenances.

1.03 WORK SEQUENCE

A. Work scheduling shall be coordinated to prevent conflicts with water and wastewater system operations and residential parcel interests.

1.04 PROGRESS OF THE WORK

A. The work shall be started within 7 days following the effective date of the Notice to Proceed, and the work shall be executed with such progress as may be required to prevent any delay to the general completion of the project. The work shall be executed at such times and in or on such parts of the project, and with such personnel, materials, and equipment to assure completion of the work in the time established by the Agreement.

B. If the Contractor for his convenience and at his own expense, should desire to carry on his work at night or outside regular hours, he shall submit written notice to the Owner. The notice shall include the desired work times and days, and the anticipated duration of this work. The Owner will review and notify the Contractor whether or not the request is approved. If approved, the Contractor shall allow ample time for satisfactory arrangements to be made for inspecting the work in progress. The Contractor shall pay the expenses for extra inspection required for work outside regular hours. Standard work hours for City of Copperas Cove are Monday through Friday, 8:00AM through 5:00PM, unless an exception is approved by the City. The Contractor shall light the different parts of the project as required to comply with all applicable Federal, State and City regulations.

1.05 CONSTRUCTION SCHEDULE

A. The Contractor shall, within ten (10) days after the effective date of the Notice to Proceed, provide and submit to the Owner for approval, the Schedule for the project.

The completed schedule shall be approved before monthly payments are made. The Schedule shall account for all the work of the Contractor and his Subcontractors and suppliers. In addition to all reasonably important construction activities, the Schedule shall provide for the proper sequence of construction considering the various crafts, purchasing time, submittal approval, material delivery, equipment fabrication, and similar time consuming factors.

B. The Schedule shall include, as a minimum, the earliest starting and finish dates, and latest starting and finish dates, and the total float for each task or item. The Contractor shall update (monitor) the schedule as necessary and shall submit to the owner a copy of the updated schedule at the same time the pay estimate is prepared. The schedule shall contain all of the items of the Periodic Estimate and Pay Schedule.

   While the Contractor bears full responsibility for scheduling all phases and stage of the work to ensure its successful prosecution and completion within the time specified in accordance with all provisions of these Specifications, the Contractor is specifically required to complete fully or complete such stages of work to enable his Subcontractors and suppliers to complete their work within the respective times specified.

C. If the Owner determines that operations are falling behind schedule at any time during the construction period, the Owner may require the Contractor to add to his plan, equipment and/or construction forces, including increases in working hours, in such quantities as are required to bring operations back on schedule. Upon receipt of written communication from the owner requiring such addition, the contractor shall furnish same at no additional cost to the Owner.

1.06 PROJECT MEETINGS

A pre-construction conference shall be held as soon as possible after Award of Contract and before work is started.

1.07 COORDINATION WITH OWNER'S OPERATIONS AND EXISTING FACILITIES

A. Parts of the proposed work under this Contract will connect with or into existing facilities. Because of this, the Contractor shall plan carefully the schedule of that portion of the work that may affect the existing facilities. Such plans and schedules shall be subject to the approval of City of Copperas Cove personnel.

B. Work that requires shutdown or in any way impedes the operations of existing facilities shall be closely coordinated with the City of Copperas Cove personnel. A minimum of 48 hours written notice shall be given before any approval will be granted.

C. Immediately after the award of a contract for this project, the Contractor shall outline and submit a scheduling plan for installation of the work, which requires interruption of operations.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

SECTION 01130

TECHNICAL SPECIFICATIONS - SITE CONDITIONS

PART 1: GENERAL

1.01 SUBSURFACE INFORMATION

A. A copy of the geotechnical report(s) is attached to these documents, and are incorporated as part of these documents.

B. The Contractor shall be responsible for any additional subsurface explorations and tests he deems necessary

1.02 SITE INVESTIGATION AND REPRESENTATION

A. The Contractor acknowledges that he has satisfied himself as to the nature and location of the work; the general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, river/stream stages, or similar physical conditions at the site, the conformation and conditions of the ground; the character of equipment and facilities needed preliminary to and during the execution of the work and all other matters which can in any way affect the work or the cost thereof under the Contract.

B. The Contractor further acknowledges that he has satisfied himself as to the character, quality, and quantity of surface and subsurface materials to be encountered from inspecting the site and from evaluating information derived from exploratory work that has been done by the Owner as presented in the geotechnical report, as well as from information presented herein as a part of these Contract Documents. Any failure by the Contractor to acquaint himself with all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the work. Neither the Owner nor the Engineer assume responsibility for any conclusion or interpretation made by the Contractor on the basis of the information made available by the Owner or the Engineer.

C. Existing ground profiles shown on the Plans were plotted from field surveys.

1.03 RESPONSIBILITY FOR UTILITY PROPERTIES AND SERVICE

A. Known utilities and structures adjacent to or encountered in the work are shown on the Drawings. The locations shown are taken from existing records and the best information available from existing plans; however, it is expected that there may be some discrepancies and omissions in the locations and quantities of utilities and structures shown. Those shown are for the convenience of the Contractor only, and no responsibility is assumed by either the Owner or the Engineer for their accuracy or completeness.

B. Neither the Owner nor his officers or agents shall be responsible to the Contractor for damages as a result of the Contractor's failure to protect utilities encountered in the work.

C. The Contractor shall at all times provide unobstructed access to fire hydrants, underground conduit, manholes, and water or gas valve boxes.

D. Where the Contractor's operations could cause damage which might result in considerable expense, loss, and inconvenience when his operations are adjacent to or near railway, telegraph, telephone, television, power, oil, gas, water, sewer, irrigation, or other systems, no operations shall be commenced until the Contractor has made all arrangements necessary for the protection of these utilities and services.

E. The Contractor shall notify all utility offices that are affected by the construction operation at least 15 days in advance of commencing construction operations. The Contractor shall not expose any utility without first obtaining permission from the affected agency. Once permission has been granted, locate and, if necessary, expose and provide temporary support for all existing underground utilities in advance of operations.

F. The Contractor shall be solely and directly responsible to the Owners and operators of such utility properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage that may result from the construction operations under this Contract.

G. In the event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental breakage due to construction operations, the Contractor shall promptly notify the proper authority and cooperate with said authority in restoration of service as promptly as possible and bear all costs of repair. In no event shall interruption of any water or utility service be allowed unless prior approval is granted by the owner of the utility.

H. The Contractor shall replace, at his own expense, any and all other existing utilities or structures removed or damaged during construction, unless otherwise provided for in these Contract Documents.

I. Where existing utility lines or structures are so located as to physically conflict with permanent structures to be constructed under this Contract, the conflicting utility line or structure shall be permanently relocated. Such relocations shall be considered as required by their CONTRACT.

J. The Contractor shall give immediate notice to the Engineer, the Owner and the owner of the utility (where applicable) when a physical conflict is determined to exist. The actual relocation of a public utility will be accomplished by the owner of the utility at his expense unless otherwise specified in these Contract Documents. Any delays resulting from the required relocations of the utilities are the responsibility of the Contractor.

K. Where existing utility lines or structures are so located as to interfere with the Contractor's execution of the work, but do not physically conflict with permanent structures to be constructed under this Contract, any modification, alteration, or relocation of interfering utility, either permanent or temporary, shall be accomplished at the expense of the Contractor.

L. The Contractor shall give immediate notice to the Engineer and the Owner of the utility when an interference is determined to exist and shall obtain approval to relocate such utility or to discontinue service therein from the Engineer and the owner of the utility. The owner of the utility shall have the right to do all work required to discontinue, relocate, and replace interfering utilities and charge the Contractor for all costs thereof. When approved by the Engineer and the owner of the utility, all work required to discontinue, relocate, and replace interfering utilities may be done by, or arranged for, by the Contractor. All such discontinuance, relocation, and replacement shall be accomplished in accordance with all requirements of the owner of the utility.

1.04 INTERFERING STRUCTURES

A. Take necessary precautions to prevent damage to existing structures whether on the surface, aboveground, or underground. An attempt has been made to show major structures on the Plans. While the information has been compiled from the best available sources, its completeness and accuracy cannot be guaranteed, and it is presented as a guide to avoid known possible difficulties.

B. Protect existing structures from damage, whether or not they lie within the right-of-way or the limits of the easements obtained by the Owner. Where existing structures must be removed to properly carry out the work, or are damaged during the work, they shall be restored at the Contractor's own expense to at least their original condition and to the satisfaction of the Engineer.

C. The Contractor may, with the approval of the Engineer and without additional compensation, remove and replace in a condition as good as or better than original, any small interfering structures such as fences and signposts that interfere with the Contractor's operations.

1.05 FIELD RELOCATION

During the progress of the work, minor relocations of the work may be necessary. Such relocations shall be made only by direction of the Engineer and the Owner. If existing structures are encountered that will prevent construction as shown, notify

the Engineer before continuing with the work in order that the Engineer may make such field revisions as necessary to avoid conflict with the existing structures. If the Contractor shall fail to notify the Engineer when an existing structure is encountered and proceeds with the work despite this interference, he shall be responsible for any damage that may occur.

1.06 LAND MONUMENTS

The Contractor shall preserve or replace any existing Federal, State, County, City, and private land monuments encountered. All monument replacement by the Contractor shall be performed by a land surveyor licensed in the State of Texas.

1.07 PAYMENT

The work specified in this Section shall be considered incidental and payment will be included as part of the appropriate lump sum or unit prices specified in the Bid Form.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

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SECTION 01140

TECHNICAL SPECIFICATIONS - CONTRACTOR'S USE OF PREMISES

PART 1: GENERAL

1.01 DESCRIPTION

A. Contractor shall limit his use of the premises, for Work and for storage, to the areas designated on the Drawings, or approved by Owner.

B. Contractor shall submit to the Owner for approval a plan of operations, designating proposed areas of the property to be used for his operations, material storage, equipment storage, employee's parking, offices and shops. The area shall affect minimal interference with the present operations.

C. Contractor shall assume full responsibility for the protection and safekeeping of products under this Contract stored on the site.

D. Contractor shall move any stored Products, under Contractor's control, which interfere with operations of Owner.

E. Contractor shall obtain and pay for the use of additional storage or work areas needed for operations.

F. Any damage to existing facilities, including contamination, which may be caused by Contractor's personnel, callers, visitors, materials or equipment, shall be repaired or corrected at the sole expense of the Contractor.

G. Any fence that is damaged or removed by the Contractor will be replaced at the Contractor's expense in like kind, and to the satisfaction of the Engineer and the Owner.

H. Owner will occupy premises during performance of the work for the conduct of his/her normal operations. Coordinate all construction operations with Owner to minimize conflict and facilitate owner usage.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

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SECTION 01150

TECHNICAL SPECIFICATIONS - CONTROL OF WORK

PART 1: GENERAL

1.01 CONSTRUCTION AREA

A. The Contractor shall furnish plans and equipment which will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress which will insure the completion of the work within the time stipulated in the Proposal. If at any time such plan appears to the Engineer to be inefficient, inappropriate or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, he may order the Contractor to increase the efficiency, change the character or increase the plans and equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such an order shall in no way relieve the Contractor of his obligations to secure the quality of work and rate of progress required.

1.02 PRIVATE LAND

A. The Contractor shall not enter or occupy private land outside of easements, except by written permission of the respective landowner.

1.03 PIPE LOCATIONS

A. Pipelines shall be located substantially as indicated on the Drawings, but the Engineer and the Owner reserve the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

1.04 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access during construction shall be removed when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the Excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting staking excavated material in the street, and requiring that the trench shall not remain open overnight.

B. The Contractor shall take precautions, such as fences and barricades, to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles that could be dangerous to the public shall be well lighted at night.

1.05 TEST PITS

A. Test pits for the purpose of locating underground pipelines or structures in advance of the construction shall be excavated and backfilled by the Contractor at the direction of the Engineer and the Owner. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer and the Owner.

1.06 MAINTENANCE OF TRAFFIC

A. Unless permission to close a street is received in writing from the proper authority, all excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, he shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Engineer.

B. Detours around construction will be subject to the approval of the Owner and the Engineer. Where detours are permitted, the Contractor shall provide all necessary barricades and signs as required to divert the flow of traffic. While Traffic is detoured, the Contractor shall expedite construction operations and periods when traffic is being detoured will be strictly controlled by the Owner.

C. The Contractor shall take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. The Contractor shall be fully responsible for damage or injuries whether or not police protection has been provided.

1.07 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in some other manner acceptable to the Engineer.

1.08 MAINTENANCE OF FLOW

A. The Contractor shall, at his own cost, provide for flow of sewers, drains and water courses interrupted during the progress of the work, and shall immediately cart away and remove all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the Engineer and the Owner well in advance of the interruption of any flow.

1.09 COOPERATION WITIN THIS CONTRACT

A. The Contractor shall cooperate with Subcontractors or trades, and shall assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the Contractor and his Subcontractor having jurisdiction, unless otherwise indicated herein or directed by the Engineer.

1.10 CLEANUP

A. During the course of the work, the contractor shall keep the site of his operations in as clean and neat a condition as is possible. He shall dispose of all residue resulting from the construction work and, at the conclusion of the work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from the construction operations, and shall leave the entire site of the work in a neat and orderly condition.

1.11 PAYMENT

A. Payment for the work in this Section will be included as part of the total lump sum or appropriate unit prices stated in the Bid Form.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

SECTION 01170

TECHNICAL SPECIFICATIONS - MOBILIZATION, BONDS AND INSURANCE

PART 1: GENERAL

1.01 SCOPE

A. This item shall consist of the mobilization of personnel, equipment and supplies at the project site in preparation for beginning work on contract items, and the payment of bonds and insurance. Mobilization shall include, but is not limited to, the movement of equipment, personnel, material, supplies, etc. to the project site and the establishment of office and other facilities, as necessary, prior to beginning the work.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

3.01 MEASUREMENT AND PAYMENT

Measurement and payment of the item "Mobilization, Bonds and Insurance" as specified herein will be by the lump sum not to exceed 5% of the total contract amount, which may be included with the first partial payment request after work is accomplished.

END OF SECTION

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SECTION 01330

TECHNICAL SPECIFICATIONS – SUBMITTAL PROCEDURES

PART 1: GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

A. This Section specifies the general methods and requirements of submissions applicable to the following work-related submittals: Shop Drawings, Product Data, Samples, Mock Ups, Construction Photographs, Construction and Submittal Schedules, and Operation and Maintenance Manuals. Detailed submittal requirements will be specified in the technical specifications sections.

B. All submittals shall be clearly identified by reference to Specification Section, Paragraph, Drawing No. or Detail as applicable. Submittals shall be clear and legible and of sufficient size for sufficient presentation of data.

C. All submittals, including shop drawings and product data, shall be provided in digital form, unless infeasible to do so, as described further in Parts 1.03 and 1.04.

D. Operation and Maintenance Manuals shall be provided, as described further in Part 1.10.

1.02 SHOP DRAWINGS, PRODUCT DATA, SAMPLES

A. Shop Drawings

1. Shop drawings as specified in individual work Sections include, but are not necessarily limited to, custom-prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications, as applicable to the Work.

2. All shop drawings submitted by subcontractors for approval shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.

3. The Contractor shall check all subcontractor's shop drawings regarding measurements, size of members, materials, and details to satisfy himself that they conform to the intent of the Drawings and Specifications. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors for correction before submission thereof.

4. All details on shop drawings submitted for approval shall show clearly the relation of the various parts to the main members and lines of the structure, and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted for approval.

B. Product Data

1. Product data as specified in individual Sections, include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliance and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listing and printed product warranties, as applicable to the Work.

C. Samples

1. Samples specified in individual Sections, include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols and units of work to be used by the Engineer or Owner for independent inspection and testing, as applicable to the Work.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following:

1. Field measurements
2. Field construction criteria
3. Catalog numbers and similar data
4. Conformance with the Specifications

B. Each shop drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor: "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." Shop drawings and product data sheets shall bear the above Certification Statement on the cover sheet and hard copies shall be bound together in an orderly fashion. The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the Resident Project Representative a copy of each submittal transmittal sheet for shop drawings, product data and samples at the time of submittal of said drawings, product data and samples to the Engineer.

C. All submittals, including shop drawings and product data, shall be provided in digital form, unless infeasible to do so. Digital files of submittals shall be in Adobe Acrobat (pdf files), with the Contractor's Certification Statement. Submittals which are infeasible to submit digitally, i.e. samples, shall be provided in hard copy form.

D. The Contractor shall utilize a 10-character submittal identification numbering system in the following manner:

1. The first character shall be a D, S, P, M, or R, which represents Shop/Working Drawing and other Product Data (D), Sample (S), Preliminary Submittal (P), Operating/Maintenance Manual (M), or Request for Information (R).
2. The next five digits shall be the applicable Specification Section Number.
3. The next three digits shall be the numbers 001-999 to sequentially number each initial separate item or drawing submitted under each specific Section number.
4. The last character shall be a letter, A-Z, indicating the submission, or resubmission of the same Drawing (i.e. A=1st submission, B=2nd submission, C=3d submission, etc.). A typical submittal number would be as follows:

D 03300-008-B

D = Shop Drawing
03300 = Specification Section for Concrete
008 = The eighth initial submittal under this specification section
B = The 2nd submission (first resubmission) of that particular shop drawing

D. Notify the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

E. The review and approval of shop drawings, samples or product data by the Engineer shall not relieve the Contractor from his/her responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefore.

F. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the Contractor's risk. The Owner will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

G. Project work, materials, fabrication, and installation shall conform with approved shop drawings, applicable samples, and product data.

1.04 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor.

B. Each submittal, appropriately coded, will be returned within 30 working days following receipt of submittal by the Engineer.

C. Number of submittals required:

1. Shop Drawings and Product Data as defined in Paragraphs 1.02 A and B: Digital copies may be e-mailed when file size permits. If file size is too large to email Contractor shall provide three (3) CD's with a complete set on each CD. Unless specified otherwise, individual submittal files may not be broken into smaller pieces for the purpose of emailing. Each individual submittal shall be delivered as one complete file. One digital copy, with response, will be returned to the Contractor.
2. Samples, and other submittals which are not feasible to provide digitally: Submit the number stated in the respective Specification Sections.

D. Submittals shall contain:

1. The date of submission and the dates of any previous submissions.
2. The Project title and number.
3. Contractor identification.
4. The names of:
   a. Contractor
   b. Supplier
   c. Manufacturer
5. Identification of the product, with the specification section number, page and paragraph(s).
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the Work or materials.
8. Applicable standards, such as ASTM or Federal Specification numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8-in X 3-in blank space for Contractor and Engineer stamps.

1.05 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, WORKING DRAWINGS AND SAMPLES

A. The review of shop drawings, data, and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed as:

1. permitting any departure from the Contract requirements;
2. relieving the Contractor of responsibility for any errors, including details, dimensions, and materials; and/or
3. approving departures from details furnished by the Engineer, except as otherwise provided herein.

B. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting an exception.

D. Submittals will be returned to the Contractor under one of the following codes.

Code 1 — "NO EXCEPTION TAKEN" is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.

Code 2 — "APPROVED AS NOTED". This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 — "APPROVED AS NOTED/CONFIRM". This combination of codes is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.

Code 4 — "APPROVED AS NOTED/RESUBMIT". This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the resubmittal.

Code 5 — "NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 — "COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal which provide additional data to aid the Contractor.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

E. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the Engineer, on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the Contractor. The Contractor shall make corrections to any work done because of this type revision that is not in accordance to the Contract Documents as may be required by the Engineer.

F. Costs incurred by the Owner as a result of additional reviews of a particular submittal, after the second time it has been reviewed, shall be borne by the Contractor. Reimbursement to the Owner will be made by deducting such costs from the Contractor’s subsequent Pay Requests.

F. Partial submittals may not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor, and will be considered "Not Approved" until resubmitted. The Engineer may at his/her option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

G. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the Engineer at least seven working days prior to release for manufacture.

H. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

1.06 DISTRIBUTION

A. Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the Engineer. Number of copies shall be as directed by the Engineer but shall not exceed 6.

1.07 MOCK UPS

A. Mock Up units as specified in individual Sections, include but are not necessarily limited to, complete units of the standard of acceptance for that type of work to be used on the Project. Remove at the completion of the Work or when directed.

1.08 CONSTRUCTION PHOTOGRAPHS

A. The Contractor shall have, at a minimum, an average of five color photographs per month made of the work during its progress and ten color photographs of the completed facilities. The number of photographs and views taken shall be sufficient to document the progress of the project, with additional photographs taken if Project Representative/Engineer directs, and to adequately display the finished project upon completion.

B. All photographic work shall be done by a qualified, established commercial photographer acceptable to the Engineer. The photographic work shall be done with a digital camera with a minimum of 10 effective megapixels.

C. The monthly progress digital pictures shall be furnished to the Engineer and Owner monthly, promptly upon completion. At the completion of the Project a complete set of the photographs shall be furnished to the Engineer and Owner on CD.

D. Each photograph shall be identified with the following:

1. Contractor's Name
2. Short Description of View
3. Photo No. and Date Taken
4. Photographer's Firm Name

1.09 GENERAL PROCEDURES FOR SUBMITTALS

A. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work sections, of the Specifications, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the Work.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Complete Operation and Maintenance (O&M) Manuals shall be supplied by the Contractor for all equipment and products supplied. Manuals shall include all necessary information for operation and maintenance, including equipment introduction and operation, troubleshooting, maintenance, drawings, parts list, warranty, and field start-up reports.

B. Two (2) complete sets of electronic files on CD shall be provided for review. Once revised and approved, two (2) complete final sets of electronic files on CD, as well as one (1) complete hard copy set, shall be provided. Digital files shall be in Adobe Acrobat (.pdf) format.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

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SECTION 01450

TECHNICAL SPECIFICATIONS – QUALITY CONTROL AND SPECIAL INSTRUCTIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Section Includes: Special Inspection as well as quality control requirements and procedures for products and workmanship and includes the following;

1. Sampling and testing of materials
2. Testing of equipment
3. Requirements for testing laboratories
4. Procedures and limitations of inspection
5. Registered Professional Land Surveyor (RPLS) Services

B. The Owner shall hire an independent testing laboratory for inspections and material testing as specified further in this Section. The cost of the initial tests will be paid by the Owner. Any second, or subsequent testing, due to failures of the initial tests will be paid by the Contractor. The Contractor will be responsible for coordinating and scheduling with the testing facility. The Owner shall hire an independent testing laboratory for the following inspections. All other inspections and material testing will be at the expense of the Contractor.

1. Concrete foundation including subgrade
2. Coating and welding inspections of the tank

C. The Contractor shall acquire surveying services for construction staking.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. E 329 - Standard for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
2. E 543 - Standard Specification for Agencies Performing Nondestructive Testing

1.03 PRODUCTS AND WORKMANSHIP

A. When specified, products will be tested and inspected either at point of origin or at Work site.

1. Notify OWNER's Representative in writing well in advance, of when products will be ready for testing and inspection at point of origin.
2. Do not construe that satisfactory tests and inspections at point of origin is final acceptance of products. Satisfactory tests or inspections at point of origin do not preclude retesting or reinspection at Work site.

B. Do not ship products, which require testing, and inspection at point of origin prior to testing and inspection.

1.04 AUTHORITY AND DUTIES OF OWNER'S REPRESENTATIVE OR INSPECTOR

A. OWNER's Representative or Inspector employed or retained by OWNER or ENGINEER is authorized to inspect the Work.

B. Inspections may extend to entire or part of the Work and to preparation, fabrication, and manufacture of products for the Work.

C. Deficiencies or defects in the Work, which have been observed, will be called to CONTRACTOR's attention.

D. Inspector Will Not:

1. Alter or waive provisions of Contract Documents.
2. Inspect CONTRACTOR's means, methods, techniques, sequences, or procedures for construction.
3. Accept portions of the Work, issue instructions contrary to intent of Contract Documents, or act as foreman for CONTRACTOR; supervise, control, or direct CONTRACTOR's safety precautions or programs; or inspect for safety conditions on Work site, or of persons thereon, whether CONTRACTOR's employees or others.

E. Inspector Will:

1. Conduct on-site observations of the Work in progress to assist ENGINEER in determining when the Work is, in general, proceeding in accordance with Contract Documents.
2. Report to ENGINEER whenever Inspector believes that Work is faulty, defective, does not conform to Contract Documents, or has been damaged; or whenever there is defective material or equipment; or whenever Inspector believes the Work should be uncovered for observation or requires special testing.

1.05 SAMPLING AND TESTING

A. General:

1. Prior to delivery and incorporation in the Work, Contractor shall submit listing of sources of materials, when specified in Sections where materials are specified.
2. When specified in Sections where products are specified,
   a. Submit sufficient quantities of representative samples of character and quality required of materials to be used in the Work for testing or examination.
   b. Test materials in accordance with standards of national technical organizations.

B. Sampling:

1. Furnish specimens of materials when requested.
2. Do not use materials, which are required to be tested until testing indicates satisfactory compliance with specified requirements.
3. Specimens of materials will be taken for testing whenever necessary to determine quality of material.
4. Assist Testing Lab/Engineer/Inspector in preparation of test specimens at site of Work, such as soil samples and concrete test cylinders.

C. Test Standards:

1. Perform sampling, specimen preparation, and testing of materials in accordance with specified standards, and when no standard is specified, in accordance with standard of nationally recognized technical organization.
2. Physical characteristics of materials not particularly specified shall conform to standards published by ASTM, where applicable.
3. Standards and publication references in Contract Documents shall be edition or revision in effect on date Project Bid Proposals are opened.

1.06 TESTING LABORATORY SERVICES

A. Qualification of Laboratory:

1. Meets "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories.
2. Meets requirements of ASTM E 329 and ASTM E 543.
3. Has authorization to operate in state in which Project is located.

4. Will submit copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards (NBS) during most recent tour of inspection, with memorandum of remedies of deficiencies reported by inspection.
5. Has testing equipment calibrated at reasonable intervals by devices of accuracy traceable to NBS or accepted values of natural physical constants.
6. Shall be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than $1,000,000.
7. Laboratory staff monitoring concrete work shall be ACI certified inspectors.
8. Laboratory staff performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". The inspector may be supported by assistant inspectors who may perform specific inspection functions under the supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). The inspector shall regularly monitor the work of the assistant inspectors, generally on a daily basis.

B. Laboratory Duties:

1. Cooperate with ENGINEER and CONTRACTOR.
2. Provide qualified personnel.
3. Notify ENGINEER and CONTRACTOR, in writing, of response time needed to schedule testing or inspections after receipt of notice.
4. Perform specified inspections, sampling and testing of materials and methods of construction in accordance with specified standards to ascertain compliance of materials with requirements of Contract Documents.
5. Promptly notify ENGINEER and CONTRACTOR of observed irregularities or deficiencies of construction.
6. Promptly submit written report of each test and inspection; one copy each to ENGINEER, OWNER, and CONTRACTOR. Each report shall include:
    a. Date issued.
    b. Project title and number.
    c. Testing laboratory name, address and telephone number.
    d. Name and signature of laboratory inspector.
    e. Date and time of sampling or inspection.
    f. Record of temperature and weather conditions.
    g. Date of test.
    h. Identification of product and Specification section.
    i. Location of sample or test in Project.
    j. Type of inspection or test.
    k. Results of tests and compliance with Contract Documents.
    l. Interpretation of test results, when requested by ENGINEER.
7. Provide a Final Report(s) in accordance with Part 1.04 of this Section.

C. Limitations of Authority of Testing Laboratory: Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.
2. Approve or accept portion of Work.
3. Perform duties of CONTRACTOR.

1.07 CONTRACTOR'S RESPONSIBILITIES:

A. Acquire surveying services for construction staking.

B. Coordinate and schedule the Testing Laboratory for all testing and inspections required.

C. Cooperate with laboratory personnel and provide access to construction and manufacturing operations.

D. Secure and deliver to laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

E. Provide to laboratory concrete mix design proposed to be used for concrete, and other materials mixes, which require control by testing laboratory.

F. Furnish copies of product test reports.

G. Furnish Incidental Labor and Facilities:

1. To provide access to construction to be tested.
2. To obtain and handle samples at Work site or at source of product to be tested.
3. To facilitate inspections and tests.
4. For safe storage of test samples.
5. For proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing as required by ASTM Specifications C31.

H. Notify laboratory in advance of when observations, inspections and testing is needed for laboratory to schedule and perform in accordance with their notice of response time.

I. Provide current welder certifications for each welder to be employed.

J. Furnish fabrication and erection inspections of all welds in accordance with AWS D1.1, Chapter 6.

K. Prequalification of all welding procedures to be used in executing the work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXCAVATION

A. Review geotechnical parameters and assumptions used in the development of calculations and drawings for retention systems, including lateral design forces and surcharge effects.

B. Observe the excavation process, the exposed faces of the excavation and the installation of retention systems. Check for compliance with the Contract Documents and make alternative recommendations as may be required to suit field conditions.

C. Review required submittals as they pertain to geotechnical requirements.

D. Check the adequacy and accuracy of the Contractor's monitoring program, equipment, procedures and measurements related to movements of the excavated face and adjacent structures.

E. Check the adequacy of the Contractor's dewatering equipment and procedures.

F. Immediately report any unsafe conditions. Request additional shoring or bracing where judged to be necessary as the excavation progresses.

3.02 PIER DRILLING

A. The laboratory representative shall make continuous inspections to determine that the proper bearing stratum is obtained and that shafts are clean and dry before placing concrete.

B. The laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, whether or not

casing is required, actual penetration into bearing stratum, and elevation of top of bearing stratum.

3.03 FILLING AND BACKFILLING

A. The Contractor shall make available to the laboratory adequate samples and quantities of each fill and backfill material type from the proposed sources of supply not less than 14 days prior to the start of the work.

B. Laboratory shall analyze samples as required to provide a soil description and to determine compliance with quality requirements. Perform, at a minimum, the following tests:
   1. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
   2. Test for moisture density relations of soil in accordance with ASTM D698.

C. Furnish a report for each individual test and state whether sample conforms to specified requirements or state reasons for non-compliance.

D. Inspect underslab and wall drainage material and placement for compliance with specified requirements.

E. Make in-place compaction tests for moisture content, moisture-density relationship and density of fill material after compaction to determine that foundation pads and backfill materials have been compacted to the specified density. Number of tests shall be as follows:
   1. Structural Fill/Backfill
      a. One test for each 5000 square feet of area of each lift placed under foundation mats or building slabs. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
      b. One test for each 100 linear feet, or portion thereof, of each lift placed against foundation walls with locations staggered from those in the previous lift.
      c. One test for each lift placed below any isolated footing, and every 100 linear feet under continuous footings, with locations taken on a different side from that in the lift below.
   2. Non-Structural Fill/Backfill, Subgrade and Road Base
      a. One test for each 5,000 square feet of area of each lift of earth fill (non-structural fill) not under roadways or access drives. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
      b. One test for each 3,000 square feet of area of each lift under roadways or access drives. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
   3. Piping
      a. One test for each 300 linear feet of trench backfill. Stagger test locations in each lift from those in previous lift.

3.04 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with the Contract Documents and approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor for correction. If uncorrected by the Contractor, they shall be listed in the report.

B. Observe and report on the following:
   1. Number and size of bars.
   2. Bending and lengths of bars.
   3. Splicing.
   4. Clearance to forms including chair heights.
   5. Clearance between bars or spacing.
   6. Rust, form oil, and other contamination.
   7. Grade of Steel.
   8. Securing, tying and chairing of bars.
   9. Excessive congestion of reinforcing steel.
   10. Installation of anchor bolts and placement of concrete around anchor bolts.
   11. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
   12. Visually inspect deformed bar anchors on embedded assemblies for compliance with Contract Documents.

3.05 CONCRETE INSPECTION AND TESTING

A. Receive and evaluate all proposed concrete mix designs submitted by the Contractor. If the mix designs comply with the Drawings and Specifications, the laboratory shall submit a letter to the Engineer certifying compliance. Mix designs not complying with the Drawings and Specifications shall be returned by the Laboratory as unacceptable.

B. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.

C. Mold and cure three specimens from each sample in accordance with ASTM C31. The test cylinders shall be stored in the field 24 hours and then carefully transported to the laboratory and cured in accordance with ASTM C31.

D. Test specimens in accordance with ASTM C39. Two specimens shall be tested at 28 days for acceptance and one shall be tested at seven days for information.

E. Make one strength test (three cylinders) for each 100 cubic yards or fraction thereof, of each mix design placed in one day.

F. Make one slump test for each set of cylinders following the procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever the consistency of the concrete appears to vary. Slump tests corresponding to samples from which strength tests are made shall be reported with the strength test results. Other slump tests need not be reported.

G. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.

H. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.

I. Monitor the addition of water at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. Report any significant deviation from the approved mix design to the Engineer, the Contractor, and the concrete supplier.

J. Observe the placing of all concrete, except non structural slabs-on-grade and sitework. Observe and report on placing method, consolidation, cold joints, length of drop and displacement of reinforcing. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.

K. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which concrete was discharged from the truck.

L. Evaluation and Acceptance:

1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.

2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings," ACI 301, Chapter 18 have been met

M. Comply with ACI 311, "Guide For Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).

N. Inspect the application of curing compound and monitor all curing conditions to assure compliance with Specification requirements. Report curing deficiencies to the Contractor immediately and submit a report to the Engineer.

3.06 EXPANSION BOLT INSTALLATION

A. Make periodic inspections of the drilling of holes and installation of expansion bolts for compliance with the Contract Documents. Verify installation for a minimum of 1 out of every 4 expansion bolts for compliance with manufacturer's installation instructions.

3.07 MASONRY

A. Testing laboratory (Special Inspector) shall provide a qualified inspector to inspect all structural masonry work on a periodic basis. Inspect the work in progress at least once for each 2500 square feet of wall laid, but not less than once each day, to check for compliance with the Contract Documents and the applicable building code.

B. As masonry construction begins, verify that preparation of site-prepared mortar, construction of mortar joints and grade, size and location of reinforcing steel.

C. Prior to initial grouting, verify that preparation of site-prepared grout, grout spaces and size and location of reinforcing steel.

D. Make periodic inspections of the following:

1. Proportions and preparation of site-prepared mortar.
2. Construction of mortar joints.
3. Size and location of reinforcement, connectors and anchorages.
4. Proportions and preparation of site-prepared grout.
5. Ensure that grout space is clean.
6. Size, length (including splices) and location of reinforcement.
7. Connectors and anchors.

E. Make detailed inspections of the cells and installation of grout and reinforcing in the existing Sludge Building CMU wall as noted on Sheet S1.7.

F. Provide compressive tests for mortar and grout at least once for monitoring purposes for each 5000 square feet of wall laid.

1. Mold, cure and test 3 mortar cube specimens for each sample in accordance with ASTM C109 and ASTM C780. Test one specimen at 7 days and the remaining two at 28 days.

2. Mold, cure and test three 3" diameter x 6" tall grout specimens in accordance with ASTM C31, ASTM C39 and ASTM C172. Test one specimen at 7 days and the remaining two at 28 days.

3.08 STRUCTURAL STEEL

A. Inspect all structural steel during and after erection for conformance with Contract Documents and shop drawings.

B. Inspection:
1. Examination of steel for straightness and alignment.
2. Examination of all fabricated pieces for compliance with Contract Documents and shop drawings.
3. Visual examination of all shop welding.
4. Examination of shop painting.
5. Proper erection of all pieces.
6. Proper installation of all bolts, including the checking of calibration of impact wrenches used with high strength bolts.
7. Plumbness of each structure and proper bracing.
8. Field Painting.
9. Visual examination of all field welding.

C. Qualification of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed in the work, together with certification that welders have passed qualification tests within the last year using procedures specified in the AWS D1.1. Testing laboratory shall verify qualifications of all welders.

D. Inspection of shop and field welding shall be "verification inspection," in accordance with Section 6 of AWS D1.1 and as follows:

1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and check for seams, folds, and delaminations.

2. Ultrasonically test all penetration welds in accordance with AWS D1.1.

3. Inspect surfaces to be welded. Surface preparations, fit-up and cleanliness of surface shall be noted.

4. The inspector shall mark the welds requiring repairs and shall make a reinspection.

5. The testing laboratory shall advise the Owner and the Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other than those specified. Such further tests and examinations shall be performed as authorized by the Owner and the Architect.

6. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.

E. Inspection of bolted construction shall be in accordance with AISC "Specification for Structural Steel Buildings" and as follows:

1. All bolts shall be visually inspected to ensure that the plies have been brought into snug contact.

2. High strength bolting shall be inspected in accordance with Section 9 of the AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts."

F. Inspection of stud welding shall be in accordance with Section 7.8 of AWS D1.1. Visually inspect all studs for compliance with the Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular. Studs failing this test shall be replaced.

3.09 METAL FLOOR AND METAL ROOF DECK

A. Field Inspection shall consist of the following:

1. Check types, gauges and finishes for conformance with the Contract Documents and shop drawings.

2. Examination of proper erection of all metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.

3. Certification of welders.

4. Field welded shear studs used to fasten metal floor decking to supporting steel shall be inspected and tested as described in the structural steel section of this specification section.

3.10 REGISTERED PROFESSIONAL LAND SURVEYOR (RPLS) SERVICES

A. The Contractor shall acquire surveying services for construction staking.

B. Construction Staking: The Surveying Services firm shall establish horizontal and vertical controls for this Project.

3.11 MEASUREMENT AND PAYMENT

A. Payment for all work and services provided for under this item shall be included in the lump sum price for the associated work.

END OF SECTION

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SECTION 01500

TECHNICAL SPECIFICATIONS - TEMPORARY FACILITIES AND CONTROLS

PART 1: GENERAL

1.01 TEMPORARY OFFICES

A. Temporary offices may be established on the job site where approved or directed by the Engineer, adequately furnished, and maintained in a clean, orderly condition by the Contractor. The Contractor or his/her authorized representative shall be present in the field at all times while work is in progress. Instructions received there from the Engineer shall be considered as delivered to the Contractor.

B. The Contractor shall supply all fuel for heating and pay all electrical bills.

1.02 TEMPORARY LIGHT AND POWER

A. Furnish temporary light and power, complete with wiring, lamps, and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the reasonable needs of all subcontractors. Make all necessary arrangements with the local electric company for temporary electric service, and pay all expenses in connection therewith.

B. Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilot light.

C. Provide grounded extension cords. Use “Hard-service” cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.

1.03 TEMPORARY AIR, STEAM AND WATER

A. The Contractor shall provide all air and steam, including temporary piping and appurtenances required there of, as may be required for the cleaning and testing of pipelines and equipment necessary for his/her work. Temporary piping and appurtenances shall be removed upon approval of equipment being tested. Metered water for cleaning and testing will be provided by Owner. If retesting is required, Contractor shall provide metered water at his expense.

1.04 TEMPORARY SANITARY FACILITIES

A. Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed in a fiberglass or other approved non-absorbent shell.

1.05 FIRE EXTINGUISHERS

A. Provide portable UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide portable UL-rated Class ABC dry chemical extinguishers or a combination of NFPA recommended Classes for the exposure. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

1.06 LAYOUT OF TEMPORARY FACILITIES

A. Before starting the work, the contractor shall submit to the Engineer his requirements for space for temporary structures and storage of materials. Where on site space for temporary facilities is limited, the allocation of the available space will be made by the Engineer. Should the Contractor require space in addition to that allocated, the Contractor shall make his own arrangements for storage of materials and equipment in locations off the construction site. For the allocated space, the Contractor shall submit to the Engineer for approval, his proposed plan and layout for all temporary offices, sanitary facilities, temporary construction roads, storage buildings, storage yards, temporary water service and distribution, temporary power service and distribution, and temporary telephone service.

B. Combustible materials (paints, solvents, fuels, etc.) shall be stored in a well-ventilated building removed from other buildings.

1.07 STORAGE YARDS

A. The Contractor shall construct temporary storage yards for the storage of materials that are not subject to damage by weather conditions. Materials such as pipe and reinforcing and structural steel shall be stored on pallets or racks, off the ground, and in a manner that allows ready access for inspection and inventory.

1.08 CONTRACTOR'S WORK AREA

A. The Contractor shall limit his operations and storage of equipment and materials to the areas designated and as directed by the Owner.

B. Except as provided herein, no sidewalk, private property, or other area adjacent to the plant site shall be used for storage of the Contractor's equipment and materials unless prior written approval is obtained from the legal owner.

C. The Contractor shall maintain the area during construction in a manner that will not obstruct operations on street areas. He shall proceed with his work in an orderly manner, maintaining the construction site free of debris and unnecessary equipment or materials.

D. At all times, maintain areas covered by the Contract and public properties free from accumulations of waste, debris, and rubbish caused by construction operations.

E. Evacuated materials shall be removed from the site in a manner that will cause the least damage to adjacent lawns, grassed areas, trees, gardens, shrubbery, or fences regardless of whether these are on private property or on public right-of-ways.

F. Cleaning and disposal operations shall comply with local ordinances and antipollution laws. Do not burn or bury rubbish and waste materials on the project site. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Do not dispose of wastes into streams or waterways.

G. Wet down dry materials and rubbish to allay dust and prevent blowing dust.

H. Provide approved containers for collection and disposal of waste materials, debris, and rubbish and make arrangements for appropriate periodic emptying of the containers.

1.09 PROTECTION OF THE FINISHED CONSTRUCTION

A. The Contractor shall assume the responsibility for the protection of all finished construction and shall repair and restore any and all damage to finished work to its original or better state.

B. Where responsibility can be determined, the cost for replacement or repair of damaged work shall be charged to the party responsible. If responsibility cannot be determined, the cost shall be borne by the Contractor.

1.10 PAYMENT

A. The work specified in this Section shall be considered incidental and payment will be included as part of the appropriate lump sum or unit prices stated in the Proposal.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

SECTION 01550

TECHNICAL SPECIFICATIONS – TRAFFIC CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Providing safe and effective work areas and to warn, control, protect, and expedite vehicular and pedestrian traffic entering, exiting, and through the construction zone. It shall be the sole responsibility of the CONTRACTOR to provide for the safety of the traveling public within the limits of the project, including work in the public right-of-way and on private property.

B. Due to the access location, traffic controls may be necessary for trucks and other construction traffic entering and exiting the site and neighborhood.

1.02 REFERENCES

A. Manual on Uniform Traffic Control Devices, United States Department of Transportation, Federal Highway Administration (latest edition): In this Section it is referred to as MUTCD.

1.03 REQUIREMENTS

A. General:

1. Traffic control and lane closures shall be in accordance with the MUTCD and the government agency with jurisdiction of the right-of-way.

2. Construction within the right of way shall be done during the work hour requirements of the governmental agency with jurisdiction of the right-of-way. If the CONTRACTOR desires to perform work outside of the work hour requirements it is the CONTRACTOR'S responsibility to contact the governmental agency and gain permission.

3. One lane shall remain open at all time during construction, unless the CONTRACTOR has gained permission for a road closure with the governmental agency with jurisdiction of the right-of-way.

4. The CONTRACTOR shall maintain all required traffic control devices and trenches within the right-of-way at all times, 24 hours per day, 7 days per week including nights, holidays, and weekends.

5. Access for emergency vehicles shall be maintained at all times.

6. All signs and street marking damage caused by or related to the construction of this project shall be replaced in kind by the CONTRACTOR. In the case of partial damage to lane stripes and traffic lettering the whole stripe or marking in its entirety shall be replaced.

7. CONTRACTOR shall provide access to private resident's households at all times throughout the project.

B. Temporary surfaces:

1. The CONTRACTOR shall be required to provide temporary surfacing of all excavated areas immediately after completing the backfilling of any section of the Work. If permitted by the government agency with jurisdiction of the right-of-way, the CONTRACTOR may be allowed to leave excavations open provided that traffic control devices, approved by the governmental agency maintaining the right-of-way, are in place and maintained, and excavations

are covered with steel plates (non skid surface type) at the close of each working day. The temporary steel plates shall comply with the requirements of the governmental agency controlling the right-of-way.

C. Barricades and enclosures:

1. CONTRACTOR shall effect and maintain at all times during the prosecution of the Work, barriers, and lights necessary for the protection of workmen and the public. CONTRACTOR shall provide suitable barricades, lights, signs, and watchmen at all places where the Work causes obstructions to the normal traffic or constitutes in any way a hazard to the public.

2. Statutory Requirements: CONTRACTOR shall install and maintain all barricades, signs, lights, and other protective devices within rights-of-way in strict conformity with applicable statutory requirements by the government agency having jurisdiction in accordance with an approved Traffic Control Plan.

D. Traffic control devices:

1. All traffic control devices not in use, or that will not be used for a period greater than 24 hours, shall be removed by the CONTRACTOR from the work area. The sidewalk area shall not be used at any time to store unused traffic control devices unless the sidewalk is closed and an approved barricade plan is provided for rerouting pedestrians.

2. CONTRACTOR shall maintain all barricades and other traffic control devices in clean and effective condition and replace devices in poor condition immediately.

3. CONTRACTOR shall begin placing barricades in the direction of traffic and remove them in the direction of opposing traffic.

E. Flaggers:

1. An adequate number of flaggers and watchmen shall be present at all times during construction to provide safety of the traveling public within the limits of the project.

1.04 SUBMITTALS

A. Project-specific traffic control plan (TCP) shall be prepared by the CONTRACTOR:

1. Plan shall include work hours. Including off peak hour work requirements.

2. Plan shall address pedestrian access.

3. For street closure, provide details related to the notification of all emergency services, such as police and fire. Provide details related to the notification of services, such as mail and garbage collection.

B. For work in the rights-of-way, the TCP must be submitted to the respective governmental agency with jurisdiction of the right-of-way for acceptance.

C. A TCP shall be required for each phase or segment of the construction meeting the requirements of the Manual on Uniform Traffic Control Devices. Each TCP shall be considered separately.

D. At a minimum, the TCP shall provide, for each phase of the work, the placement and spacing of all traffic control devices (including signs, markings, channelizing devices, lighting devices, flaggers, etc.) and spacing/location of these within the following traffic control areas:

1. Advance Warning Signs.
2. Transition Areas.
3. Buffer Spaces.
4. Work Areas.
5. Termination Areas.

E. Additionally, the TCP must clearly show the following minimum information. Include location, size, height, text height, and color of each sign, where applicable:

1. Method for protecting excavations, work sites, and school zone crosswalks.
2. Method of barricading at intersections.
3. Driveway access plan.
4. Provisions for emergency vehicle access.
5. All set-up changes to accommodate different phasing of the work.
6. Lane widths and transitions.
7. Twenty-four-hour emergency contact information.
8. Business access signs.
9. Sidewalk “closed/cross here” signs.
10. No parking signs.
11. Project signs.
12. Fresh oil signs.
13. Duration of traffic control and barricade plan.
14. All advance warning signs.
15. Lane closures.
17. Detour locations.
18. Required signage and barricading associated with bus stop closures.
19. Required signage and barricading associated with school zone/safe route to school.

F. Submit 2 copies of the approved TCP to the ENGINEER within 48 hours of approval by government agencies.

G. After Review and comment on the TCP by the government agency with jurisdiction of the right-of-way shall in no way relieve the CONTRACTOR of the responsibility for traffic and safety requirements. Such acceptance shall in no way be construed as confirmation of the technical accuracy or adequacy of the contents of the TCP and shall not relieve the CONTRACTOR of the obligation to institute traffic control measures in full compliance with contract requirements and in conformance with local agency requirements.

H. If, during the execution of the work, the CONTRACTOR determines that the traffic control is not functioning as intended, the CONTRACTOR may make revisions to the TCP as necessary, provided that the local agencies with jurisdiction have accepted the changes. Submit two (6) copies and digital files of the approved revised TCP to the ENGINEER within 48 hours of approval by government agencies.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials shall conform to the Uniform Standard Specifications, and Uniform Standard Drawings as applicable.

2.02 PERMANENT STRIPING

A. Permanent striping shall conform to the requirements of the governmental agency with jurisdiction of the right-of-way.

PART 3 EXECUTION

3.01 TRAFFIC CONTROL REQUIREMENTS

A. All traffic control within public rights-of-way shall conform to the requirements of the encroachment permits and traffic control plans approved by the government agency with jurisdiction in the right-of-way.

B. All traffic control on private property shall warn, control, protect, and expedite vehicular and pedestrian traffic through the private property.

3.02 MEASUREMENT AND PAYMENT

A. Payment for all work provided for under this item shall be considered subsidiary to other work under this Contract.

END OF SECTION

SECTION 01560

TECHNICAL SPECIFICATIONS - ENVIRONMENTAL PROTECTION PROCEDURES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work covered by this Section consists of furnishing all labor, materials and equipment and performing all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this Specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.

B. The control of environmental pollution requires consideration of air, water and land, and involves management of noise and solid waste, as well as other pollutants.

C. Schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. Provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to any construction activity in that area. Specific requirements for erosion controls are specified in Section 02370.

D. These Specifications are intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. There are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

E. All phases of sedimentation and erosion control shall comply with and be subject to the approval of the Texas Commission on Environmental Quality, and U.S. EPA and completed within the guidelines specified on the Plans.

1.02 APPLICABLE REGULATIONS

Comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

1.03 NOTIFICATIONS

The Engineer and/or Owner will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. The Contractor shall, after receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his/her authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

1.04 IMPLEMENTATION

A. Prior to commencement of the work, meet with the Owner to develop mutual understandings relative to compliance with this provision and administration of the environmental pollution control program.

B. Remove temporary environmental control features, when approved by the Engineer, and incorporate permanent control features into the project at the earliest practicable time.

1.05 PROTECTION OF WATERWAYS

A. The Contractor shall observe the rules and regulations of the State of Texas and agencies of the U.S. Government prohibiting the pollution of any lake, stream, river, or wetland by the dumping of any refuse, rubbish, dredge material, or debris therein.

B. Contractors are specifically cautioned that disposal of materials into any waters of the State must conform with the requirements of the Texas Commission on Environmental Quality, and an applicable permit from the U.S. Army Corps of Engineers.

C. The Contractor shall be responsible for providing holding ponds or an approved method which will handle, carry through, or divert around his work all flows, including storm flows and flows created by construction activity, so as to prevent silting of waterways or flooding damage to the property or adjacent properties.

D. The Contractor is responsible for researching the need for a U.S. EPA NPDES permit for the construction site. If one is required, the Contractor is responsible for obtaining the permit and for monitoring the site per the permit requirements until final competition.

1.06 DISPOSAL OF EXCESS EXCAVATION AND OTHER WASTE MATERIALS

A. Excess excavated material not required or suitable for backfill and other waste material must be disposed of at sites approved by the Owner and Engineer.

B. Unacceptable disposal sites, include, but are not limited to, sites within a wetland or critical habitat and sites where disposal will have a detrimental effect on surface water or groundwater quality.

C. The Contractor may make his own arrangements for disposal subject to submission of proof to the Engineer that the Owner(s) of the proposed site(s) has a valid fill permit issued by the appropriate governmental agency and submission of a haul route plan including a map of the proposed route(s).

D. The Contractor shall provide watertight conveyance of any liquid, semi-liquid, or saturated solids which tend to bleed or leak during transport. No liquid loss from transported materials will be permitted whether being delivered to the construction site or being hauled away for disposal. Fluid materials hauled for disposal must be specifically acceptable at the selected disposal site.

1.07 USE OF CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture or any other applicable regulatory agency. Use of all such chemicals and disposal of residues shall be in conformance with the manufacturer's instructions.

B. Any oil or other hydrocarbon spilled or dumped on the Owner's site during construction must be excavated and completely removed from the site prior to final acceptance. Soil contaminated by the Contractor's operations shall become the property of the Contractor, who will bear all costs of testing and disposal.

C. Before a Contractor commences work, the following steps shall be completed:

1. The Owner will inform Contractor of his rights under the Texas Hazards Communication Act.
2. The Owner will provide a copy of the Chemical List giving the hazardous chemicals to which the Contractor, his employees and agents may be exposed to on the project site.
3. The Owner will provide copies of all MSDSs to the Contractor for the hazardous chemicals which he may be exposed to on the project site.
4. The Owner will inform the Contractor of his obligation to inform his employees and agents of each of the above requirements.
5. The Contractor shall provide MSDSs for all hazardous chemicals he may bring onto the project site that Owner's employees may be exposed to.
6. The contractor shall sign a Contractor Acknowledgement certifying that he has received the information provided by the Owner on hazardous chemicals and maintain the Acknowledgement with the original Contract.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 EROSION CONTROL

A. Provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion control measures, such as siltation basins, hay check dams, mulching, jute netting and other equivalent techniques, shall be used as appropriate. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled and the ground surface restored to original condition.

B. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to redo the amount of sediment contained in the water to allowable levels.

C. All preventative measures shall be taken to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by the Texas Commission on Environmental Quality. Contractor shall submit two copies of approved contingency plans to the Engineer.

3.02 PROTECTION OF LAND RESOURCES

A. Land resources within the project boundaries and outside the limits of permanent work shall be restored to a condition, after completion of construction, that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Drawings.

B. Outside of areas requiring earthwork for the construction of the new facilities, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. Where trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment, dumping or other operations, protect such trees by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly before beginning operations near them.

D. Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition. The Engineer will decide what method of restoration shall be used and whether damaged trees shall be treated and healed or removed and disposed of.

All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in. in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.

Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer, shall be immediately removed and replaced.

E. The locations of the Contractor's storage, and other construction buildings, required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Drawings and shall require written approval of the Engineer and shall not be within wetlands or floodplains. the preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the Engineer.

G. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials, or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling and plowing will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon.

H. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

3.03 PROTECTION OF AIR QUALITY

A. Burning. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

B. Dust Control. The Contractor will be required to maintain all excavations, embankment, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded, and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the Engineer.

D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer.

3.04 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION.

During the life of this Contract, maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is not longer being created.

3.05 NOISE CONTROL

The Contractor shall make every effort to minimize noises caused by his/her operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with State and Federal regulations.

3.06 DISCHARGE OF STORMWATER ASSOCIATED WITH CONSTRUCTION ACTIVITIES

The Contractor shall be responsible ensuring that project is in compliance with requirements of TPDES General Permit TXR 150000. As applicable to the project, Contractor shall implement the Storm Water Pollution Prevention Plan (SWPPP), submit Notice of Intent (NOI) to TCEQ, post NOI and Site Notice, submit copy of NOI to Municipal Separate Storm Sewer System (MS4). See Section 02370 – Erosion and Sedimentation Control for further details.

3.07 PAYMENT

The work specified in this section shall be considered incidental and payment will be included as part of the appropriate lump sum or unit prices specified in the Bid Form.

END OF SECTION

SECTION 01650

TECHNICAL SPECIFICATIONS – PRODUCT DELIVERY, STORAGE AND HANDLING

PART 1: GENERAL

1.10 SCOPE OF WORK

A. The successful equipment manufacturer shall be required to deliver all equipment specified in this Document to the job site. The General Contractor responsible for performing all construction improvements shall be responsible for unloading and inspecting the equipment shipment, as well as storage and protection of the equipment upon delivery as specified herein. The equipment supplier shall also perform an inspection of the equipment upon delivery as specified herein. The equipment supplier shall coordinate delivery of equipment with the General Contractor.

B. The contractor's proposal shall include the costs associated with delivery of equipment and performing a storage inspection as specified herein.

C. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item. The equipment manufacturer will be required to assist the General Contractor with work associated with this section as specified herein.

1.02 TRANSPORTATION AND DELIVER

A. Transport and handle items in accordance with manufacturer's instructions.

B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Engineer.

C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.

D. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.

E. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.

F. Provide necessary equipment and personnel to unload all items delivered to the site.

G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e. Owner, other Contractors) perform inspection in the presence of the Engineer. Notify Engineer verbally, and in writing, of any problems.

1.03 STORAGE AND PROTECTION

A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the Engineer by him/her. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.

B. Store loose granular materials on solid flat surfaces in a sell-drained area. Prevent mixing with foreign matter.

C. All structural and miscellaneous steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water and to minimize rusting.

D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weather-tight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.

1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.
2. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.
4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

SECTION 01770

TECHNICAL SPECIFICATIONS - CONTRACT CLOSEOUT PROCEDURES

PART 1: GENERAL

1.01 SCOPE OF WORK

This Section specifies administrative and procedural requirements for project closeout, including but not limited to:

1. Closeout procedures.
2. Final cleaning.
3. Adjusting.
4. Project record documents.
5. Spare parts and maintenance materials.

1.02 RELATED WORK

1. Section 00610 – Performance Bond
2. Section 00620 – Payment Bond
3. Section 00640 – Contractor's Affidavit of Bills Paid
4. Section 00700 – General Conditions
5. Section 00800 – Special Conditions

1.03 RECORD DOCUMENTS

A. Maintain on site, one set of the following documents; actual revisions to the Work shall be recorded in these documents:

1. Contract Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other Modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

E. Contract Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finish floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract Drawings.

F. Submit documents to Owner with claim for final Application for Payment.

1.04 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's and Owner's inspection.

B. Provide submittals to Owner that are required by governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due. Include all close out documentation as indicated in the General Conditions.

1.05 FINAL CLEANING

A. At the completion of work and immediately prior to final inspection, cleaning of the entire project shall be accomplished according to the following provisions:

1. The Contractor shall thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. The cleaning shall leave the structures and site in a complete and finished condition to the satisfaction of the Owner.
2. All Subcontractors shall similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts.
3. The Contractor shall remove all temporary structures and all debris, including all dirt, sand, gravel, rubbish and waste material. See Section 01500. Temporary Facilities and Utilities.
4. Should the Contractor not remove rubbish or debris, or not clean the buildings and site as specified above, the Owner reserves the right to have the cleaning done at the expense of the Contractor.

B. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

C. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.

D. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.

E. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.

F. Replace air-handling filters if units were operated during construction.

G. Vacuum clean all interior spaces, including inside cabinets. Broom clean paved surfaces, mow any areas planted with grass which are in excess of 2 inches high, and rake clean other surfaces of grounds.

H. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

I. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.

1.06 ADJUSTING

Adjust operating products and equipment to ensure smooth and unhindered operation.

1.07 FINAL INSPECTION

A. After final cleaning and restoration and upon written notice from the Contractor that the work is completed, the Engineer, Owner, and or Inspector(s), will make a preliminary inspection, with the Contractor present. Upon completion of this preliminary inspection, the Engineer, Owner, and/or Inspector will notify the Contractor, in writing, of any particulars in which this inspection reveals that the work is defective or incomplete.

B. Upon receiving written notice from the Engineer, Owner, and/or Inspector, the Contractor shall immediately undertake the work required to remedy deficiencies and complete the work to the satisfaction of the Owner.

C. When the Contractor has corrected or completed the items as listed in the Engineer's/Owner's written notice, he shall inform the Owner in writing, that the required work has been completed. Upon receipt of this notice, the Engineer, Owner and/or Inspector(s), and the Contractor, will make the final inspection of the project.

D. Should the Engineer, Owner, and/or Inspector find all work satisfactory at the time of his inspection, the Contractor will be allowed to make application for final payment in accordance with the provisions of the Standard Form of Agreement. Should the Engineer and/or Owner still find deficiencies in the work, the Engineer and/or Owner will inform the Contractor of the deficiencies and will deny the Contractor's request for final payment until such time as the Contractor has satisfactorily completed the required work.

1.08 ACCESSORY ITEMS

The Contractor shall provide to the Owner, upon acceptance of the equipment, all special accessories required to place each item of equipment in full operation. These special accessory items include, but are not limited to, the specified spare parts, adequate oil and grease as required for the first lubrication of the equipment, initial fill-up of all chemical tanks and fuel tanks, light bulbs, fuses, hydrant wrenches, valve wrenches, valve keys, handwheels, and other expendable items as required for initial start-up and operation of all equipment.

1.09 GUARANTEES, BONDS, AND AFFIDAVITS

No application for final payment will be accepted until all guarantees, bonds, certificates, licenses, and affidavits required for work or equipment as specified are satisfactorily filed with the Engineer.

1.10 RELEASE OF LIENS OR CLAIMS

No application for final payment will be accepted until satisfactory evidence of release of liens has been submitted to the Owner as required by the General Conditions.

1.11 FINAL PAYMENT

Final payment will be made to the Contractor in accordance with the General Conditions.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

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SECTION 02001

TECHNICAL SPECIFICATIONS – MISCELLANEOUS WORK AND CLEANUP

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to do the miscellaneous work not specified in other sections but obviously necessary for the proper completion of the work as shown on the Drawings.

B. When applicable the Contractor will perform the work in accordance with other sections of this Specification. When no applicable specification exists the Contractor shall perform the work in accordance with the best modern practice and/or as directed by the Engineer and/or Owner.

C. The work of this Section includes, but is not limited to, the following:

1. Crossing and Relocating Existing Utilities
2. Restoring of Driveways, Fences and Curbing
3. Cleaning Up
4. Incidental Work
5. Restoring Easements and Rights-of-Way

1.02 CROSSING AND RELOCATING EXISTING UTILITIES

A. This item includes any extra work required in crossing culverts, water courses including streams and drainage ditches, drains, gas mains, water mains and water services and other utilities. This work shall include but is not limited to the following: bracing, hand excavation and backfill (except screened gravel) and any other work required for crossing the utility or obstruction not included for payment in other items of this specification. Notification of Utility companies shall be the Contractor's responsibility.

B. In locations where existing utilities cannot be crossed without interfering with the construction of the work as shown on the Drawings, the Contractor shall remove and relocate the utility as directed by the Engineer or cooperate with the Utility Companies concerned if they relocate their own utility.

C. At pipe crossings and where designated by the Engineer, the contractor shall furnish and place crushed stone bedding so that the existing utility or pipe is firmly supported for its entire exposed length. The bedding shall extend to the mid-diameter of the pipe crossed. Payment for crushed stone at pipe crossings will be made according to the unit price bid established in the Proposal.

D. The installation and/or relocation of pipe lines shall be done so that the separation distances prescribed in 30 TAC 290.44 (e) between water lines and contaminated liquid lines is maintained.

1.03 RESTORING OF DRIVEWAYS AND FENCES

A. Existing public and private driveways disturbed by the sewer construction shall be replaced. Paved drives shall be repaved to the limits and thickness existing prior to construction. Gravel dirt roads and drives shall be replaced and regraded.

B. Fences in the vicinity of the work shall be protected from damage under this item. If damaged, fences shall be replaced in condition equal to that prior to being damaged and the work shall be satisfactory to the Engineer.

1.04 CLEANING UP

The Contractor shall remove all construction material, excess excavation, buildings, equipment and other debris remaining on the job as a result of construction operations and shall restore the site of the work to a neat and orderly condition.

1.05 INCIDENTAL WORK

Do all incidental work not otherwise specified, but obviously necessary to the proper completion of the contract as specified and as shown on the Drawings.

1.06 RESTORING THE EASEMENTS AND RIGHTS-OF-WAY

A. Portions of the work are within easements through private property. The Contractor shall be responsible for all damage to private property due to his/her operations. He/She shall protect from injury all walls, fences, cultivated shrubbery and vegetables, fruit trees, pavement, underground facilities, such as water pipes, or other utilities, which may be encountered along the easement. If removal and replacement are required, it shall be done in a workmanlike manner so that replacement is equivalent to that which existed prior to construction.

B. Existing lawn and sod surfaces damaged by construction easements shall be replaced. The Contractor may cut and replace the lawn and sod, or he/she may restore the areas with an equivalent depth and quality of loam, seeded and fertilized as specified in Section 02921. These areas shall be maintained and reseeded, if necessary, until all work under this Contract has been completed and accepted. The Contractor shall perform any additional work required to restore easements to their original condition.

END OF SECTION

SECTION 02200

TECHNICAL SPECIFICATIONS – SITE PREPARATION

PART 1: GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required, and perform all clearing and grubbing complete as shown on the Drawings and as specified herein.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 PREPARATION

A. Protect existing improvements from damage by site preparation work. Areas outside the limits of clearing shall be protected from damage and no equipment or materials shall be stored in these areas

B. Protect trees or groups of trees, designated by the Engineer to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means.

3.02 CLEARING AND GRUBBING

A. Except as otherwise directed, cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots and any other objectionable material within the limits defined on the Drawings.

B. All trees, stumps, brush, shrubs, roots and other objectionable material shall be cut, grubbed, removed and disposed of from areas to be occupied by buildings, structures, roads, pipelines and any other areas to be stripped.

C. Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees designated to remain.

D. No stumps, trees, limbs, or brush shall be buried in any fills or embankments.

3.03 STRIPPING

A. Strip topsoil from all areas to be excavated or filled. Avoid mixing topsoil with subsoil and stockpile topsoil in areas on the site as approved by the Engineer. Topsoil shall be free from brush, trash, large stones, and other extraneous material and protected until it is placed as specified.

3.04 DISPOSAL OF MATERIALS

A. All tree trunks, limbs, roots, stumps, brush, foliage, other vegetation and objectionable material shall be removed from the site and disposed of in a permitted disposal site in a manner satisfactory to the Engineer.

B. Burning of cleared and grubbed materials will not be permitted.

C. Unused topsoil shall be disposed of in a permitted disposal site in a manner satisfactory to the Engineer.

3.05 MEASUREMENT AND PAYMENT

A. No separate payment for work performed under this item. Include cost of same in Contract prices bid for item of which this work is a component part.

END OF SECTION

SECTION 02235

TECHNICAL SPECIFICATIONS – GRANULAR FILL MATERIALS

PART 1: GENERAL

1.01 DESCRIPTION

Granular fill materials are specified in this Section, but their use for bedding pipe, replacement of unsuitable material, gravel cushion in ledge excavation, pavement base, foundation support and similar uses are specified in detail elsewhere. The Engineer may order the use of fill materials for purposes other than those specified in other Sections if, in his/her opinion, such use is advisable.

PART 2: PRODUCTS

2.01 MATERIALS

A. Common fill shall consist of sandy clay material free of organic material, loam, wood, trash, and other objectionable material which may be compressible, or which cannot be compacted properly. Common fill shall not contain stones larger than 6-inches in any dimension, broken concrete, masonry, rubble, asphalt pavement, or other similar materials. It shall have physical properties, as approved by the Engineer, such that it can be readily spread and compacted.

B. Select common fill shall be as specified above for common fill except that the material shall contain no stones larger than 2-inches in its largest dimension.

C. Gravel Backfill shall consist of hard, durable, particles of proper size and gradation, free from sand, loam, clay, excess fines and deleterious materials. The size of the particles shall be uniformly graded such that not less than 100 percent of the particles will pass a 1/2-inch sieve, 98-100 percent will pass the 3/8-inch sieve, 15-60 percent will pass as No. 4 sieve, and 0-5 percent will pass a No. 10 sieve.

D. Crushed Stone Base shall consist of sound, durable stone, free of any foreign materials, angular in shape, free from structural defects and comparatively free of chemical decay. This material shall comply with TxDOT item 247, Type A, Grade 3. The stone shall have a maximum size of 7/8-inch.

E. Bedding sand shall consist of a clean coarse-grained cohesionless material which 100 percent of its particles shall pass a 1/4-inch sieve, 0-25% will pass a No. 60 Sieve, 0-5% will pass a No. 100 sieve and all material passing the No. 60 sieve shall have a P.I. of not more than 4.

F. Cement Stabilization Sand Backfill shall consist of a mixture of ASTM C33 fine aggregate and Type I cement. The mix shall be proportioned of two sacks of cement per cubic yard and 51 gallons of water per cubic yard of cement stabilized sand.

PART 3: EXECUTION (NOT USED)

END OF SECTION

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SECTION 02240

TECHNICAL SPECIFICATIONS – DEWATERING

PART 1: GENERAL

1.01 GENERAL SCOPE

A. Furnish all labor, materials, equipment and incidentals necessary to dispose of water entering the excavation or parts of the Work.

1.02 RELATED SECTIONS

A. Section 02260 – Trench and Excavation Safety Protection
B. Section 02300 – Earthwork
C. Section 02316 – Trenching, Backfilling and Compaction

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01330-Submittal Procedures. Information shall include the following for all instances where dewatering is anticipated:

1. Dewatering Plan: Including arrangement, location, depths, types and sizes of system components, including pumps, filters, and piping.
2. Dewatering Calculations: Including pump sizing, water drawdown curves, and all other necessary calculations.
3. Dewatering Plan and Calculations to be fully coordinated with the Trench and Excavation Safety Plan.

1.04 PROJECT CONDITONS

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 GENERAL

A. Contractor shall perform work in accordance with all applicable State, County and local regulations.

B. Contractor shall locate dewatering facilities where they will not interfere with utilities, other construction work, or otherwise cause harm to existing or proposed improvements. Water shall be disposed of in a manner which will not damage adjacent property or create a menace to public health and safety.

C. Contractor shall intercept and divert precipitation and surface water away from excavations through the use of dikes, ditches, pipes, sumps or other means.

D. Contractor shall provide and maintain, through the course of the project and/or each specific excavation, ample means and devices with which to promptly remove and dispose of water entering excavations or other parts of the work, whether water be surface water or underground water.

3.02 MEASUREMENT AND PAYMENT

A. No separate payment for work performed under this Item. Include cost of same in Contract prices bid for all items of which this work is a component part.

END OF SECTION

SECTION 02260

TECHNICAL SPECIFICATIONS – TRENCH AND EXCAVATION SAFETY PROTECTION

PART 1: GENERAL

1.01 GENERAL SCOPE

A. This Section shall govern the protection systems required during trenching and excavations. This shall include the design, furnishing and installing, maintaining, and removing the excavation support and protection

B. Contractor is responsible for acquiring, submitting and having approved, installing and maintaining a Trench and Excavation Safety Protection Plan in accordance with the most recent provisions of the Occupational Safety and Health Administration Standards (OSHA).

1.02 SYSTEM REQUIREMENTS

A. Design Requirements
B. Performance Requirements

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01330-Submittal Procedures. Information shall include the following:
   1. Trench and/or Excavation Safety Protection Plan.
      a. Drawing of each proposed installation.
      b. Drawings and installation instructions for each type of equipment proposed.

   2. Calculations for each installation and/or where loadings differ.

   3. Any other drawings and/or details necessary to illustrate the proposed Trench and Excavation Safety Protection Plan, the proper installation and maintenance of the system, and to demonstrate OSHA compliance.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 INSTALLATION AND REMOVAL

A. Install means for providing safe and stable excavations as indicated on the approved Submittals.

B. Except for concrete encased soldier piles, steel piles, slurry walls, and similar shoring systems, remove shoring by completion of the Work.

   1. Select a shoring system and removal method which will minimize large voids and settlement.
   2. If necessary, settlement shall be prevented by fillings voids with sand, pea gravel, or pressure injected grout.

3.02 MAINTENANCE

A. Trench and Excavation Safety System is to be maintained in accordance with the manufacturer's recommendations and with the approved Submittals.

B. Where measurements and observations indicate the possibility of failure or excessive movement appropriate action is to be taken immediately.

3.03 PAYMENT

A. Payment shall include all components of the trench excavation safety protection system which can include, but not be limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or temporary diversion and proper recapture and transportation of water to provide adequate drainage. Payment shall also include the additional excavation and backfill required, any jacking, jack removal, and removal of the trench supports after completion. Payment shall also include any retention by Contractor of Structural Engineer/Geotechnical Engineer or Consultant/Safety/Equipment or other consultant necessary to prepare, install, maintain, remove, or otherwise implement the Trench and Excavation Safety Protection Plan.

B. Payment shall be made at the unit price bid per linear foot for trenches, regardless of the frequency of depths.

C. Payment shall be made at the lump sum price bid for all other excavations.

END OF SECTION

SECTION 02300

TECHNICAL SPECIFICATIONS - EARTHWORK

PART 1: GENERAL

1.01 GENERAL SCOPE

A. Earthwork shall consist of loosening, excavation, removing, transporting, depositing, compacting, trenching, backfilling in final location all materials, wet or dry, as required for construction; and all pumping and draining of excavation.

1.02 RELATED SECTIONS

A. Section 01330 – Submittal Procedures
B. Section 01450 – Quality Control
C. Section 02220 – Site Preparation
D. Section 02240 – Dewatering
E. Section 02260 – Trench and Excavation Safety Protection

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01330-Submittal Procedures. Information shall include the following:
   1. Material data for any select fill and bedding, including supplier and all data to show compliance with this Section.
   2. Shoring, sheeting and bracing plans in accordance with OSHA regulations.
   3. Excavation Plan: Submit proposed excavation plan.

1.04 QUALITY ASSURANCE

A. Testing
   1. Material and compaction testing shall be performed by an independent third party firm in accordance with applicable standards and as specified herein. See General and Special Condtions for responsibility of testing firm acquisition.
   2. Standard proctor tests in accordance with ASTM D698 shall be performed on an adequate number of samples representative of the material to be used. Results for the moisture-density analysis, Atterberg limits analysis and sieve analysis shall be provided to the Engineer.
   3. Density tests shall be conducted on the upper level trench backfill, each course of flexible base, each lift of earth fill and/or each lift of structural backfill as applicable. The Engineer or inspector shall designate the exact location of density tests and reserves the right to increase or decrease the amount of testing required depending on compaction methods employed and the resultant success of compaction efforts. All density tests results, whether passing or failing, shall be provided to the Engineer. See Section 01450 – Quality Control for quantity and further details on required density tests.

PART 2: PRODUCTS

2.01 MATERIALS

A. Topsoil

Topsoil shall be provided as specified in Section 02921 – Loaming and Seeding throughout the construction area and hydro-mulch with a mixture of grasses, or sod approved by the Engineer.

B. Fill Material

1. General
   i. Fill material shall be selected to meet the requirements and conditions for the particular fill or backfill for which it is to be used. The acquisition and purchase of required fill material shall be the responsibility of the Contractor.
   ii. Excavated on-site material may be re-used as part of the trench backfill and site fill, providing it meets the requirements listed below.

2. Gravel/Drain Rock
   i. Gravel/Drain Rock shall consist of hard, durable particles of stone or gravel, crushed and screened to the specified size and gradation.
   ii. The material shall be free from organic matter, lumps or balls of clay, or other deleterious material.
   iii. Conform to the size and graded to within the limits shown in the following table, when tested in accordance with ASTM C 136:

Sieve Size	Percent by Weight Passing Sieve
2 inch	100
1-1/2 inch	95-100
3/4 inch	50-100
3/8 inch	15-55
Number 4	0-25
Number 8	0-5
Number 200	0-2

3. Sand
   i. Sand shall be clean, coarse, natural sand and screened to the specified size and gradation.
   ii. The material shall be free from organic matter, lumps or balls of clay, or other deleterious material.
   iii. Conform to the size and graded to within the limits shown in the following table, when tested in accordance with AASHTO T-27 or ASTM C 136:

Sieve Size	Percent by Weight Passing Sieve
1/2 inch	100
Number 200	0-20

4. Select Native Material
   i. Select Native Material shall be sound, on-site earthen materials free of debris and suitable for re-use.
   ii. The material shall have less than 3 percent organics by weight when tested in accordance with ASTM D2974.
   iii. The Contractor shall verify that the native material is capable of compaction to the specified density before placing it as fill. If material will not compact to the specified density, or is un-workable, Contractor shall either work material in a manner which will improve the material or remove the material from the site and replace with Select Imported Material at no additional cost to Owner.

iv. Conform to the size and graded to within the limits shown in the following table, when tested in accordance with ASTM C 136:

Sieve Size	Percent by Weight Passing Sieve
3 inch	100
2-1/2 inch	75-100
Number 200	0-15

5. Select Imported Material
   i. Select Imported Material shall be granular, non-expansive, earthen materials free of debris.
   ii. The material shall have less than 3 percent organics by weight when tested in accordance with ASTM D2974.
   iii. The material shall have a Liquid Limit less than 30 and a Plasticity Index less than 12 when tested in accordance with ASTM D4318.
   iv. Conform to the size and graded to within the limits shown in the following table, when tested in accordance with ASTM C 136:

Sieve Size	Percent by Weight Passing Sieve
3 inch	100
2-1/2 inch	95-100
3/4 inch	80-100
Number 4	50-90
Number 200	0-15

PART 3: EXECUTION

3.01 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. Existing power and telephone lines, trees, fences, pipelines or other conduits, and structures in the vicinity of the work shall be supported and protected from injury by the Contractor during the construction and until the completion of the work. The Contractor shall be liable for all damages to such structures, as herein provided, and shall save and keep the Owner harmless from any liability or expense for injuries, damages, or repairs to same.

B. A thorough attempt has been made to show the type, size, location and number of all utilities, however, no guarantee is made as to the location and number of utilities. The Contractor shall notify all owners of utilities prior to commencement of and sufficiently in advance to have the utilities mark the location of their facilities. The Contractor shall be prepared at all times with labor, equipment, and materials to make repairs to damaged mains or utilities.

C. Where existing and proposed utilities or structures cross, the Contractor shall verify the location and depth of the existing utility and notify the Engineer 500 ft in advance of crossing, so that alignments can be adjusted if necessary.

3.02 MAINTAINING DRAINAGE

A. The Contractor shall provide and maintain temporary drainage for all excavations, drains, ditches, trenches, and structures. The Contractor shall keep the excavation dry through the construction operations. Whenever necessary, in order to provide proper drainage, the Contractor shall, at his expense, install underdrains, furnish and operate all necessary pumping equipment, drainage sumps, wellpoint systems and other drainage facilities. See Section 02240 – Dewatering for more detail.

B. All grading in the vicinity of trench excavations shall be controlled to prevent surface water from flowing into the trenches. Any water accumulated in the trenches shall be removed by pumping or by other approved methods.

3.03 BLASTING

A. Blasting for excavation will not be allowed, except in very extreme circumstances as approved by the Owner's representative and only when proper precautions are taken for the protection of persons and property. The hours of blasting and the limits on charge size will be fixed by the Owner's representative. Any damage caused by blasting shall be repaired by the Contractor at his expense.

B. The Contractor shall carry proper and adequate blasting insurance. The Contractor's method of procedure in blasting shall conform to federal, state and local laws.

3.04 PILING OF EXCAVATED MATERIAL

A. All excavated material shall be piled in a manner that will not endanger the work and will avoid obstructing roads and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage. Natural watercourses shall not be obstructed.

3.05 SHORING, SHEETING AND BRACING

A. Where necessary, trenches and other excavations shall be properly sheeted and braced in accordance with OSHA regulations and to furnish acceptable working conditions. See Section 02260 – Trench and Excavation Safety Protection for more detail.

3.06 SEASONAL LIMITS

A. No fill material shall be placed, spread or compacted during unfavorable weather conditions. When the work is interrupted by snow or rain, filling operations shall not be resumed until field tests by the Owner's representative indicate that the moisture content and density of the fill are as specified.

3.07 CONTROL OF DUST

A. The Contractor shall, at all times, keep the construction area watered or swept of all loose material produced by his operations in order that traffic and construction do not raise an objectionable amount of dust. When conditions warrant, the Contractor shall apply a suitable dust palliative to control dust.

3.08 BARRICADES, GUARDS, AND SAFETY PROVISIONS

A. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns, and guards, as required and deemed necessary by the Owner's representative for protection of life and property shall be placed and maintained during the construction. All material piles, equipment, and pipe, which may serve as obstructions to traffic, shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor. The rules and regulations of the visibility authorities respecting safety provisions shall be observed. Under no circumstances will any existing road be permitted to remain closed at any time.

3.09 DISPOSAL OF SURPLUS MATERIAL

A. The Contractor shall at his own expense make arrangements for the disposal of surplus materials, such as rocks, trees, brush and other unwanted backfill materials, at a permitted disposal site. The Contractor shall not dump material on any private property without the written permission of the Owner thereof.

3.10 CONCRETE STRUCTURES

A. General

See 3.11 Structural Excavation and Backfill for excavation, subgrade preparation and backfill requirements.

B. Grading

For building floor slabs, or portions of slabs, that do not abut paving or sidewalks, the Contractor shall grade the site so that the floor slab shall be level with a minimum of 4" elevation above finish grade at all points, and graded so that

drainage flows freely away from the slab. Slabs, or portions of slabs, that do abut paving or sidewalks shall be a minimum of 2" and a maximum of 6" above the paving/sidewalk and the paving/sidewalk sloped away from the slab.

3.11 STRUCTURAL EXCAVATION AND BACKFILL

A. Excavation

1. The Contractor may employ any method of excavation (with the exception of blasting) provided it meets with the approval of the Geotechnical Engineer. Excavation shall not disturb or weaken any subgrade for foundation purposes.

2. Excavations for a number of the new structures will require open or braced cuts. All excavations shall be sloped, shored or shielded in accordance with Occupational Safety and Health Administration (OSHA) requirements. An excavation plan prepared by a qualified engineer, licensed in the State of Texas, is required for each excavation in excess of 20 ft., such as the Lift station excavation, or any other excavation where required by OSHA.

3. Each structural foundation excavation shall be monitored by a qualified representative of the Geotechnical Engineer to ensure that the exposed final subgrade is suitable before backfilling.

4. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades and from flooding the Project site and surrounding area.
   a. Reroute surface water away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
   b. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

5. Foundation pad construction shall begin promptly after completion of excavation and approval of the subgrade. Prolonged exposure of the subgrade to air or water may require additional excavation to provide a fresh subgrade.

6. Excavations for walls shall extend a sufficient distance beyond the outside face of wall to allow for placing and removal of forms, installations of services, and inspection of work.

7. Structural excavation carried beyond or below the lines and grades indicated on the drawings shall be refilled with approved materials and compacted as directed by the Engineer at the expense of the Contractor, except when under footings, where concrete shall be used.

B. Foundation Pad Construction – As required by the structural series drawings for each structure.

C. Backfilling

1. All lumber, rubbish and braces shall be carefully removed from excavations.

2. No backfill shall be placed against concrete walls until the walls have been inspected and approved by the Engineer. Shoring and sheeting shall be carefully and completely removed as the backfilling progresses, unless otherwise authorized by the Engineer. Where sheeting is left in place, all cavities behind such sheeting shall be solidly filled.

3. Backfill material shall be placed in horizontal, uniform layers not exceeding eight inches (8") in thickness before compaction, and shall be brought up uniformly on all sides of the structure or facility. Each layer of backfill shall be compacted to a dry density of at least 90% of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to 2 percentage points above optimum, unless specified otherwise on the Plans.

4. Backfill material may be a native material unless a free-draining granular backfill is specified on the drawings.

a. Native material shall not contain rocks larger than three inches (3") in its greatest dimension.
b. Free-draining granular backfill shall be a clean, non-plastic, relatively well-graded granular soil consisting of either a sand or a sand and gravel mixture with less than 5% passing through a No. 200 sieve. Free-draining backfill shall be overlain with a 1-ft. depth of compacted on-site clay with a plasticity index of at least 25.

3.12 EARTHFILL EMBANKMENT CONSTRUCTION

A. General

1. Earth fill embankment construction shall consist of constructing embankments, including the preparation of the areas upon which they are to be placed, buttress fills, dikes, the placing and compacting of approved materials within areas where unsuitable material exists in holes, pits and other depressions.
2. Areas over which fills are to be placed shall be cleared of vegetation, scarified and then wetted and rolled prior to placing fill materials. The area shall be compacted to a dry density of at least 95% of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to 2 percentage points above optimum, unless specified otherwise on the Plans.
3. When fill is to be made and compacted on hillside, where new fill is to be compacted against existing fill, or where embankment is built one-half width at a time, the slopes or original hillsides and old or new fills shall be benched a minimum of four feet (4') horizontally as the fill is placed. A new bench shall be started where the vertical cut for the next lower bench intersects the existing ground. Material thus cut out shall be re-compacted along with the new embankment material at the Contractor's expense.
4. Embankment shall not be constructed when material is frozen or a blanket of snow prevents proper compaction.

B. Compacting

1. Fill compaction shall be in accordance with the attached Geotechnical Report.

3.13 EARTHFILL CONSTRUCTION

A. General

1. Earth fill construction shall consist of filling on the site in areas which are not under structures, roadways, or other facilities otherwise mentioned in this Section.
2. Areas over which fills are to be placed shall be cleared of vegetation, scarified and then wetted and rolled prior to placing fill materials. The area shall be compacted to a dry density of at least 90% of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to 3 percentage points above optimum, unless specified otherwise on the Plans.
3. When fill is to be made and compacted on hillside, where new fill is to be compacted against existing fill, or where embankment is built one-half width at a time, the slopes or original hillsides and old or new fills shall be benched a minimum of four feet (4') horizontally as the fill is placed. A new bench shall be started where the vertical cut for the next lower bench intersects the existing ground. Material thus cut out shall be re-compacted along with the new embankment material at the Contractor's expense.
4. Fill shall not be constructed when material is frozen or a blanket of snow prevents proper compaction.
5. Fill material shall be placed in horizontal, uniform layers not exceeding eight inches (8") in thickness before compaction and compacted to a dry density of at least 90% of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to 2 percentage points above optimum, unless specified otherwise on the Plans.

3.14 MEASUREMENT AND PAYMENT

A. No separate payment for work performed under this Item. Include cost of same in Contract prices bid for all items of which this work is a component part.

END OF SECTION

SECTION 02316

TECHNICAL SPECIFICATIONS – TRENCHING, BACKFILLING AND COMPACTION

PART 1: GENERAL

1.01 GENERAL SCOPE

A. Furnish all labor, materials, equipment and incidentals necessary to perform all trenching, bedding, backfilling and compaction for pipelines and appurtenances.

1.02 RELATED SECTIONS

A. Section 01330 – Submittal Procedures
B. Section 02260 – Trench and Excavation Safety Protection
C. Section 02300 - Earthwork

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01330-Submittal Procedures. Information shall include the following:
   1. Material data for any select fill and bedding, including supplier and all data to show compliance with this Section.
   2. Sample of bedding or fill material when requested by Owner or Engineer.

1.04 QUALITY ASSURANCE

A. Testing
   1. Material and compaction testing shall be performed by an independent third party firm in accordance with applicable standards and as specified herein. See General and Special Conditions for responsibility of testing firm acquisition.
   2. Standard proctor tests in accordance with ASTM D698 shall be performed on an adequate number of samples representative of the material to be used. Results for the moisture-density analysis, Atterberg limits analysis and sieve analysis shall be provided to the Engineer.
   3. Density tests shall be conducted on the upper level trench backfill. The Engineer or inspector shall designate the exact location of density tests and reserves the right to increase or decrease the amount of testing required depending on compaction methods employed and the resultant success of compaction efforts. All density tests results, whether passing or failing, shall be provided to the Engineer.
      i. Trench Backfill: Not to exceed 300 feet.

PART 2: PRODUCTS

2.01 MATERIALS

A. General
   1. Bedding and fill material shall be free of leaves, grass, roots, stumps and other organic material.
   2. Trench backfill material shall be either Select Native Material or Select Imported Material as specified in Section 02300 – Earthwork.

B. Pipe Bedding Gravel
   1. Pipe Bedding Gravel shall be clean gravel, free of mud, clay, vegetation or other debris, and shall conform to ASTM C 33 for stone quality.
   2. Conform to the size and graded to within the limits shown in the following table, when tested in accordance with ASTM C 136:

Sieve Size	Percent by Weight Passing Sieve
1-1/2 inch	100
1 inch	90-100
1/2 inch	15-60
Number 4	0-10
Number 8	0-5

C. Sand
   1. Sand for use as pipe bedding shall only be used for pipes or conduits 4 inches and smaller, or when specified on the Plans or authorized by the Engineer.
   2. Sand shall be clean, granular and homogeneous material composed primarily of mineral matter. It shall be free of mud, silt, clay lumps or balls.
   3. The material removed by decantation TxDOT Test Method Tex-406-A, plus the weight of any clay lumps, shall not exceed 4.5 percent by weight.
   4. The resistivity shall not be less than 3000 ohms-cm as determined by TxDOT Test Method Tex-129-E.
   5. Conform to the size and graded to within the limits shown in the following table, when tested in accordance with AASHTO T-27 or ASTM C 136:

Sieve Size	Percent by Weight Passing Sieve
1/4 inch	100
Number 60	0-25
Number 100	0-5

PART 3: EXECUTION

3.01 GENERAL

A. Stabilize excavation as specified in Section 02260 – Trench and Excavation Safety Protection.

B. Before installing pipes or conduits in fill, place fill and compact it, in accordance with Section 02300 – Earthwork, to not less than 2 feet above top of pipe or conduit. After placing and compacting fill, excavate through fill and fine grade as required in this Section.

3.02 INSTALLATION

A. Trench Excavation
   1. General Requirements
      a. All excavation for pipe lines shall be of a depth to permit a minimum cover of 36 inches above the top of the pipe, unless otherwise shown.
      b. All excavation for pipe lines and conduits shall be of a depth to permit placing of supports and other special appurtenances.
      c. All trenches shall have vertical sides from the bottom to a point at least 12 inches above the top of the pipe.
      d. Trench bottoms shall be free of loose material before placing the bedding material.

2. Pipe Clearance
   a. Trench Widths
      i. Pipe Sizes 24 inches and smaller: Not less than the outside diameter plus 12 inches, and not more than the outside diameter plus 24 inches.
      ii. Pipe Sizes greater than 24 inches: Not less than the outside diameter plus 18 inches, and not more than the outside diameter plus 30 inches.
      iii. Whenever the maximum allowable trench width is exceeded for any reason, the Contractor shall, at the Contractor's expense, embed or cradle the pipe in concrete in a manner satisfactory to the Engineer.
   b. Pipe Clearance in Rock: Ledge rocks, boulders, and large stones shall be removed to provide a clearance of not less than 6 inches below and on each side of all pipe, valves, and fittings.

3. Excavation in Poor Soil
   a. If the bottom of the excavation is found to consist of soft or unsuitable material which is incapable of properly supporting the pipe, remove such material to a depth and for the length required as determined by the Engineer, and then refill trench to grade with bedding material.

B. Pipe Bedding
   1. Pipe bedding shall be laid in 12 inch maximum horizontal, uniform, lifts. Each lift shall be compacted be vibratory plate or other acceptable method.

   2. Pipe bedding material shall first be placed so that pipe is supported for the full length of the barrel with full bearing on the bottom segment of the pipe equal to a minimum of 0.4 of the outside diameter. Then the remainder of the bedding shall be placed to 12 inches above the top of pipe. Alternate methods of pipe laying which are recommended by the manufacturer may be used if approved by the Engineer.

   3. Pipe Displacement: In the event there is movement or floating after the pipe is laid, the Contractor shall re-excavate, relay, and backfill the pipe.

C. Backfilling
   1. For Areas to be Covered with Grass (Outside Roadways, Structures, Etc): Backfill above the pipe bedding to within 4 inches of finished grade with Select Native Material or Select Imported material. Each layer of backfill shall be compacted to a dry density of at least 90% of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to 2 percentage points above optimum. Backfill remaining 4 inches with top soil.

   2. For Areas Under Roadways, Sidewalks, Structures or other Improvements: Backfill above the pipe bedding to a depth as shown on the Plans and in the Details. Each layer of backfill shall be compacted to a dry density of at least 98% of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to 2 percentage points above optimum, unless specified otherwise on Plans. Finish as shown on Plans and Details.

   3. Jetting (Water Consolidation of Backfill): Shall be used only when approved by Engineer. The jet pipe shall not be less than one and one half (1-1/2) inches in diameter and shall extend to within 15 inches of the top of the pipe during jetting of backfill over pipe. The source of water for jetting shall be a water tank with a pressure of 60 psi. All "bridges" shall be completely broken down during the jetting process. Jet points along the line of the ditch shall be staggered from side to side at intervals not to exceed 6 feet center to center or as necessary so that the backfill takes full possible subsidence while water is being introduced into it through the jet pipe. If the compaction requirements specified above are not met within 30 calendar days after jetting the backfill, the trench shall be re-excavated. Backfill material shall then be compacted by tamping and/or rolling until the compaction requirements are satisfied.

3.03 QUALITY CONTROL

A. Piping System Testing: Test Piping System in accordance with Section 15955 – Piping Systems Testing.

B. Compaction Testing: Trench backfill shall be tested in accordance with Section 02300 – Earthwork.

3.04 MEASUREMENT AND PAYMENT

A. No separate payment for work performed under this Item. Include cost of same in Contract prices bid for all items of which this work is a component part.

END OF SECTION

SECTION 02370

TECHNICAL SPECIFICATIONS - EROSION AND SEDIMENT CONTROL

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals necessary to perform all installation, maintenance, removal and area cleanup related to sedimentation control work as shown on the Drawings and as specified herein. The work shall include, but not necessarily be limited to; installation of temporary access ways and staging areas, silt fences, stone filter boxes, rock berms, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, excelsior matting installation and final cleanup.

B. Storm Water Pollution Prevention Plan (SWPPP). The SWPPP shall be implemented and maintained, in accordance with the Texas Commission on Environmental Quality General Permit TXR 150000. The General permit is available upon request.

1. The Contractor shall prepare the SWPPP. The SWPPP will be made available for viewing and review at the same location as Bid Documents are available for purchase. Three (3) copies of the SWPPP will be provided to the Contractor after Award of the project.
2. The Contractor shall be responsible for submitting Notice of Intent (NOI) to TCEQ, posting NOI and Site Notice, and submitting copy of NOI to Municipal Separate Storm Sewer System (MS4).
3. The Contractor shall be responsible for the implementation, any necessary field adjustments, routine inspections, and weekly reports in accordance with the prepared SWPPP.

1.02 RELATED SECTIONS

A. Section 01560 – Environmental Protection Procedures
B. Section 02300 – Earthwork
C. Section 02921 – Loaming and Seeding

1.03 SUBMITTALS

Within 10 days after award of Contract, the Contractor shall submit to the Engineer for approval, technical product literature for all commercial products to be used for sedimentation and erosion control, in accordance with Section 01300 - Submittals.

1.04 QUALITY ASSURANCE

A. The Contractor shall be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off site areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Drawings necessary to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the Owner will be considered.

B. Sedimentation and erosion control measures shall conform to the requirements outlined in the Texas Commission on Environmental Quality General Permit TXR 150000.

PART 2: PRODUCTS

2.01 MATERIALS

Crushed stone for sediment filtration devices, access ways and staging areas shall conform to Texas Department of Transportation "Standard Specifications for Construction of Highways, Streets and Bridges."

A. Berm structural stone shall be rip-rap as follows:

1. Rip-rap shall be sound, durable rock which is roughly rectangular shape and of suitable quality to insure permanence in the condition in which it is to be used. Rounded stones, boulders, sandstone or similar soft stone will not be acceptable. Material shall be free from overburden, spoil, shale, and organic material, meet the Engineer's approval and be well graded within the following limits:
2. Unless otherwise shown on the plans, all stones except spalls shall weigh between 50 and 250 pounds each, and at least 50 percent of the stones shall weigh more than 100 pounds each.

B. Silt Fence

1. Steel posts shall be a minimum of 5 feet in length, 2-1/2-in by 2-1/2-in by ¼-in angle post with self-fastening tabs and a 5-in by 4-in (nominal) steel anchor plate at bottom.
2. Welded wire fabric shall be 4-in by 4-in mesh of 12 gauge by 12 gauge steel wire.
3. Silt fence fabric shall be a woven, polypropylene , ultraviolet resistant material such as Mirafi 100X as manufactured by Mirafi, inc., Charlotte, NC or equal.
4. Tie wires for securing silt fence fabric to wire mesh shall be light gauge metal clips (hog rings), or 1/32-in diameter soft aluminum wire.
5. Prefabricated commercial silt fence may be substituted for built-in-field fence. Pre-fabricated silt fence shall be "Envirofence" as manufactured by Mirafi Inc., Charlotte, NC or equal.

C. One quarter inch woven wire mesh shall be galvanized steel or hardware cloth.

D. Straw mulch shall be utilized on all newly graded areas to protect areas against washouts and erosion. Straw mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold or other objectionable material. The straw mulch shall contain at least 50 percent by weight of material to be 10-in or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

E. Latex acrylic copolymer, such as Soil Sealant with coalescing agent as manufactured by Soil Stabilization Co., Merced, CA or approved equivalent shall be used as straw mulch tackifier.

F. An asphalt tackifier shall only be used when temperatures are too low to allow the use of a latex acrylic copolymer and only with prior written approval from the Engineer.

G. Excelsior matting blanket shall be installed in all seeded drainage swales and ditches as shown on the Drawings or as directed by the Engineer. Excelsior matting shall be AMXCO Curlex Blanket as manufactured by American Excelsior Company, Arlington, TX or equal.

PART 3: EXECUTION

3.01 INSTALLATION

A. Silt Fence Installation

1. Silt fences shall be positioned as indicated on the Drawings and as necessary to prevent off site movement of sediment produced by construction activities as directed by the Engineer.
2. Dig trench approximately 6-in wide and 6-in deep along proposed fence lines.
3. Drive metal-stakes, 8 feet on center (maximum) at back edge of trenches. Stakes shall be driven 2 feet (minimum) into ground.
4. Hang 4 by 4 woven wire mesh on posts, setting bottom of wire in bottom of trench. Secure wire to posts with self-fastening tabs.
5. Hang filter fabric on wire carrying to bottom of trench with about 4-in of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and secure with tie wires 12-in O.C. both ways.
6. Backfill trench with excavated material and tamp.
7. Install pre-fabricated silt fence according to manufacturer's instructions.

B. Construct filter boxes as detailed on the Drawings, from ¼-in woven wire mesh or hardware cloth and wood. Fill with crushed stone and place over all drop inlets and manholes to storm drain system as each inlet is completed. This should be done prior to setting casting, if there is a delay between installation of inlet structures or drain manholes and setting of castings. An alternate method is to ring each inlet with a silt fence.

C. Rock Berm Installation –

Place berm structural stone across channel just below lower sandbag wall at work area. Face upstream side of structural berm with crushed stone.

D. Staging areas and access ways shall be surfaced with a minimum depth of 4-in of crushed stone.

3.02 MAINTENANCE AND INSPECTIONS

A. Inspections-

Contractor shall make a visual inspection of all sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas or into the vent trench, Contractor shall promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.

B. Device Maintenance-

1. Silt Fences
   a. Remove accumulated sediment once it builds up to one-half of the height of the fabric.
   b. Replace damaged fabric, or patch with a 2-ft minimum overlap.
   c. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.
2. Filter Boxes: Replace crushed stone when it becomes saturated with silt.
3. Stone Filter Berm
   a. Muck out trapped silt from dewatering operations when it has built up to within 6-in of the top of the berm.
   b. Replace crushed stone filter when saturated with silt.
4. Add crushed stone to access ways and staging area as necessary to maintain a firm surface free of ruts and mudholes.

3.03 TEMPORARY MULCHING

A. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading.

B. Straw mulch shall be applied at rate of 100 lbs/1000 ft^2 and tackified with latex acrylic copolymer at a rate of 1 ga/1000 ft^2 diluted in a ratio of 30 parts water to 1 part latex acrylic copolymer mix.

3.04 EXCELSIOR MATTING

A. Excelsior matting blankets shall be installed in all seeded drainage swales and ditches as shown on the Drawings and as directed by the Engineer in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. The blankets shall be applied in the direction of water flow, and stapled. Blankets shall be placed a minimum of three rows (of 4-ft) wide (total approx. 12-ft width) within the drainage swale/ditch and stapled together in accordance with manufacturer's instructions. Side overlaps shall be 4-in minimum. The staples shall be made of wire, .091-in. in diameter or greater, "U" shaped with legs 10-in. in length and a 1-1/2-in crown. The staples shall be driven vertically into the ground, spaced approximately two linear feet apart, on each side, and on row in the center alternately spaced between each side. Upper and lower ends of the matting shall be buried to a depth of 4-inches in a trench. Erosion stops shall be created every 25 feet by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be 4-in below the ground surface. Staple on both sides of fold. Where matting must be cut or more than one roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of 4-in. Overlap lower end of upstream roll 4-in past edge of downstream roll and staple.

   To ensure full contact with soil surface, roll matting with a roller weighing 100 pounds per foot of width perpendicular to flow direction after seeding, placing matting and stapling. Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below.

3.05 REMOVAL AND FINAL CLEANUP

Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner. Regrade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Drawings.

END OF SECTION

SECTION 02501

TECHNICAL SPECIFICATIONS - CONNECTIONS TO AND WORK ON EXISTING SYSTEM

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall supply all materials, equipment and labor required to maintain flow in the existing water and wastewater systems, handle system flows, construct and maintain all temporary connections and diversions and construct the permanent connections to the new system as shown on the Drawings and as directed by the Engineer and/or Owner.

B. The Contractor shall supply all materials, equipment and labor required for plugging existing lines, all work on existing manholes (including all work and materials required to reshape existing manhole inverts with concrete and connecting new waterlines to existing manholes) and all additional work required.

C. Should damage of any kind occur to the existing water line or sewer line, the Contractor shall at his/her own expense, as part of the work under this item, make repairs to the satisfaction of the Engineer and/or Owner.

D. The Contractor shall notify the Engineer and/or Owner immediately of any discrepancies in elevations of existing water lines, sewer lines and manholes between those shown on the Drawings and those established during construction in order that the Engineer can make the necessary modifications.

E. All new pipes for connection shall conform to the pipe specifications in Division 15.

1.02 RELATED WORK

Excavation and backfill are included in Section 02300.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 HANDLING WATER OR WASTEWATER FLOWS

A. The Contractor shall provide all labor, equipment and materials necessary to maintain existing flows, including temporary diversions and all pumping of water or wastewater that may be required and shall immediately cart away and remove all offensive matter at his/her own expense.

B. All procedures for maintaining flows must meet the approval of the Engineer and/or Owner and the Contractor shall be required to submit to the Engineer and/or Owner, for approval, a detailed written plan of all methods of flow maintenance ten days in advance of flow interruption.

END OF SECTION

SECTION 02921

TECHNICAL SPECIFICATIONS – LOAMING AND SEEDING

PART 1: GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to place topsoil, finish grade, apply fertilizer, hydraulically apply seed and mulch or sod and maintain all seeded areas as shown on the Drawings and as specified herein, including all areas disturbed by the Contractor.

1.02 RELATED WORK

A. Site preparation including clearing, grubbing and stripping is included in Section 02200.

B. Earthwork including trenching, backfilling, compaction and grading including the stockpiling of topsoil is included in Section 02300.

1.03 SUBMITTALS

Samples of all materials shall be submitted for inspection and acceptance upon Engineer's and/or Owner's request.

PART 2: PRODUCTS

2.01 MATERIALS

A. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality and shall be obtained from a well drained site that is free of flooding. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, clay, peat and other extraneous matter and shall not be delivered to the site or used while in a frozen or muddy condition. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than 3 percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius. The topsoil shall meet the following mechanical analysis:

	Percentage Finer
1-in screed opening	100
No. 10 mesh	95-100
No. 270 mesh	35-75
0.002 mm*	5-25

*Clay size fraction determined by pipette or hydrometer analysis.

At least ten days prior to anticipated start of topsoiling operations a one pint sample of topsoil material shall be delivered to the Owner for testing and approval. Based on tests performed by the Engineer and/or Owner, the topsoil shall be identified as acceptable, acceptable with certain fertilizer and limestone applications or unacceptable. If the topsoil is found acceptable the fertilizer and lime requirements will be as specified or as recommended by the Engineer and/or Owner. If the topsoil is found unacceptable, the Contractor shall be responsible for identifying another source of topsoil and shall incur all expenses associated with testing additional samples. All topsoil incorporated into the site work shall match the sample provided to the Engineer for testing. Topsoil stockpiled under other Sections of this Division may be used subject to the testing and approval outlined above. Contractor will be responsible for screening stockpiled topsoil and providing additional topsoil as required at his/her own expense.

B. Fertilizer shall be commercial mixed free granules or pelleted fertilizer, 10-20-10 (N-P205-K20) grade for lawn and naturalized areas. Fertilizer shall be delivered to the site in original unopened containers each showing the manufacturer's guaranteed analysis confirming to applicable state fertilizer laws. At least 40 percent of the nitrogen in the fertilizer used shall be in slowly available (organic) form.

C. Lime shall be ground limestone containing not less than 85 percent calcium and magnesium carbonates and be ground to such fineness that at least 50 percent shall pass a 100-mesh sieve and at least 90 percent shall pass a 20-mesh sieve.

D. Seed shall be labeled in accordance with USDA Rules and Regulations under the Federal Seed Act and applicable State seed laws. Seed shall be furnished in sealed bags or containers bearing the date of the last germination, which date shall be within a period of 6 months prior to commencement of planting operations. Seed shall be from same of previous year's crop; and shall have a weed content of not more than 1 percent and contain no noxious weeds. The seed mixtures shall consist of seed proportioned by weight as follows:

Broadcast Seeding

1. From September 15 to March 1, seeding shall be with a combination of 2 pounds per 1,000 s.f. of unhulled Bermuda and 7 pounds per 1,000 s.f. of Winter Rye with a minimum purity of 95% and with 90% germination.
2. From March 2 to September 14, seeding shall be 2 pounds per 1,000 s.f. of hulled Bermuda with a minimum purity of 95% and with 85% germination.

Hydraulic Seeding

1. From September 15 to March 1, seeding shall be with a combination of 1 pound per 1,000 s.f. of unhulled Bermuda and 7 pounds per 1,000 s.f. of Winter Rye with a minimum purity of 95% and with 90% germination.
2. From March 2 to September 14, seeding shall be 1 pound per 1,000 s.f. of hulled Bermuda with a minimum purity of 95% and with 85% germination.

E. The seed shall be furnished and delivered premixed in the proportions specified above. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturers for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.

F. Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis.

G. Contractor may revegetate site with a bermuda sod instead of seed.

H. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content and not contain in excess of 10 percent moisture.

I. Erosion control blanket installed in all drainage swales and ditches as directed by the Engineer shall be AMXCO Curlex Blanket as manufactured by American Excelsior Company, Arlington, TX.

PART 3: EXECUTION

3.01 APPLICATION

A. Unless otherwise shown on the Drawings, topsoil shall be placed to a minimum compacted depth of 6-in on all parts of the site not covered with structures, pavement, or existing woodland.

B. For all areas to be seeded:

1. Fertilizer (10-20-10) shall be applied at the rate of thirty pounds per 1,000 square feet or as determined by the soil test.
2. Seed shall be applied at the rate of five pounds per 1,000 square feet.
3. Fiber mulch shall be applied at the rate of forty pounds per 1,000 square feet.

C. After the topsoil is placed and before it is raked to true lines and rolled, limestone shall be spread evenly over the loam surface and thoroughly incorporated by heavy raking to at least one half the depth of topsoil.

D. The application of fertilizer may be performed hydraulically in one operation with hydroseeding and fiber mulching. The Contractor is responsible for cleaning all structures and paved areas of unwanted deposits of the hydroseeded mixture.

3.02 INSTALLATION

A. Previously established grades, as shown on Drawings shall be maintained in a true and even condition.

B. Subgrade shall be prepared by tilling prior to placement of topsoil to obtain a more satisfactory bond between the two layers. Tillage operations shall be across the slope. Tillage shall not take place on slopes steeper than 2 horizontal to 1 vertical or where tillage equipment cannot be operated. Tillage shall be accomplished by disking or harrowing to a depth of 9-in parallel to contours. Tillage shall not be performed when the subgrade is frozen, excessively wet, extremely dry or in other conditions which would not permit tillage. The subgrade shall be raked and all rubbish, sticks, roots and stones larger than 2-in shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam.

C. Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.

D. After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All stiff clods, lumps, roots, litter and other foreign material shall be removed from the loamed area and disposed of by the Contractor. The areas shall also be free of smaller stones, in excessive quantities, as determined by the Engineer. The whole surface shall then be rolled with a hand roller weighing not more than 100 pounds per foot of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.

E. Seeding, sodding, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by the Engineer. The Contractor shall not hydroseed during high winds.

F. Schedules for seeding and fertilizing must be submitted to the Engineer for approval prior to the work. Seeding as specified herein shall be accomplished between the period of March 1 to June 1. Seeding during the period from October 1 to March 1 shall only be undertaken upon approval of the Engineer. Seeding during the period from June 1 to October 1 shall only be performed if irrigation is provided.

G. Seeding or sodding shall be done within ten days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quality to the specified rates. Prior to the start of work, the Contractor shall furnish the Engineer with a certified statement as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Contractor's hydroseeder. Upon completion of seeding operations, the Contractor shall furnish the Engineer with a certified statement on the actual quantity of solution applied.

H. In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainage ways, the Contractor shall carry out seeding and mulching as soon as he/she has satisfactorily completed a unit or portion of the project those areas by what ever means necessary as approved by the Engineer and shall be responsible for prevention of siltation in the areas beyond the limit of work.

I. Erosion control blankets shall be installed in all drainage swales and ditches as directed by the Engineer in accordance manufacturer's instructions. The area to be covered shall be properly prepared, fertilized and seeded before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. The blankets shall be applied in the direction of water flow, butted snugly at the ends and side and stapled. Blankets shall be placed a minimum of three rows (of four foot) wide (total 12-ft width) within the drainage swale/ditch and stapled together in accordance with manufacturer's instructions. The staples shall be made of wire, .091-in. in diameter or greater, "U" shaped with legs 6-in. in length and a 1-in crown. The staples shall be driven vertically into the ground, spaced approximately two linear yards apart, on each side and one row in the center alternately spaced between each side. Adjoining blankets shall not be overlapped and shall utilize a common row of staples to attach.

J. When newly graded subgrade areas cannot be topsoiled and seeded because of season or weather conditions and will remain exposed for more than 30 days, the Contractor shall protect those areas against erosion and washouts by whatever means necessary such as straw applied with a tar tack, wood chips or by other measures as approved by the Engineer. Prior to application of topsoil, any such materials applied for erosion control shall be thoroughly incorporated into the subgrade by discing. Fertilizer shall be applied prior to spreading of topsoil.

K. On slopes, the Contractor shall provide against washouts by an approved method. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

3.03 MAINTENANCE AND PROVISIONAL ACCEPTANCE

A. The contractor shall keep all seeded areas watered, lawn areas mowed and in good condition, reseeding all seeded areas if and when necessary until a good, healthy, uniform growth is established over the entire area seeded and shall maintain all seeded areas in an approved condition until provisional acceptance.

B. The Engineer and/or Owner will inspect all work for provisional acceptance at the end of the ten week maintenance period, upon the written request of the contractor received at least ten days before the anticipated date of inspection. The maintenance period must occur during the growing season between March 15 and October 1 and shall include a minimum of three mowings.

C. A satisfactory stand will be defined as a section of turf of 10,000 square feet or larger that has:

1. No bare spots larger than three square feet.
2. No more than ten percent of total area with bare spots larger than one square foot.
3. Not more than fifteen percent of total area with bare spots larger than 6-in square.

D. After the inspection has occurred but prior to provisional acceptance, a soil test shall be performed to determine if additional soil fertilization should occur. If necessary additional fertilizer not to exceed 30 lbs per 1000 sq. ft. of 20-10-10 shall be applied as directed by the Engineer.

E. The Contractor shall furnish full and complete written instructions for maintenance of the seeded areas to the Owner at the time of provisional acceptance.

F. The inspection by the Engineer and/or Owner will determine whether maintenance shall continue in any area or manner.

G. After all necessary corrective work and clean-up has been completed, and maintenance instructions have been received by the Owner, the Engineer and/or Owner will certify in writing the provisional acceptance of the lawn areas. The Contractor's responsibility for maintenance of lawns, or parts of lawns shall cease on receipt of provisional acceptance.

3.04 GUARANTEE PERIOD AND FINAL ACCEPTANCE

A. All seeded areas shall be guaranteed by the contractor for not less than one full year from the time of provisional acceptance.

B. At the end of the guarantee period, inspection will be made by the Engineer and/or Owner upon written request submitted by the Contractor at least ten days before the anticipated date. Seeded areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer and/or Owner, shall be renovated, reseeded and maintained meeting all requirements as specified herein.

C. After all necessary corrective work has been completed, the Engineer and/or Owner shall certify in writing the final acceptance of the seeded areas.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

Design, fabrication, erection, and stripping of formwork for cast-in-place concrete, including shoring, reshoring, falsework, bracing, bulkheads, keys, blockouts, sleeves, pockets, and accessories. Erection shall include installation of items furnished by other trades in formwork.

1.02 RELATED SECTIONS

A. Section 01450 – Quality Control
B. Division 2
C. Section 05311 – Steel Floor Deck
D. Section 05313 – Steel Roof Deck

1.03 REFERENCES

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
B. ACI 301 - Specifications for Structural Concrete for Buildings.
C. ACI 347 - Guide to Formwork for Concrete.
D. ACI SP-4 - Formwork for Concrete.

1.04 QUALITY ASSURANCE

A. Construct and erect concrete formwork in accordance with ACI 117, 301 and 347.

B. Forms, shores, reshores, falsework, bracing, and other temporary supports shall be designed by the Contractor to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

C. The Contractor shall be responsible for determining when temporary supports and bracing may be safely removed, but in no case shall the curing time before form removal be less than specified herein.

1.05 TOLERANCES

A. Construct formwork, deposit and finish concrete as required to provide surfaces complying with the following tolerances (allowable variation):

1. Vertical alignment:

i. Lines, surfaces and arises less than 100 feet in height - 1 inch.

ii. Control joints, wall corners, vertical grooves and other lines exposed to view – 1/4 inch in 10 feet.

B. Lateral alignment:

1. Members - 1 inch.

2. Centerline of openings 12 inches or smaller and edge location of larger openings in slabs - 1/2 inch.

3. Sawcuts, joints, and weakened plane embedments in slabs - 3/4 inch.

C. Level alignment:

1. Elevation of top surfaces of slabs - 3/8 inch in any 20 ft. ¾ inch maximum for total length.

2. Lintels, sills, parapets, horizontal grooves and other lines exposed to view – ½ inch.

D. Cross-sectional dimensions: Overall dimensions of beams, joists, and columns and thickness of walls and slabs.

1. 12 inch dimension or less - plus 3/8 inch to minus 1/4 inch.

2. Greater than 12 inch to 3 foot dimension - plus 1/2 inch to minus 3/8 inch.

3. Greater than 3 foot dimension - plus 1 inch to minus 3/4 inch.

E. Relative Alignment:

1. Offsets between pieces of formwork facing material:

i. Class A - Architecturally or prominently exposed surfaces – 1/8 inch gradual or abrupt.

ii. Class B – Surfaces to receive plaster or stucco – ¼ inch gradual or abrupt.

iii. Class C – Exposed surfaces in generally unfinished spaces – ¼ inch abrupt, ½ inch gradual.

iv. Class D - Concealed surfaces - 1 inch gradual or abrupt.

2. Grooves: Specified width 2 inches or less - 1/8 inch.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.07 SUBMITTALS

A. Submit in accordance with Section 01330 – Submittal Procedures.

B. Submittals for Review:

1. Shop drawings for fabrication and erection of forms for concrete surfaces architecturally exposed to view. Show general construction of forms, including jointing and special formed joints or reveals, location and pattern of form tie placement, inserts and anchorages and other items which visually affect exposed concrete.

2. Samples of chamfer strips, form liners, form ties and other items which visually affect exposed concrete.

PART 2: PRODUCTS

2.01 FORM MATERIALS

A. Forms for Unexposed Concrete:

1. Construct formwork of plywood, lumber, metal, or other acceptable material. Lumber shall be dressed on at least two edges and one side for tight fit.

B. Forms for Exposed Concrete:

1. Construct formwork with plywood, metal, or other panel type materials designed to provide continuous straight and smooth as-cast surfaces with minimum number of joints. Joints shall be made tight and shall be backed so that edges of adjoining formwork shall remain flush and true. Joints shall be vertical or horizontal, unless noted otherwise.

2. Wood forms shall be constructed of 3/4 inch, APA B-B Plyform, Class 1, Exterior conforming to PS-1. Panels shall be mill oiled and all edges shall be sealed.

2.02 FORMWORK ACCESSORIES

A. Form Ties: Removable or snap-off metal of adjustable length; cone type; one inch break back dimension; free of defects that will leave holes larger than one inch diameter in concrete surface.

B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

C. Rustications, Bevels and Chamfers: Steel, polyvinyl chloride, or milled and sealed wood of size and shape shown on the Drawings.

D. Protection Board: For use over void forms under structural slabs. Hard-pressed cellulose fiber board, 1/8 inch minimum thickness.

E. Flashing Reglets: Galvanized steel; same gauge as flashing metal but not less than 26 gauge; longest possible lengths; release tape sealed slots; with alignment splines for joints; securable to concrete formwork.

F. Sleeves and Blockouts: Formed with galvanized metal, galvanized pipe, polyvinyl chloride pipe, fiber tubes, or wood.

G. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

PART 3: EXECUTION

3.1 FORM CONSTRUCTION

A. General: Construct forms to the sizes, shapes, lines and dimensions shown on the Drawings. Provide for openings, offsets, keyways, rustications, reglets, chamfers, blockouts, bulkheads, anchorages, inserts, and other features as required.

B. Fabricate formwork for easy removal without hammering or prying against concrete surfaces. Do not damage cast concrete surfaces during formwork removal.

C. Kerf wood inserts for ease of removal.

D. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

E. Fit forms placed for successive concrete placements for continuous surfaces, to accurate alignment, and within allowable tolerances.

F. Minimize form joints. Symmetrically align joints and make watertight to prevent leakage of mortar.

G. Form intersecting planes to provide true corners with edge grain of plywood not exposed as form for concrete.

H. Erect, support, brace, and maintain falsework to safely support all applied loads until such loads can be supported by the concrete structure.

I. Construct formwork to cambers shown or specified on the Drawings to allow for structural deflection of the hardened concrete. Provide additional elevation or camber in formwork as required for anticipated formwork deflections due to weight and pressures of concrete and construction loads.

J. Forms for Exposed Concrete:

1. Drill forms from the contact face to the outside to suit form ties used. Do not splinter forms by driving ties through improperly prepared holes.

2. Provide sharp, clean corners at intersecting planes without visible edges or offsets. Back joints with extra studs or girts if required to maintain corners.

3. Provide extra studs, girts, walers, and bracing to prevent bowing of forms.

4. Form shapes, recesses and projections with smooth finish materials, and install in forms with sealed joints.

5. Locate form ties in level horizontal rows, plumbed vertically, and in symmetrical arrangements, unless noted otherwise.

6. Patches of holes and defects in formwork shall be indistinguishable from surrounding form surfaces.

K. Corner Treatment: Form exposed corners of beams, walls and columns to produce chamfered, smooth, solid, unbroken lines, unless noted otherwise. Extend terminal edges of chamfers to required limits and miter at changes in direction.

1. Form chamfers with 3/4 inch by 3/4 inch strips, unless noted otherwise.
2. Unexposed corners may be formed square or chamfered.

L. Foundation Elements: The sides of all below grade portions of beams, pier caps, walls, and columns shall be formed straight and to the lines and grades specified.

3.2 APPLICATION OF FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.

B. Do not apply form release agent where concrete surfaces are scheduled to receive subsequent finishes which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.3 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for work embedded in or passing through concrete. In case of conflict with reinforcing steel or structural embeds, consult Architect before placement.

B. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.4 FORM REMOVAL

A. Formwork not supporting concrete, such as side forms for beams, walls, and columns, may be removed after cumulatively curing at not less than 50 degrees Fahrenheit (10 degrees Celsius) for 12 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal, and provided curing and protection operations are maintained.

B. Formwork supporting conventionally reinforced concrete shall not be removed until concrete has attained 100 percent of its specified 28 day compressive strength as established by tests of field cured cylinders. In the absence of cylinder tests, supporting formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span.

C. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems which allow form removal without disturbing shores, but only after the Contractor has demonstrated to the satisfaction of the Engineer that the early removal of forms will not cause excessive sag, distortion or damage to the concrete elements.

D. Wood forms shall be completely removed. Provide temporary openings if required.

E. Provide adequate methods of curing and thermal protection of exposed concrete if forms are removed prior to completion of specified curing time.

F. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.

3.5 REUSE OF FORMS

A. Clean and repair surfaces of forms to be reused. Damaged forming material shall not be replaced and shall not be used in construction.
B. Apply form release agent to concrete contact surfaces prior to each reuse of the forms.

END OF SECTION

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PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor and materials required to fabricate, deliver and install reinforcement and embedded metal assemblies for cast-in-place concrete, including steel bars, welded steel wire fabric, ties and supports.

1.02 RELATED SECTIONS

A. Section 01330 – Submittal Procedures
B. Section 01450 - Quality Control
C. Section 03300 - Cast-In-Place Concrete

1.03 REFERENCES

A. Comply with the provisions of the following codes and standards, unless noted otherwise:

1. ACI 301 - Specifications for Structural Concrete for Buildings.
2. ACI 315 - Details and Detailing of Concrete Reinforcement.
3. CRSI - Manual of Practice.
4. CRSI 63 - Recommended Practice for Placing Reinforcing Bars.
5. CRSI 65 - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

1.04 QUALITY ASSURANCE

A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, and Documents 63 and 65.

B. The latest adopted edition of all standards referenced in this Section shall apply unless noted otherwise. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.05 SUBMITTALS

A. Submittals for review:

1. Shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315, “Details and Detailing of Concrete Reinforcement”.

2. Indicate sizes, spacings locations and quantities of reinforcing steel, wire fabric, bending diagrams, splicing, stirrup spacing, supporting and spacing devices and assemblies as required for fabrication and placement of reinforcement.

PART 2: PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel: ASTM A615, grades as indicated on the drawings.

B. Welded Steel Wire Fabric: ASTM A185, "Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement." Furnish in flat sheets, not rolls.

2.02 ACCESSORIES

A. Tie Wire: Minimum 16 gage, annealed type.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete in conformance with CRSI recommendations.

C. For slabs on grade, provide sand plates, horizontal runners, or precast concrete blocks on bottom where base material will not support chair legs or where vapor barrier has been specified.

2.03 EMBEDDED METAL ASSEMBLIES

A. Steel Shapes and Plates: Conform to ASTM A36

B. Deformed Bar Anchors: Welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division.

C. Headed Studs: Welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division.

D. Reinforcing Bars to be welded: ASTM A706.

2.04 INSERTS

A. Provide metal inserts required for anchorage of materials or equipment to concrete construction where not supplied by other trades.

2.05 FABRICATION OF REINFORCEMENT

A. Fabricate with tolerances complying with CRSI “Manual of Standard Practice.”

2.06 FABRICATION OF EMBEDDED METAL ASSEMBLIES

A. Fabricate metal assemblies in the shop. Holes shall be made by drilling or punching. Holes shall not be made by or enlarged by burning. Welding shall be in accordance with AWS D1.1.

B. Welding of deformed bar anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division.

PART 3: EXECUTION

3.01 INSTALLATION

A. Before placing concrete, clean reinforcement to remove soil, loose rust, mill scale, ice, or other materials which reduce bond with concrete.

B. Accurately position reinforcement and secure reinforcement against displacement by construction or concrete placement operations.

C. Place reinforcement to obtain minimum concrete cover specified. Tie bars and bar supports together with tie wire to hold reinforcement in position. Set tie wires so that the twisted ends are directed away from exposed concrete surfaces.

D. Installation tolerances:

1. Top and bottom bars in slabs, tilt-up wall panels, girders, beams and joists:
   i. Members 10" deep (or thick) or less: ±3/8"

ii. Members more than 8" deep (or thick): ±1/2"

2. Concrete Cover to Formed or Finished Surfaces: ±3/8" for members 10" deep (or thick) or less; ±1/2" for members over 10" deep (or thick), except that tolerance for cover shall not exceed 1/3 of the specified cover.

E. Concrete Cover:

1. Reinforcing in structural elements deposited against the ground: 3”

2. Reinforcing in formed beams, columns and girders: 1 ½”

3. Exterior faces of wall panels: 1 3/4”

4. Interior faces of wall panels: 1”

5. Top surface of slabs: ¾”

6. Bottom surfaces of slabs-on-grade cast over vapor barriers and other formed surfaces exposed to weather or in contact with ground: 2”

7. Bottom surfaces of slabs above ground: ¾”

F. Splices: Provide standard reinforcement splices by lapping and tying ends. Comply with ACI 318 for minimum lap of spliced bars where not specified on the documents. No. 14 and 18 bars shall not be lap spliced.

END OF SECTION

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PART 1: GENERAL

A. All materials and procedures used in cast-in-place concrete construction shall comply with the requirements of the authorities having jurisdiction over this project.

1.01 WORK INCLUDED

A. Furnish all labor and materials required to perform the following:
   1. Cast-in-place concrete.
   2. Concrete mix designs.

1.02 RELATED SECTIONS

A. Section 01330 – Submittal Procedures
B. Section 01450 – Quality Control
C. Section 03105 - Concrete Formwork
D. Section 03200 - Concrete Reinforcement
E. Section 03290 – Joints in Concrete Structures
F. Section 03351 - Concrete Floor Finishing

1.03 REFERENCES

A. The latest adopted edition of all standards referenced in this section shall apply.

   1. ACI 301 - Specifications for Structural Concrete for Buildings

   2. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete

   3. ACI 305 - Hot Weather Concreting

   4. ACI 306 - Cold Weather Concreting

   5. ACI 308 - Standard Practice for Curing Concrete

   6. ACI 309 - Recommended Practice for Consolidation of Concrete

   7. ACI 318 - Building Code Requirements for Reinforced Concrete

   8. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

   9. ACI 212.2 - Guide for Use of Admixtures in Concrete

   10. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete

   11. ACI 304.2 - Placing Concrete by Pumping Methods

   12. ASTM Standards in Building Codes (as referenced)

1.04 QUALITY ASSURANCE

A. Refer to Division 1 for required laboratory testing and inspection.

B. Trial Batches: Contractor shall provide and pay for qualification of proposed materials and the establishment of mix designs in accordance with ACI 301.

C. Contractor's responsibilities to testing laboratory:

1. Furnish labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.

2. Advise the testing agency sufficiently in advance of operations to allow testing agency adequate time for the assignment of testing personnel.

3. Furnish and maintain adequate facilities for the proper curing of concrete test specimens on the project site in accordance with ASTM C31.

D. Evaluation and Acceptance of Placed Concrete:

1. The strength level will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.

2. When the strength level of the concrete for any portion of the structure, as indicated by cylinder tests, falls below the specified requirements, the Contractor shall provide improved curing conditions and/or adjustments to the mix design as required to obtain the required strength. If the average strength of the laboratory control cylinders falls so low as to be deemed unacceptable, the Contractor shall follow the core test procedures set forth in ACI 301. Locations of core tests shall be approved by the Engineer. Core sampling and testing shall be at the Contractor's expense.

a. If the results of the core tests indicate that the strength of the structure is inadequate, any replacement, testing, or strengthening as may be ordered by the Architect shall be provided by the Contractor without cost to the Owner.

1.05 SUBMITTALS

A. Submit in accordance with Section 01330 – Submittal Procedures.

B. Submit proposed mix designs with independent testing laboratory documentation of average strength results (see following sections for additional concrete mix design submittal requirements). Average strength results shall meet the requirements of ACI 301. Mix designs shall be submitted for review.

C. Submit manufacturer's data showing compliance with specifications for the following products:

1. Curing compounds
2. Sealer

1.06 CONCRETE MIX DESIGNS

A. General: The Contractor is responsible for ensuring that the concrete is properly placed, finished, cured and meets the quality and performance requirements of this Section. It is understood that adjustments to mix designs may be necessary during the course of the Project. However, adjustments should be anticipated. Therefore, approved mix designs with anticipated adjustments must be submitted for review as normally required for proposed concrete mix design submittals.

B. Selection of Proportions: Unless noted otherwise, proportions of ingredients for concrete mixes shall be determined (designed) by an independent testing laboratory or qualified concrete supplier in accordance with ACI 301. If a testing laboratory provides concrete mix designs, it shall be selected by the Contractor, approved by the Architect, and paid by the Contractor.

C. Fly ash may be used as a substitute for cement: 20 percent by volume of cement replacement minimum, 30 percent by volume maximum.

D. Concrete strengths:

i. Sidewalks: As specified on the drawings
ii. Tank Foundation: As designed and specified by the Tank Manufacturer

E. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. If a suitable record of strength tests is not available, proportions shall be selected on the basis of laboratory trial batches to produce an average strength greater than the specified strength f'c by the amount defined in ACI 301.

F. Maximum size of coarse aggregate shall not be more than 1.5" nor more than one-fifth of the narrowest dimension between sides of forms, one-third of the depth of slabs, nor three-fourths of the minimum clear spacing between reinforcing bars. Maximum size of coarse aggregate in concrete to be cast on metal deck shall not exceed ¾".

G. All proposed concrete mix designs shall include the following information:

1. Proportions of cement, fly ash, fine and coarse aggregates, and water.

2. Maximum water/cement ratio, design strength, maximum slump, and air content.

3. Type of cement along with ASTM C150 Cement Mill Test Certificates. Type of fly ash along with ASTM C 618 Fly Ash Test Certificates.

4. Fine and coarse aggregate gradation, including maximum size of coarse aggregates.

5. Type and quantities of all admixtures.

H. Water/cementitious materials ratio, W/CM, of concrete used in the construction of foundation mats or slabs on or above ground shall not exceed 0.53.

PART 2: PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I.

B. Normal Weight Aggregates: ASTM C33. Provide aggregates from a single source for all exposed concrete. Do not use any aggregates that may deteriorate over time in a continually wet environment or that may cause spalling of concrete at exposed

surfaces.

C. Water: Potable.

2.02 ADMIXTURES

A. General: Do not use admixtures which have not been incorporated and tested in accepted mixes. Set controlling admixtures shall comply with the applicable standards of ASTM C494.

B. Admixtures containing more than 0.05 percent calcium chloride ions shall not be used in the concrete mix.

C. Fly ash and fly ash source shall conform to the State of Texas Department of Highways and Public Transportation (TxDOT) Materials Specification D-9-8900, "Fly Ash".

2.03 CURING MATERIALS

A. General: Volatile organic compound (VOC) rating shall meet the applicable environmental regulations of the authorities having jurisdiction over this project.

B. Material providing water retention not exceeding loss of 0.055 gm/cm2 in 72 hours when used at a coverage of 200 square feet per gallon and tested in accordance with ASTM C156.

1. Curing compound shall conform to the requirements of ASTM C309. Curing compound used on exposed concrete shall be non-discoloring and shall not darken or yellow with age. Acceptable manufacturers are:
   a. Master Builders
   b. W.R. Meadows
   c. Dayton Superior
   d. Euclid Chemical
   e. Sonneborn

2.04 MISCELLANEOUS MATERIALS

A. Bonding Agent: Two component, moisture insensitive, extended pot life epoxy bonding agent equal to "Sikadur 32 Hi-Mod LPL", by the Sika Corporation.

B. Anchoring Cement for grouting anchor bolts and dowels: "Super Por-Rok" Exterior Anchoring Cement by the Minwax Construction Products.

C. Drilled anchor bolts: Selected for the appropriate use and installed in accordance with manufacturer's recommendations. Shall be from one of the following:

1. Wej-It Bolt, Wej-It Corporation
2. Kwik Bolt II, Hilti Fastening Systems
3. Trubolt, Ramset Fastening Systems

D. Non-shrink Grout: Premixed cementitious compound containing non-metallic aggregate, and capable of developing minimum compressive strength of 5000 in 28 days. Grout shall conform to ASTM C1107, Grade B when tested at fluid consistency equal to "Euco NS" by the Euclid Chemical Company or "Masterflow 713" by Master Builders.

E. Waterstops: See Specification Section 03290.

PART 3 EXECUTION

3.01 PRODUCTION OF CONCRETE

A. Concrete shall not be mixed for placing until the mix designs and corresponding strength tests for each class of concrete have been accepted by the Architect for use on the project. Compressive strength shall be as noted on the drawings.

B. Concrete shall be produced and supplied to the jobsite in accordance with ASTM C94.

C. Admixtures: Shall be introduced in quantities and according to methods recommended by the manufacturer of the admixture.

D. Use accelerating admixtures in cold weather only when approved by the Engineer. Use of admixtures will not relax cold weather placement requirements.

E. Use set-retarding admixtures during hot weather only when approved by the Engineer.

F. Fly ash shall not be used in combination with Type IP cement.

G. When approved by the laboratory inspector, water may be added to the truck at the jobsite to adjust the slump, but the water content shall not exceed the maximum specified water/cement ratio for the mix (design).

H. Mixing time: Unless otherwise approved by the laboratory inspector, discharge shall be completed within 90 minutes after the introduction of water to the cement.

3.02 PLACING CONCRETE

A. Before placing concrete, Contractor shall ensure that formwork, reinforcing steel and all other embedded items have been properly installed and tied in.

B. Contractor shall schedule and coordinate the delivery of concrete to ensure its continuous placement. Contractor shall submit proposed construction joint locations for review and approval by the Architect where necessary to properly manage concrete placement.

C. Contractor shall coordinate concrete finishing and installation of control joints with concrete placement operations as necessary to meet project requirements.

D. All work shall be in accordance with ACI 304.

E. Sprinkle subgrades sufficiently to control water loss from concrete.

F. Concrete shall not be placed on frozen ground.

G. Anchor bolts: Install anchor bolts as required. Use templates to set anchor bolts and secure into position before placing concrete. Do not stab anchor bolts into concrete. Anchor bolts shall be placed within the following tolerances measured after concrete placement:

1. Spacing within a bolt group: 1/8"
2. Location of bolt group (center): 1/2"
3. Rotation of bolt group: 5 degrees

4. Bolt projection: ± 3/8"

H. Deposit concrete in such manner that no concrete is placed on concrete that has hardened sufficiently to cause the formation of seams (or other planes of weakness).

I. Deposit concrete as necessary to avoid segregation.

J. Prepare previously placed concrete by cleaning with steel brush and applying water or bonding agent. Apply bonding agent in accordance with manufacturer's instructions.

K. Construction Joints: Construction Joints shall be placed only in positions approved by the Engineer or as indicated on the drawings. Should construction joints prove to be absolutely unavoidable, the joints shall be located at or near midspan of the beams, joists, or slabs.

Exposed concrete face of construction joints shall be kept continuously wet from time of initial set until pouring of new concrete against it. The contact surface shall be thoroughly cleaned by chipping the entire surface not earlier than 8 days after the first pour or jet washing the surface, not less than 3-1/2 nor more than 6-1/2 hours after the concrete is placed, or by sandblasting. The joint surface shall consist of clean aggregate solidly embedded in the mortar matrix. All wash water shall be entirely removed from the surface. All construction joints in waterbearing tanks, except joints above water level, shall have "waterstops" installed; also, any additional ones shown on drawings. All waterstop splices, joints, corners, or intersections shall be welded or molded.

Watertight concrete is required for all submerged structures and waterbearing structures. Any cracks or imperfections developing at any point shall be repaired to the satisfaction of the Engineer.

L. Concrete on Metal Deck: Before placing concrete on metal deck, clean surfaces to remove all dirt and debris.

1. Deflection of deck and/or supporting steel structure will take place when concrete is poured. The minimum thickness of concrete shall be provided and the top surfaces of slabs shall be placed within the specified tolerances. Where there is residual camber in steel beams, finish the concrete surface to follow the camber of the beam, but finish the concrete so that the surface does not vary by more than 1/4" from one beam to the adjacent beam, nor by more than 1/2" total for the entire floor. No adjustment shall be made to the contract price for additional concrete required because of deflection of deck or steel or due to differential camber.

M. Weather Conditions:

1. Cold weather: Temperature of concrete delivered at the jobsite shall conform to the following minimum:

Air Temperature	Concrete Temperature
30 to 45 degrees F.	55 to 90 degrees F.
0 to 30 degrees F.	60 to 90 degrees F.
Below 0 degrees F.	65 to 90 degrees F.

Water heated to 100 degrees Fahrenheit (minimum) shall be combined with the aggregates before the cement is added. Cement shall not be added to water and aggregates having a temperature greater than 100 degrees Fahrenheit.

a. Comply with ACI 306, "Cold Weather Concreting"

b. When the outdoor temperature is less than 40 degrees Fahrenheit, temperature of concrete shall be maintained at not less than 50 degrees Fahrenheit for the required curing time.

i. Arrangements shall be made before placement to maintain required temperature without injury from excessive heat.

ii. Combustion heaters shall not be used during the first 48 hours without precautions to prevent exposure of concrete and workmen to exhaust gases containing carbon dioxide and carbon monoxide.

2. Hot, Dry and/or Windy Weather: Temperature of concrete delivered to the jobsite shall not exceed 90 degrees Fahrenheit. Ingredients shall be cooled before mixing to prevent concrete temperature in excess of 95 degrees Fahrenheit.

a. Comply with ACI 305, "Hot Weather Concreting"

b. Provisions shall be made for windbreaks, shading, fog spraying, sprinkling, or wet cover when necessary.

c. Use specified evaporation retarder to prevent rapid drying of surface during finishing.

3.03 FILL FOR STEEL PAN STAIRS

A. Mix one part Portland Cement and two parts crushed stone or gravel passing 3/8" sieve and retained on a 1/8" sieve, measured by volume with only sufficient water to produce a dry consistency for proper placing and finishing.

B. Placing: Place fill and reinforcement in all steel pan treads and landings. Reinforcement shall be 2"x2" by 14 gauge welded wire fabric extending over the area of each tread and landings. Support reinforcement 3/4" above bottom of steel pans. After sufficient hardening of the concrete fill, steel trowel the exposed surface to a smooth finish.

3.04 FINISHING CONCRETE SLAB SURFACES

A. Refer to Specification Section 03351 for finishing requirements for concrete slab surfaces.

3.05 CONCRETE SURFACE REPAIRS

A. Filling Tie Rod and Bolt Holes: Holes resulting from the removal of bolts or tie rods shall be solidly filled with sand-cement grout. All excess mortar at the faces of filled holes shall be struck off flush.

B. Patching Defective Areas: Repair and patch non-structural defective areas in formed surfaces. Where reinforcing steel is exposed and at severe honeycombs, cracks, voids or other defects which may impair structural capacity, notify the Architect prior to attempting to make repairs.

1. Chip out any honeycombs down to solid concrete. Make edges of cuts perpendicular to concrete surface. Thoroughly clean and flush with water and brush coat the area to be patched with specified bonding compound. Trowel sand cement mixture into honeycombs, bubbles and voids larger than 1/4". Strike off and finish flush with surrounding surface.

2. For exposed to view surfaces, blend white and gray or buff Portland cement so that, when dry, the patch will match the color of the surrounding surface. Test blend at inconspicuous locations to verify mixture and color match. Finish surfaces to match texture of surrounding surface.

3.06 CURING AND SEALING

A. Comply with ACI 308 recommendations. Protect all freshly placed concrete from washing by rain, flowing water, etc. Do not allow the concrete to dry out from the time it is deposited in the forms until the expiration of the curing period specified in this Section.

B. Immediately after finishing operations have been completed, concrete surfaces shall be cured by one of the following methods:

1. Cure concrete by keeping exposed concrete surfaces continuously wet with clean water for a period not less than seven days after placing. Each day forms are left in place and exposed concrete surfaces are kept wet will be counted as one day of curing.

2. Contractor may use a non-bituminous liquid curing compound as specified. Curing compound must be coordinated and consistent with subsequent flooring application requirements. When under hot weather concreting conditions (Paragraph 3.2), concrete must be kept wet for a period of 24 hours minimum before applying curing compound. Curing liquid shall be applied in 2 coats (at right angles to one another) at the rate and method of application as recommended by the manufacturer. Patches in architectural concrete shall be cured for seven days. Patches shall be protected from drying to the same extent as the mass of the concrete.

3.07 CLEANUP

A. Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at the Contractor's expense, and in conformity with all of the requirements of the Drawings and Specifications. Removal and replacement of concrete work shall be done in such manner as not to impair the appearance or strength of the structure in any way.

B. Cleaning: Upon completion of the work all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the site. After sweeping floors, wash floors with clean water. Finished concrete surfaces shall be left in a clean condition, satisfactory to the Owner.

END OF SECTION

PART 1: GENERAL

1.1 WORK INCLUDED

A. Finishing slabs-on-grade and monolithic floor slabs.

1.2 RELATED SECTIONS

A. Section 03300 - Cast-in-Place Concrete

1.3 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings
B. ACI 302 - Guide for Concrete Floor and Slab Construction

1.4 QUALITY ASSURANCE

A. Refer to Division 1 for required laboratory testing and inspection.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 FLOOR FINISHING

A. Concrete slabs shall be finished as specified below, within the tolerances specified elsewhere in this Section.

B. Highway straightedges are recommended for use in lieu of bullfloats for all slab placement and finishing operations.

C. Screeding: Immediately after placing, slab shall be vibrated and struck off true by double screeding to the required level, at or below the elevation or grade of the finished slabs as indicated on the Drawings. Vibrators shall not be used to spread the concrete.

D. Float Finish

1. Locations: All concrete surfaces under waterproofing membrane, setting beds for brick, mud-set tile, pavers, or terrazzo, and noncomposite topping slabs.

2. Finishing: After concrete has stiffened sufficiently, and after bleed water has disappeared, the surface shall be floated at least twice to produce a uniform texture with no coarse aggregate visible. Use hand floats or power machine floats, applying sufficient pressure to bring the moisture to the surface.

E. Trowel Finish

1. Locations: Exposed concrete floors not otherwise specified, concrete surfaces under carpets, vinyl tile and thin set tile.

2. Finishing: After concrete has stiffened sufficiently to permit operation and after bleed water has disappeared, hand or machine float the surface. Spreading dry cement to absorb bleed water is not acceptable. Follow immediately by steel troweling at least twice with hand or machine trowels.

F. Broom Finish

1. Locations: Exterior stairs, ramps, walks, curbs, islands, parking and drive areas, and other locations noted on the Drawings.

2. Finishing: Same method as specified for trowel finish, except after initial troweling brush concrete surfaces with soft brush or broom to texture specified by the Architect. Striations shall run in the direction of the drainage slope, if any, unless otherwise specified.

G. Heavy Broom Finish

1. Locations: Ramps steeper than 7 percent slope, loading ramps, and other locations where noted on the Drawings.

2. Finishing: As soon as the surface of the concrete is sufficiently stiffened, wood float the surface to a true plane with no coarse aggregate visible. Ramp surfaces shall be cross jointed with a Goldblatt Groover (Model #06-314-M7) or equal jointing tool for the entire width of the ramps. Space cross joints at 6" intervals. The concrete surfaces between grooves shall be brushed with a stiff fiber brush to produce uniformly striated surfaces parallel with cross jointing. Grooved joints and brushed finish texture shall be approved by the Architect.

3.2 CONCRETE FINISH MEASUREMENT AND TOLERANCES

A. Slabs shall be level within a tolerance of plus or minus 1/4" in 10'-0", not to exceed 3/4" total variation, anywhere on the floor. Levelness shall be checked on a 10'-0" grid using a level after removal of forms.

B. Floor Elevation Tolerance Envelope:

1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:

i. Slabs: +/- 3/4"

ii. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'-0" at any point, up to 3/4" from theoretical elevation at any point.

C. Remedial Measures for Slab Finish Construction not Meeting Specified Tolerances:

1. Application of Remedial Measures. Remedial measures specified herein are required whenever either or both of the following occur:

i. The composite overall values of flatness or levelness of any test section or the entire floor installation measure less than specified values.

ii. Any individual test sample (line of measurements) measures less than the specified absolute minimum flatness or levelness value.

2. Modification of Existing Surface:

    i. If, in the opinion of the Engineer or Owner's representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall immediately undertake the approved repair method.

    ii. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time required to make the repair.

    iii. Repair method(s), at the sole discretion of the Engineer or Owner's Representative, may include grinding (floor stoning), planing, retopping with specified floor leveling compound, or any combination of the above.

    iv. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3. Removal and Replacement:

    i. If, in the opinion of the Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall remove and replace the defective work as directed.

    ii. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.

    iii. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

END OF SECTION

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SECTION 09911

TECHNICAL SPECIFICATIONS - SURFACE PREPARATION AND SHOP PRIME PAINTING

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required for the surface preparation and application of shop primers on ferrous metals, excluding stainless steels, as specified herein.

1.02 RELATED SECTIONS

A. Section 09912 - Finish Painting

1.03 REFERENCE STANDARDS

The revision in effect at the time of bid opening for the following standards shall apply. The applicable provisions of the following standards shall apply as if written here in their entirety.

A. Steel Structures Painting Council (SSPC)

1. SSPC-SP-6 – Surface Preparation specification No. 6 Commercial Blast Cleaning.
2. SSPC-SP-10 – Surface Preparation Specification No. 10 Near White Blast Cleaning.

1.04 SUBMITTALS

A. Submittals shall be in accordance with Section 01330-Submittal Procedures. In addition to these requirements, the following information shall be provided:
   1. Detailed surface preparation procedures.
   2. Manufacturer's specifications and data on the proposed primers.
   3. Application procedures and dry film thicknesses.

PART 2: PRODUCTS

2.01 MATERIALS

A. Compatibility of Coating Systems – Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in Section 09912 for use in the field and which are recommended for use together.

PART 3: EXECUTION

3.01 GENERAL

A. Reference the specific Section for piping, valves and mechanical equipment for surface preparation and priming requirements. If not specified, this Section shall apply.

B. All items to be shop primed shall be blast cleaned as specified for applicable service prior to priming. If, in the opinion of the Engineer, any prime coating that has been improperly applied or if material contrary to these Specifications has been used, that coating shall be removed by abrasive blasting to white metal and reprimed in accordance with these Specifications.

C. Properly protect the shop prime and finish coats against damage from weather or any other cause.

D. A shop finish coat shall be equal in appearance and protection quality to a field applied finish coat. If, in the opinion of the Engineer, a shop finish coat does not give the appearance and protection quality of other work of similar nature, prepare the surfaces and apply the coat or coats of paint as directed by the Engineer to accomplish the desired appearance and protection quality. Submit to the Engineer substantial evidence that the standard finish is compatible with the specified finish coat.

3.02 SURFACE PREPARATION

A. Surfaces shall be dry and free of dust, oil, grease and other foreign materials before priming.

B. Surface preparation shall take place immediately prior to priming.

C. Wherever fabricated equipment is required to be blast cleaned, protect all motors, drives, bearings, gears, etc, from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned.

D. Surfaces shall be prepared according to the Schedule in Part 3.05, utilizing the referenced method as detailed below.

SURFACE PREPARATION METHODS			
Symbol	*Type*	*SSPC Specifications*	*Description*
1	Solvent Cleaning	SSPC-SP-1	Removal of oil, grease, dirt, soil, salts and contaminants by cleaning with solvent, vapor, alkali emulsion or steam.
2	Commercial Blast	SSPC-SP-6	Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.
3	Near-White Blast Cleaning	SSPC-SP-10	Blast cleaning nearly to white enamel cleanliness, until at least 95% of each element of surface area is free of all visible residues.

3.03 NON-PRIMED SURFACES

A. Gears, bearings surfaces, and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to the time of Final Acceptance.

B. Apply approved coating per Manufacturer's recommendations.

3.04 SHOP PRIMING

A. Shop prime in accordance with approved manufacturer's recommendations.

B. All shop prime coats shall be of the correct materials and applied in accordance with these Specifications. Remove any prime coats not in accordance with these Specifications by blast cleaning and apply the specified prime coat at no additional cost to the Owner.

C. Shop primed surfaces shall be cleaned thoroughly and damaged or bare spots prepared as approved and retouched with the specified primer before the application of successive paint coats in the field.

D. Shop priming shall be applied according to the Schedule in Part 3.05.

3.05 SCHEDULE

SURFACE PREPARATION AND SHOP PRIMING SCHEDULE			
Surface	*Surface Preparation*	*Shop Primer*	*Min. Dry Film Thickness (mils)*
Metal Doors, Frames, Windows and Architectural Metal Work	1 or 2	(A)	
Ferrous Metals			
Submerged	3	Tnemec 66-1211 Epoxoline Primer Sherwin Williams Kem Bond Hi Solids Primer Carboline Carboguard 890 Approved Equal	4.5
Non-Submerged	2	Tnemec 66-1211 Epoxoline Primer Sherwin Williams Kem Bond Hi Solids Primer Carboline Carboguard 890 Approved Equal	4
(A) Shop primer to be according to manufacturer's recommendations, but must be compatible with field applied coating. Test for compatibility before applying field coat. If not compatible, remove shop coat to a SSCP-SP-3 or SSCP-SP-6 condition or apply a barrier coat of manufacturer supplied material.			

END OF SECTION

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SECTION 09912

TECHNICAL SPECIFICATIONS - FINISH PAINTING

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work of this section consists of furnishing all materials, labor, equipment, and incidentals required to paint all exposed miscellaneous metal, pipe, fittings, supports, valves, equipment, and all other work obviously required to be painted unless otherwise specified. Minor items omitted in the schedule of work shall be included in the work of this Section where they come within the general intent of the specifications as stated herein.

B. Any painted surface which will be in contact with potable water shall meet the requirements of NSF Standard 61. All pipes are to be painted to conform to the Piping Schedule in Section 15075. Colors are to be consistent throughout.

C. Surface preparation shall conform to Section 09911.

D. The following surfaces or items are not required to be painted:

1. Portions of metal, other than aluminum, embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces which shall be painted before erection. Aluminum to be embedded in or in contact with concrete or masonry shall be coated to prevent electrolysis.
2. Stainless steel.
3. Fiberglass other than piping.
4. Packing glands and other adjustable parts, and nameplates and data plates of mechanical equipment.

E. Specific Specification Sections for shop-coated materials and equipment supersede this Section, unless specifically noted otherwise. If not specified, this Section shall apply.

1.02 RELATED SECTIONS

A. Section 09911 - Surface Preparation and Shop Prime Painting
B. Section 15075 – Mechanical Identification

1.03 REFERENCE STANDARDS

The revision in effect at the time of bid opening for the following standards shall apply. The applicable provisions of the following standards shall apply as if written here in their entirety.

A. American National Standards Institute (ANSI)
   1. ANSI Z53.1 – Safety Color Code for Marking Hazards

B. American Society for Testing and Materials (ASTM)
   1. ASTM C150 – Specification for Portland Cement
   2. ASTM D4258 – Practice for Surface Concrete for Coating

C. National Science Foundation (NSF)
   1. Standard 61

D. Occupational Safety and Health Act (OSHA)
   1. SSPC-SP-1 – Surface Preparation Specifications – Solvent Cleaning
   2. SSPC-SP-2 – Surface Preparation Specifications – Hand Tool Cleaning
   3. SSPC-SP-3 – Surface Preparation Specifications – Power Tool Cleaning
   4. SSPC-SP-6 – Commercial Blast Cleaning
   5. SSPC-SP-10 – Near White Metal Blast Cleaning

1.04 QUALITY ASSURANCE

A. All painting materials shall be fully equal to those manufactured by the Tnemec Company, Inc., Carboline Company and Sherwin-Williams Company. The painting schedule has been prepared on the basis of Tnemec, Carboline and Sherwin-Williams products and recommendations for applications. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following schedule together with sufficient data substantiated by certified tests conducted at no expense to the Owner, to demonstrate its equality to the paint(s) named, is submitted in writing to the Engineer for approval within 30 days after the signing of the Notice to Proceed. The type and number of tests performed shall be subject to the Engineer's approval. Color availability to match those colors specified will also be considered as an important property for equality.

B. All painting materials shall be delivered to the jobsite in unbroken containers, bearing the manufacturer's label.
   1. Manufacturer's name
   2. Name or title of material
   3. Manufacturer's stock number
   4. Date of Manufacture
   5. Federal Specification number, if applicable
   6. Contents by volume, for major pigment and constituents
   7. Color name and number

C. Painting materials shall be used without adulteration and mixed, thinned, and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the Engineer's approval before using.

D. Contractor shall provide finish paints which are guaranteed by the Manufacturer to be compatible with the prime coats used. Contractor shall coordinate to assure that surface preparation and shop applied prime coats are compatible with the finish coats to be used. Refer to Section 09901 for special primers

1.05 SUBMITTALS

A. Submittals shall be in accordance with Section 01330-Submittal Procedures. In addition to these requirements, the following information shall be provided:

   1. Manufacturer's specifications and data on the proposed paint systems.
   2. Detailed preparation, application procedures, and dry film thicknesses for each coating system.
   3. Certification that the systems submitted meet all applicable volatile organic carbon regulations. Equivalent systems are to be submitted at no additional costs to meet any new regulations.
   4. Color cards, including standard and special colors, for initial color selections.
   5. Certification for any coatings that will come in contact with potable water stating compliance with the requirements of NSF 61 and either the U.S. Public Health Service, the U.S. Environmental Protection Agency, or the U.S. Food and Drug Administration for use as a contact surface with potable water.

1.06 SPARE MATERIAL

A. Furnish one unopened gallon can of each type and each color of paint used.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in sealed containers with labels legible and intact.

B. Only acceptable materials for use on this project shall be stored on the project site.

C. Contractor shall comply with all health and fire regulations. Materials shall be stored in a suitable location, and not in any electrical room, instrumentation room, or near motors or other electrical equipment.

D. Work areas shall be approved by the Engineer or Owner for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations.

E. Proper containers outside of the buildings shall be provided and used for painting wastes, and no plumbing fixture shall be used for this purpose.

F. All recommendations of the paint manufacturer in regard to the health and safety of workmen shall be followed.

PART 2: PRODUCTS

2.01 PAINTING SYSTEMS

A. No paint containing lead will be allowed. Oil shall be pure boiled linseed oil.

B. Compatibility of Coating Systems – Contractor shall provide finish paints which are guaranteed by the Manufacturer to be compatible with the prime coats used. Contractor shall coordinate to assure that surface preparation and shop applied prime coats are compatible with the finish coats to be used. Refer to Section 09901 for special primers.

C. All colors will be selected by the Engineer from color charts submitted by the Contractor.

D. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat noted. Some colors will require an additional coat from what is listed to get the proper color coverage.

1. Ferrous metals submerged or subject to splashing:

    a. Tnemec
        2 Coats: N69-Color Hi-Build Epoxoline II (a) (6-8 mils DFT per coat)
    b. Carboline
        2 Coats: 890 (6 mils DFT per coat)
    c. Sherwin-Williams
        2 Coats: Kem Cure Hi-Solids (6 mils DFT per coat)

2. Exterior nonsubmerged ferrous metals:

    a. Tnemec
        1 Coat: N69-Color Hi-Build Epoxoline II (4-6 mils DFT)
        1 Coat: 73- Color Endura-Shield (2-5 mils DFT)
    b. Carboline
        1 Coat: 890 (4 mils DFT)
        1 Coat: 133 H.B. (4 mils DFT)
    c. Sherwin-Williams
        1 Coat: Recoatable Epoxy Primer, B62 Series (5 mils DFT)
        1 Coat: Hi Solids Polyurethane, B65 Series (2.5 mils DFT)

3. Interior nonsubmerged ferrous metals:

    a. Tnemec
        2 Coats: N69-color Hi-Build Epoxoline II (4-6 mils DFT per coat)
    b. Carboline
        2 Coats: 890 (4-6 mils DFT per coat)
    c. Sherwin-Williams
        1 Coat: Recoatable Epoxy Primer, B62 Series (4-6 mils DFT)
        1 Coat: Sher-Tile Hi Solids Epoxy, B67 Series (4 mils DFT)

4. Exterior galvanized, and non-ferrous metal:

    a. Tnemec
        1 Coat: N69-color Hi-Build Epoxoline II (2-3 mils DFT)
        1 Coat: 73-color Endura-Shield (2-3 mils DFT)
    b. Carboline
        1 Coat: 890 (2-3 mils DFT)
        1 Coat: 133 H.B. (3-4 mils DFT)
    c. Sherwin-Williams
        1 Coat: Heavy Duty Epoxy, B67 Series (2-3 mils DFT)
        1 Coat: Hi-Solids Polyurethane, B6t Series (2.5 mils DFT)

5. Interior galvanized, and non-ferrous metals:

    a. Tnemec
        2 Coats: N69-color Hi-Build Epoxoline II (2-3 mils DFT per coat)
    b. Carboline
        2 Coats: 890 (2-3 mils DFT per coat)
    c. Sherwin-Williams
        2 Coats: Heavy Duty Epoxy, B67 Series (2-3 mils DFT per coat)

6. Galvanized and non-ferrous metal submerged or subject to splashing:

    a. Tnemec
        1 Coat: N69-1255 Hi-Build Epoxoline II (3-5 mils DFT)
        1 Coat: N69-Color Hi-Build Epoxoline II (4-6 mils DFT)
    b. Carboline
        2 Coats: 890 (4-6 mils DFT per coat)
    c. Sherwin-Williams
        1 Coat: Kem Cure Hi Solids (4-6 mils DFT)

7. Metal surfaces exposed to temperatures above 250º F to 400º F:

    a. Tnemec
        2 Coats: 39-1261 Silicone Aluminum (0.7 – 1.5 mils DFT per coat)
    b. Carboline
        2 Coats: 1248 (1 – 1.5 mils DFT per coat)
    c. Sherwin-Williams
        2 Coats: Silver Brite Aluminum Paint-B 5952 (1 mils DFT per coat) good up to 400º F

8. Metal surfaces exposed to temperatures above 400º F:

    a. Tnemec
        2 Coats: 39-1261 Silicone Aluminums (1.5 mils DFT per coat)
    b. Carboline
        2 Coats: 4631 (1.5 mils DFT per coat)
    c. Sherwin-Williams
        2 Coats: Kem Hi Temp Aluminum 7.11 (1.5 mils DFT per coat)

9. Insulated Pipe: (Block Insulation: Same systems only 3 coats at 2-3 DFT per coat)

    a. Tnemec
        2 Coats: 6-Color Tneme-cryl (2-3 mils DFT per coat)
    b. Carboline
        2 Coats: 3359 (3 DFT mils per coat)
    c. Sherwin-Williams
        2 Coats: DTM Acrylic Gloss or Semi Gloss, B66 Series (2-3 mils DFT per coat)

10. Aluminum in contact with dissimilar materials:

    a. Tnemec
        2 Coats: N69-Color Hi-Build Epoxoline II (3 mils DFT per coat)
    b. Carboline
        2 Coats: 890 (3 mils DFT per coat)

11. Plastic Piping – Interior: (Sanding mandatory)

    a. Tnemec
        1 Coat: N69-Color Hi-Build Epoxoline II (4-6 mils DFT)
    b. Carboline
        2 Coats: 890 (3 mils DFT per coat)
    c. Sherwin-Williams
        2 Coats: Sher-Tile Hi-Solids Epoxy, B67 Series (3-4 mils DFT per coat)

12. Plastic Piping Exterior (Sanding mandatory)

    a. Tnemec
        1 Coat: N69-Color Hi-Build Epoxoline II (3-4 mils DFT)
        1 Coat: 73-Color Endura Shield (2-3 mils DFT)
    b. Carboline
        1 Coat: 890 (4 mils DFT)
        1 Coat: 133 H.B. (2.5 mils DFT)
    c. Sherwin-Williams
        1 Coat: Macopoxy 920 Pre-Prime, B58 Series (3-4 mils DFT per coat)
        1 Coat: Hi-Solids Polyurethane, B65 Series (2.5 mils DFT)

13. Interior Concrete Block

    a. Tnemec
        1 Coat: Polyamid Masonry Filler, 54-660 (10 mils DFT)
        2 Coats: N69- Color Hi-Build Epoxoline II (4-6 mils DFT per coat)
    b. Sherwin-Williams
        1 Coat: PPG 16-90 Series – Pitt Glaze Interior/Exterior Bock Filler Latex (10 mils DFT)
        2 Coats: Water Based Catalyzed Epoxy B70 Series (4-6 mils DFT per coat)

14. Exterior Concrete Block (When Specified)

    a. Tnemec
        1 Coat: Series 156 Enviro-Crete (6-8 mils DFT per coat)
        1 Coat: Series 157 Enviro-Crete TX (7-9 mils DFT per coat)

15. Concrete Tanks/Basins (When Specified)

    a. Tnemec
        1 Coat: Series 156 Enviro-Crete (6-8 mils DFT per coat)
        1 Coat: Series 157 Enviro-Crete TX (7-9 mils DFT per coat)

16. Interior Cement Plaster

    a. Tnemec
        2 Coats: N69- Color Hi-Build Epoxoline II (4-6 mils DFT per coat)

17. Interior Woodwork

    a. Tnemec
        1 Coat: Series 10-99W, Wood Primer (2.5-3.5 mils DFT)
        2 Coats: Series 1029 Enduratone (2.5-3 mils DFT per coat)

E. Any surfaces not specifically named in the Schedule and not specifically excepted shall be prepared, primed and painted in the manner and with materials consistent with these Specifications. The Engineer shall select which of the manufacturer's products, whether the type is indicated herein or not, shall be used for such unnamed surfaces. No extra payment shall be made for this painting.

PART 3: EXECUTION

3.01 GENERAL

3.02 SHOP PRIMED ITEMS

A. Unless otherwise indicated all fabricated equipment shall be shop primed and shop or field finished.

B. All items to be shop primed shall be thoroughly cleaned of all loose material prior to priming. If, in the opinion of the Engineer, any prime coating shall have been improperly applied or if material contrary to these Specifications shall have been used, that coating shall be removed by sandblasting to white metal and reprimed in accordance with these Specifications.

C. All shop prime coats shall be of the correct materials and applied in accordance with these Specifications. Remove any prime coats not in accordance with these Specifications by sandblasting and apply the specified prime coat at no additional cost to the Owner.

D. Shop primed surfaces shall be cleaned thoroughly and damaged or bare spots retouched with the specified primer before the application of successive paint coats in the field.

E. General Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.

F. A shop finish coat shall be equal in appearance and protection quality to a field applied finish coat. If, in the opinion of the Engineer, a shop finish coat does not give the appearance and protection quality of other work of similar nature, prepare the surfaces and apply the coat or coats of paint as directed by the Engineer to accomplish the desired appearance and protection quality. Submit to the Engineer substantial evidence that the standard finish is compatible with the specified finish coat.

G. Whenever fabricated equipment is required to be sandblasted, protect all motors, drives, bearings, gears, etc., from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned.

3.03 SURFACE PREPARATION

A. All surfaces to be painted shall be prepared as specified herein or in Section 09901 and/or 09911 and shall be dry and clean before painting.

B. Surface preparation shall take place immediately prior to priming.

C. Care shall be exercised not to damage adjacent work during surface preparation. Surfaces not intended to be painted shall be suitably protected from the effects of cleaning and painting operations.

D. All metal welds, blisters, etc., shall be ground and sanded smooth in accordance with SSPC-SP-10. All pits and dents shall be filed and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, grease, and dirt shall be removed by use of approved solvents, wire brushing, or sanding.

E. All plastic pipe surfaces shall be lightly sanded before painting.

F. Exposed Pipe: Pipe which shall be exposed after project completion shall be primed in accordance with the requirements herein. After installation all exterior, exposed flanged joints shall have the gap between adjoining flanges sealed with a single component polysulfide sealant to prevent rust stains.

G. Primed or Previously Painted Surfaces and Nonferrous Surfaces: All coated surfaces shall be cleaned prior to application of successive coats. All nonferrous metals not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC-SP-1, Solvent Cleaning.

H. Shop-Finished Surfaces: All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon detection. Abraded or corroded spots on shop-coated surfaces shall be “Hand Cleaned” and then touched up with the same materials as the shop coat. All shop coated surfaces which are faded, discolored, or which require more than minor touch-up in the opinion of the Engineer shall receive new surface preparation before being repainted. Cut edges of galvanized sheets and exposed threads and cut ends of galvanized piping, electrical conduit, and metal pipe sleeves, that are not to be finished painted, shall be “Solvent Cleaned” and primed with zinc dust-zinc oxide metal primer.

I. Galvanized Steel, Stainless Steel, Aluminum and Copper: unless otherwise specified, these surfaces shall not be painted, but shall be “Solvent Cleaned” in accordance with SSPC-SP-1 to remove oil and grease. Exposed copper surfaces to be painted shall be buffed or polished to bright color, the surface cleaned with mild phosphoric acid cleaner and the finish coat applied.

J. Aluminum embedded or in contact with concrete must be painted according to the schedule for aluminum in contact with dissimilar materials.

K. Machined surfaces and other bare metal surfaces, which are not to be painted, but which will require temporary protection during construction, shall be treated with a rust preventative compound.

3.04 APPLICATION

A. General

1. Unless approved otherwise, all coatings shall be applied in accordance with the Manufacturer's recommendations.

2. All work shall be done in a workmanlike manner, so that the finished coating will be free from holidays, pin holes, bubbles, runs, drips, ridges, waves, laps, unnecessary variations in color, texture and gloss. All coats shall be applied in such a manner as to produce an even film of uniform thickness.

3. Only skilled painters shall be used on the work and specialists shall be employed where required.

4. Paints shall be mixed in proper containers of adequate capacity. All paints shall be thoroughly stirred before use and shall be kept stirred while using. No unauthorized thinners or other materials shall be added to any paint.

5. Primer and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Confirm with the paint manufacturer that the paint proposed for a particular condition will be compatible with the existing painted or primed surface.

6. Repainting or touch-up painting of damaged or other areas shall be accomplished with primers and/or paints as scheduled for the new surface, and that the Manufacturer has confirmed are compatible with the existing painted or primed surface. Sample repainted areas on the actual site will be required to insure this compatibility. Finished repainted areas shall be covered by the same guarantee specified for remainder of work.

7. Thinners, when used, shall be only those thinners recommended for that purpose by the Manufacturer of the material to be thinned.

8. At the request of the Engineer, samples of the finished work prepared in strict accordance with these specifications shall be furnished and all painting shall be equal in quality to the approved samples. Finished areas shall be adequate for the purpose of determining the quality of workmanship. Experimentation with color tints shall be furnished to the satisfaction of the Engineer where standard chart colors are not satisfactory.

B. Environmental Requirements

1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.

2. Do not apply coatings in areas where dust is being generated.

3. Do not apply coatings when the temperature of surface to be painted and the surrounding air temperature are below 45° F, or when it is anticipated that the temperature will be below 45° F within 18-hours of application, unless otherwise permitted by the coating manufacturer's printed instructions.

4. Do not apply coatings in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or to damp or wet surfaces.

5. Dew or moisture condensation should be anticipated, and if such conditions are prevalent, painting shall be delayed to ensure the surfaces are dry. The day's painting shall be completed in advance of the probable time when condensation will occur, in order to permit the film an appreciable drying time prior to the formation of moisture.

6. Coating work may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the manufacturer during application and curing periods.

C. Protection

1. Protection of equipment, fittings and accessories shall be provided throughout the painting operations. Remove all electric plates, surface hardware, etc., before painting, protect and replace when completed. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed.

2. Cover or otherwise protect surrounding areas which are not to be painted.

3. Items which have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is completely dry and hard.

D. Contacting Surfaces

1. Aluminum to be embedded in or in contact with concrete or masonry shall be coated to prevent electrolysis.

2. Contacting surfaces formed by high-strength bolt connections shall not be painted.

3. Where an electrical potential is apt to exist between metal surfaces or unlike chemical composition in riveted or bolted contact, each of the contacting surfaces shall be cleaned, pretreated and given one coat of primer, all as specified for the particular metals involved.

4. Where contact with a metal surface, the contacting surfaces of the metal shall be cleaned, pretreated if required, and given three coats of the specified primer.

E. Coating Progress

1. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same dry film thickness achieved with undiluted material.

2. Deficiencies in film thickness shall be corrected by the application of an additional coat(s).

3. Where field painting on any type of surface has commenced on any portion of the work, the complete painting operation, including priming and finishing coats, on that portion of the work, shall be completed as soon as practical without prolonged delays.

4. Sufficient time as recommended by the paint manufacturer shall elapse between successive coats to permit them to dry properly for recoating and this minimum drying period shall be modified as necessary to suit adverse weather conditions. Maximum elapsed time between successive coats shall not exceed the time recommended by the coating manufacturer. The application of another coat of paint shall not cause such film irregularities as lifting or loss of adhesion of the undercoat, and the undercoat shall have dried sufficiently so as not to retard the drying of the next coat.

5. At all times prior to final acceptance of the work, when it becomes necessary, the integrity and continuity of all coats, including coats which have chalked unduly or otherwise deteriorated, shall be re-established by retouching or repainting, using paints identical with those maintained.

6. At the time of application of each successive coat, undercoats shall be cleaned of dust, grease or any foreign matter, which might adversely affect intercoat adhesion, by means of air blast, solvent cleaning or other approved means.

7. Field coats on metal shall be applied after erection, except as otherwise specified and except for surfaces to be painted which will become inaccessible after erection.

F. Inspection

1. All painting will be inspected for applied coating thickness and for pinholes and holidays. Such inspection will not relieve the Contractor of the responsibility of furnishing qualified labor and materials in strict accordance with the specifications. The Contractor shall also furnish an approved type of low voltage dry mil gauge apparatus to measure the dry film thickness. The Elcometer Thickness Gauge shall be furnished by the Contractor for inspection. The Contractor shall also furnish holiday detector devices. Holiday detector devices shall be approved low voltage type. All of the above inspection gauges shall be furnished and on the job until its completion and acceptance. The Contractor or his representative shall instruct on the proper use and care of all such gauges. The above required testing gauges furnished are returnable to the Contractor upon completion of the job. The cost of furnishing all of the above required gauges shall be borne by the Contractor.

3.05 COLORS, FINISHES AND IDENTIFICATION

A. All colors will be verified / selected by the Engineer and/or Owner from color charts submitted by the Contractor.

B. Pipes, Equipment and Plant Facilities

1. Color coding shall consist of color code painting and identification of all exposed conduits, through items, and pipelines for the transport of air, liquid, and semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors, and all operating accessories which are integral to be whole functional mechanical pipe and electrical conduit system. Colors and/or banding shall be as noted in Section 15075 – Mechanical Identification.

2. All hangers and pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports. The system shall be painted up to, but not including the flanges attached to the mechanical equipment nor the flexible conduit connected to electrical motors. When more than one pipe system is supported on the same bracket, the bracket shall be painted the same color as the adjacent wall or ceiling.

3. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to but not including, the fixed flanges or connections on the equipment.

4. The color code in Section 15075 – Mechanical Identification establishes, defines, and assigns a definite color for each category of pipe. Pipelines or conduits which are not listed on the Piping Schedule shall be assigned a color by the Engineer. The colors listed shall be interpreted as listed below. All color numbers and names herein refer to master color card. Colors of specified equal manufacturers may be substituted with approval of the Engineer.

Colors	Tnemec #	Carboline #
White	AA90	S800
Orange	SC03	4444
Yellow	BW56[SC02]	6666
Dark Yellow	BX36	N625
Green	SC07	2383
Light Green	AM52	6361
Dark Brown	AF12	9218
Dark Green	--	4372
Tan	AF32	3216
Ivory	AF82	3848
Light Grey	BG62	C731
Medium Grey	2047	0746
Dark Grey	BK33	2525
Red	SC09	5555
Blue	SC06	S150
Dark Blue	2042	A183
Medium Blue	2041	0118
Light Blue	2040	7107
Aqua	AX42	4132
International Orange	SC04	N498
Dark Bronze	BM07	2277
Tank Blue	BB42	8155
Blue Green	AX22	A337
Magenta	BP14	S585

5. All moving parts, drive assemblies, and covers for moving parts which are potential hazards shall be Safety Orange #CA26.

6. All safety equipment shall be painted in accordance with OSHA standards.

7. All inline equipment and appurtenances not assigned another color shall be painted the same base color as the piping. The pipe system shall be painted with the pipe color up to but not including the flanges attached to pumps and mechanical equipment assigned another color.

8. All conduit shall be painted to match its background surface.

9. Building surface colors shall be painted as scheduled in the Finish Schedule or as selected by the Engineer.

10. Control panels shall be factory finished

11. Each pipe system and piece of equipment shall be labeled with lettering, arrows and/or name plates, in accordance with Section 15075 – Mechanical Identification.

3.06 MEASUREMENT AND PAYMENT

A. Measurement and payment for painting shall be included in the lump sum bid price for the item of work of which this is a component part.

END OF SECTION

SECTION 09913 – Coating & Painting Steel Water Storage Tanks

City of Copperas Cove – Mountain Top North Water Improvements

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The work of this section includes the coating of all interior surfaces, and the coating of all exterior surfaces. The Contractor shall furnish all materials, labor and equipment to sand blast and paint the tank in accordance with the following schedule.

The term "interior surfaces" shall refer to the inside of the tank proper, and all appurtenances located inside the tank (i.e. ladders, etc.) to include the interior side of all manholes, hatches, rafters, connections, etc. The term "exterior surfaces" shall refer to the outside of the tank proper and all appurtenances located outside of the tank including pump discharge heads, valves, piping and motors.

The Base Bid for this project shall include the coating products as manufactured by the Tnemec Corporation or Sherwin Williams. Materials specified are those that have been evaluated for the specific service. Products of the Tnemec Corporation and Sherwin Williams are listed to establish a standard of quality. Equivalent materials of other manufacturer's may be submitted for written approval of the Engineer and Alternate Bids will be accepted using these materials in the Substitute Equipment And/Or Materials section of the Proposal Bidding Sheets. The contractor shall make arrangements for the painting contractor and paint manufacturer's representative to attend either the preconstruction meeting or a separate tank coating and painting preconstruction meeting with the Owner's Representative(s) and Third Party Inspector prior to the beginning of any surface preparation or coating work.

It is the Contractor's responsibility to protect the surrounding property during construction. Regulations of the Texas Air Control Board must be met. As long as the surrounding property is protected, and the regulations of the Texas Air Control Board are met, it is the Contractor's decision on whether or not to install a shroud.

1.02 REFERENCE SPECIFICATIONS AND STANDARDS

A. Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of interior and exterior surfaces and inspection shall conform to the applicable requirements of the Steel Structures Painting Council, NACE International, ASTM (American Society for Testing and Materials), AWWA and the manufacturer's printed instructions.

B. The Engineer's decision shall be final as the interpretation and/or conflict between any of the referenced specifications and standards contained herein.

1.03 CONTRACTOR

A. The Contractor shall have a minimum of three years practical experience and successful history in the application of the specified product to surfaces of steel water tanks. He shall substantiate this requirement by furnishing a list of references and job completions.

B. The Contractor shall submit with his bid a written statement by the coatings manufacturer stating that the Contractor is familiar with the materials specified and has workers capable of performing the work specified herein.

C. The personnel performing the work shall be knowledgeable and have the required experience and skill to adequately perform the work for this project, in accordance with SSPC-PA1, "Shop, Field and Maintenance Painting".

D. The Contractor is responsible for all claims for paint damage during the progress of the painting and is especially forewarned of this responsibility so that he may exert all possible precaution and care for protection of property.

1.04 QUALITY ASSURANCE

A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards and are approved by the Engineer. All work in both shop and field shall conform with all current applicable requirements of the ANSI/AWWA D-107 "AWWA-Standard For Composite Elevated Tanks for Water Storage". The completed tank structure shall also comply with the latest requirements of the Occupational Safety and Health Act. All members shall be designed to safely withstand the maximum stress to which they may be subjected during erection and operation. All welding shall conform to the latest version of AWWA D-107.The Contractor shall submit a list of all welders and provide a copy of current welding certifications for each welder prior to beginning construction. All welders shall be qualified in accordance with the current ASME-BPV-IX. Form QW-484 of ASME-BPV-IX shall be submitted for each welder.

Measurement of Surface Temperature, Humidity and Dew Point – On days when blasting and/or coating is being performed and during intermediate coat and final coat cure envelopes, the Contractor shall monitor and record ambient climatic conditions, and interior reservoir conditions as follows:

Air temperature, steel surface temperature, humidity and dew point shall be measured, and recorded by the Contractor prior to beginning of blasting and prior to application of coating daily. Atmospheric conditions shall be measured and recorded at least every 3 hours and when climatic conditions begin to change. All psychrometric readings shall be recorded and placed in a file located on the job site and made available for daily owner review. This file shall be turned over to the Engineer/Owner at the end of the job.

Surface temperature shall be measured by using approved thermometers. Temperature of both the sunny side and shady side of the reservoir shall be recorded periodically each day. The dew point shall be measured and recorded at least every 3 hours by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric Tables. The reservoir surface temperatures, relative humidity, dry bulb, wet bulb and dew point temperatures both interior and exterior (as appropriate) are to be recorded. A sample form for recording this data is provided at the end of this specification. The completed forms shall be kept on the job site at all times form the time coating is first applied until the coating system is complete. Prior to acceptance of the coating, copies of all Psychrometric Reports shall be delivered to the Engineer/Owner.

Air temperature, surface temperature and humidity shall be measured and monitored by the Contractor continuously between recoating intervals and during final cure until one (1) day before reservoir sterilization begins.

B. Surface Preparation: Surface preparation will be based upon comparison with: "Pictorial Surface Preparation Standards for Painting Steel Surfaces: SSPC-VIS 1-89", ASTM Designation D2200-95, "Standard Methods of Evaluating Degree of Rusting on Painted Surfaces", ASTM D 4417-91, Method A and/or Method C or NACE Standard RP0287-87, and ASTM Designation D610 "Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive". In all cases the written standard shall take precedence over the visual standard. In addition, NACE Standard RP0178-91, along with the Visual Comparator, shall be used to verify the surface preparation of welds.

C. Application: No coating or paint shall be applied when: 1) the surrounding air temperature or the temperature of the surface to be coated or painted is below the minimum surface temperature for the products specified herein, 2) rain, snow, fog or mist is present, 3) the temperature is less than 5°F above the dew point, 4) the air temperature is expected to drop below the minimum temperature for the products specified within six hours after application of coating, 5) the relative humidity is above 85% and/or surface temperature will exceed the recommended temperatures within six hours after application of coating. Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. If any of the above conditions are prevalent,

coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.

D. Thickness and Holiday Checking: Thickness of coatings and paint shall be checked with a non-destructive, magnetic-type thickness gauge, as per SSPC-PA 2 "Measurement of Dry Film Thickness with Magnetic Gages". References in PA 2 which allow 80% of the minimum thickness specified are not acceptable. Use an instrument such as a Tooke Gauge if a destructive test is deemed necessary by the Engineer.

The integrity of ALL interior coated surfaces may be checked with a low voltage holiday detector in accordance with NACE Standard RP0188. Destructive holiday detector shall not exceed the voltage recommended by the manufacturer of the coating system. A solution of 1-ounce non-sudsing type wetting agent, such as Kodak Photo-Flo, and 1 gallon of tap water shall be used to perform the holiday testing. All pinholes and/or holidays shall be marked and repaired in accordance with the manufacturer's printed recommendations and retested. The CONTRACTOR shall perform the holiday testing under the supervision of the INSPECTOR. All touched up pinholes and re-coated areas shall cure for a minimum of seven (7) days prior to re-testing for holidays. No pinholes, holidays or other irregularities will be permitted in the final coating.

E. Inspection Devices: The contractor shall furnish, until final acceptance of coating and painting is accepted, inspection devices in good working condition for detection of holidays and measurement of dry film thickness of coating and paint. The Contractor shall also furnish U.S. Department Commerce, National Bureau of Standards certified thickness calibration plates and/or plastic shims, depending upon the thickness gauge used, to test the accuracy of dry film thickness gauges and certified instrumentation to test the accuracy of holiday detectors. Dry film gauges and holiday detectors shall be made available for the Engineer's use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the Owner's Representative.

F. Inspection: Inspections shall be conducted by a third party inspection company, the ENGINEER and OWNERS representative. The inspection company shall be hired by the owner and act as an agent of the owner. The inspection company shall report to the engineer. The inspector shall communicate directly with the CONTRACTOR'S SUPERINTENDANT. Final inspections shall be performed in the presence of the ENGINEER, OWNER or their representative and the CONTRACTORS SUPERINTENDENT. All materials and equipment used in the accomplishment of testing are subject to inspection at any time by the ENGINEER, OWNER and/or INSPECTOR.

The CONTRACTOR shall not move or remove scaffolding, ladders or other fixtures necessary to provide proper inspection until such work has been inspected and approved by the INSPECTOR and/or the ENGINEER/OWNER.

For shop priming, the Owner reserves the right to have the shop operation inspected, and all material pertaining to the tank shop inspected by the Owner's Inspector. The Inspector shall inspect the material after surface preparation and prior to prime coat application and after application is completed.

All expenses incurred for transportation, lodging, and meals for inspections on work done at a location (outside 150 mile radius from project site), such as for shop surface preparation and coating work, other than the project work site shall be paid for by the Contractor. Coordination and scheduling efforts shall be considered to maximize the inspection productivity. The Inspector shall be notified at least 10 days in advance of the time the inspection will be needed.

Inspection for this project shall consist of 'hold point' inspections. The Engineer or Owner's Representative shall inspect the surface prior to abrasive blasting, after abrasive blasting but prior to application of coating materials, and between subsequent coats of material. Final inspection shall take place after all coatings are applied, but prior to placing the tank in service. The interior coating shall be allowed to cure for a minimum of 7 days prior to inspection. Contractor will insure that sufficient rigging is in place so that the Engineer/OWNER or his representative shall be able to safely conduct the required inspections. Irregularities due to poor workmanship will be corrected by the Contractor at his expense. The Owner and Engineer reserve the right to require this correction at any time during construction or at final inspection.

G. Warranty Inspection: A warranty inspection will be scheduled during the eleventh month following acceptance of all coating and painting work. The inspection will be performed by the Owner's Representative and/or Inspector. All defective work shall be repaired in accordance with this specification, AWWA D102, Section 9, unless otherwise specified herewithin. All defective work shall be repaired to the satisfaction of the Engineer and/or Owner. The Contractor shall warranty all repair work for one year.

Interior surfaces of the reservoir shall be inspected within 11 to 23 months after the reservoir work has been accepted and placed in service. If an inspection date has not been established within 23 months after the reservoir has been placed in service, the anniversary inspection shall be considered waved, except in the event the OWNER is unable to remove the reservoir from service due to extremely long dry climate conditions or otherwise adverse weather conditions or due to unexpected breakdowns in the OWNER's distribution system. The date of anniversary inspection may be extended for a period of time not to exceed thirty (30) months beyond the date of final completion and acceptance of the work.

If failures in any portion of the reservoir surface, exceed five (5) percent of that portion, as determined by the OWNER, then for that portion, the entire coating system shall be completely removed, re-coated and re-tested in accordance with the specifications herein. In the event any portion of the reservoir surface requires complete repair as provided herein, a second anniversary inspection shall be made unless the OWNER otherwise deems it not to be necessary. If subsequent anniversary inspections are to be made, time stipulations, coating removal, repair, re-testing and anniversary inspection requirements shall be the same as provided for in this specification.

The OWNER will isolate the reservoir from the distribution system and drain the reservoir. The CONTRACTOR shall open, clean out, high-pressure water wash and rinse the tank prior to anniversary inspection. After inspection of the tank is complete, the CONTRACTOR shall disinfect the reservoir and properly seal the tank prior to placing it into service, with no charge to the OWNER. Disinfection of the tank, after anniversary inspection, shall be as per disinfection procedures stated in Section 3.04 of this specification.

The CONTRACTOR shall provide suitable and adequate equipment including: lighting, ventilation, rigging, cable climbers, mirrors, inspection equipment, and sufficient man-power to clean, disinfect and move equipment and tools around the tank, etc., as may be necessary to facilitate complete inspection of all interior surfaces. The CONTRACTOR shall bear all costs of the anniversary inspection and shall incorporate such costs into his bid.

Any location, including but not limited to locations where a coating has peeled off, bubbled, blistered, chipped, or cracked, etc., or where pinholes and/or holidays are present and locations where rusting or corrosion is evident, will be considered a failure or defect of the coating system and shall be repaired as required. Repairs will be made at areas or locations where coating failures are found.

Methods of testing for coating failure which, may or may not be evident, shall include, but not be limited to, adhesion tests, film thickness measurement, holiday testing, etc. Testing may be non-destructive or destructive. The CONTRACTOR, at his expense, shall repair all areas where destructive tests are performed.

The anniversary repair work shall be completed within an agreed time period as determined by the OWNER and CONTRACTOR. All repairs shall be made as per the coating manufacturers written repair work instructions or that which is approved and acceptable to the OWNER and completed within ninety (90) calendar days of the anniversary inspection. Holiday testing will be used to check all interior coating repairs, including the interior roof.

1.05 SAFETY AND HEALTH REQUIREMENTS

A. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and manufacturer's printed instructions and appropriate technical bulletins and manuals, the Contractor shall provide and require use of personal protective lifesaving equipment for persons working on or about the project site.

B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air purifying halfmask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.

C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminants to a degree that a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured for immersion service. From the beginning of interior coating and until interior coating is complete, the CONTRACTOR shall monitor the air for its lower explosion limit (LEL). CONTRACTOR shall submit to the ENGINEER, for review and approval, the air monitor technical literature. The ENGINEER/OWNER and his representatives shall be allowed to check and inspect the monitor at any time.

D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protection devices. Noise control of equipment during working and non-working hours shall be submitted to the ENGINEER/OWNER for review and approval. If excessive noise is noted by the OWNER or neighboring residents, the CONTRACTOR shall modify or replace the existing equipment to reduce the noise to an OWNER acceptable level. CONTRACTOR shall bear all costs of noise reduction and incorporate this cost and any others into their bid.

E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Engineer or Owner's Representative, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the inspector.

F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected here requested by the Inspector or Engineer to facilitate inspection and be moved by the Contractor to locations requested by the Engineer or Owner's Representative.

G. Submittals: The Contractor is required to submit the following upon selection:

1. Contractor qualifications certifying experience and references for the work contemplated.
2. Safety Program in writing and a schedule of regularly scheduled safety orientation meetings complying with OSHA.
3. Detailed work schedule.
4. Quality Control program.
5. Methodology for compliance with full containment of spent abrasive and proper disposal.
6. TACB Form PI-7, "Registration Form for Standard Exemptions"

H. Air Monitoring: Ambient Air Quality – Visible Emissions: Visible emissions shall be used as criteria for project shut down until corrections to the containment are made. Visible emissions shall be determined in accordance with 40 CFR 60, Appendix A, Method 22.

If required by the Texas Air Control Board, the Contractor shall provide additional monitoring as follows:
Ambient Air Quality for Particulate Matter (40 CFR 50): Emissions in excess of 150 up/m^3 of PM 10 over a 24-hour period shall be cause for shut down of the project until corrections to the containment are made to comply with this level. Monitoring for this level shall be accomplished using high volume air samplers.

1.06 PRODUCT DELIVERY, STORAGE & HANDLING

A. All materials shall be brought to the jobsite in original sealed containers. Within 48 hours of coating delivery to the job site, the CONTRACTOR shall record the batch number stamped on each coating container and submit a typed list to the ENGINEER. Minimum information required will include: date of delivery to job site, name and signature of superintendent recording the data, list of batch number including corresponding coating identification, date of manufacture and volume of

each container. They shall not be used until the ENGINEER has inspected the contents. Manufacturer's Material Safety Data Sheets (MSDS) for all coating products used on the jobsite shall be submitted to the OWNER at the preconstruction conference or prior to commencing work. Materials exceeding storage life recommended by the manufacturer shall be rejected.

B. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings and paints must be stored to conform to City, County, State and Federal safety codes for flammable coating or paint materials. At all times coatings and paints shall be protected from freezing.

PART 2 - MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. Materials specified are those that have been evaluated for the specific service. Products of the Tnemec Company, Inc. are listed to establish a standard of quality. Equivalent materials of other manufacturer's may be submitted on written approval of the Engineer. As part of the proof of equality the Engineer will require, at the cost of the Contractor, a certified and notarized comparison as listed in subsection 'C' below.

B. Requests for substitution shall include manufacturer's literature for each product giving name, product number, generic type, descriptive information, solids by volume, recommended dry film thickness and certified lab test reports showing results to equal the performance criteria of the products specified herein. In addition, a list of five projects shall be submitted in which each product has been used and rendered satisfactory service.

C. All requests for product substitution shall be made in a timely manner so that the project is not delayed because of the review of the product substitution comparison. Review of the product substitution comparison by the Owner and Owner's Representatives may take up to 21 days. The requirements for an approved equal are:

1. For approval of an equal manufacturer the bidder shall provide to the owner in writing a detailed side-by side comparison of the proposed equal products characteristics, performance characteristics and application conditions for each coating specified in this specification. For consideration for approval this written comparison shall be certified and notarized by the manufacturer as true and correct.
2. For products characteristics this detailed side-by-side comparison shall include for example, but not limited to, volume solids, weight solids, VOC, mix ratio, spreading rate per coat, drying schedule and flash point.
3. For performance characteristics this detailed side-by-side comparison shall include for example, but not limited to, abrasion resistance, corrosion weathering, direct impact resistance, dry heat resistance and pencil hardness.
4. In addition to the detailed side-by-side comparison for approval of an equal manufacturer, bidder shall provide to the owner in writing three (3) tanks (with a minimum capacity and height as the proposed tank) that have the proposed or equal coating system on each tank and date coating system was put into service. In addition the tank names, locations, and owner's name with contact person and telephone number shall be provided. Each of the three (3) tanks shall be located in an area with similar climatic conditions as the location of the project stated herein.
5. As a minimum standard any equal coating system shall have a five (5) year service history.

D. Any material savings shall be passed to the owner in the form of a contract dollar reduction.

E. Manufacturer's color charts shall be submitted to the Engineer at least 30 days prior to coating and/or paint application. General Contractor and Painting Contractor shall coordinate work so as to allow sufficient time (normally seven to ten days) for paint to be delivered to the job site.

2.02 GENERAL REQUIREMENTS

A. All materials shall be lead-free as defined by the Consumer Product Safety Act, Part 1303. Additionally, all materials shall be free of other heavy metals such as chrome, mercury and cadmium.

B. All materials for the interior wetted portion of the tank shall meet therequirements of ANSI/NSF Standard 61 for potable water contact.

C. No coating submitted or used on this project shall have a VOC (Volatile Organic Content) in excess of 3.04 lbs/gal unthinned.

D. Prior to applying prime coat, the surface will be inspected by the Owners representative.

2.03 MATERIAL PREPARATION

A. Mix and thin materials according to manufacturer's latest printed instructions.

B. Do not use materials beyond manufacturer's recommended shelf life.

C. Do not use mixed materials beyond manufacturer's recommended pot life.

2.04 SHOP-APPLIED PRE-CONSTRUCTION PRIMER

A. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard RP0178 designation "C" and herein.

B. Surface Preparation: SSPC-SP10 Near-White Metal Blast Cleaning. Anchor Profile shall be 1.5 to 2.5 mils as per ASTM D 4417, Method C or NACE Standard RP0287.

C. Zinc-Rich Primer:
- Tnemec Series 91-H2O Hydro-Zinc 2000 applied at 1.0 to 1.5 dry mils, thin only with approved thinner, Tnemec 41-2 or 41.3; or
- Sherwin Williams Zinc Clad Ultra PCP applied at 1.0 to 1.5 dry mils, thin only with manufacturer approved thinner.

2.05 FIELD-APPLIED COATING SYSTEMS

1. TANK INTERIOR COATING SYSTEM – WET AREA

A. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard RP0178 designation "C" and herein.

B. Surface Preparation: SSPC-SP10 Near-White Metal Blast Cleaning on all bare metal areas (such as weld seams, etc.) and all abraded areas. Anchor profile shall be 1.5 to 2.5 mils as per ASTM D 4417, Method C or NACE Standard RP0287. All (100%) of shop-primed areas shall be uniformly and thoroughly prepared as per SSPC-SP7 Brush Off Blast Cleaning and above. If the shop primer is other than specified above, a complete SSPC-SP10 Near-White Blast Cleaning shall be conducted on all surface areas and shop-primed areas.

C. Coating System:

1st Coat:
- Tnemec Series 91-H2O Hydro-Zinc 2000 applied at 2.5 to 3.5 dry mils, thin only with approved thinner,

Tnemec 41-2 or 41-3 Thinner; or

- Sherwin Williams Corothane I Galvapac I applied at 3.0 to 4.0 dry mils, thin only with manufacturer approved thinner.

Stripe Coat:

- Tnemec Series N140-1255 Beige Pota-Pox Plus, or
- Sherwin Williams Macropoxy 646PW Light Blue.
- Apply by brush and scrub into all weld seams. In addition to weld seams, all edges, corners, bolts, rivets, pits shall receive a stripe coat. This shall be a separate step. The 2nd coat or subsequent coat shall not be applied until the recoat time has been achieved.

2nd Coat:

- Tnemec Series N140-1255 Beige Pota-Pox Plus applied at 4.0 to 6.0 dry mils, thin only with approved thinner, Tnemec 41-4 Thinner; or
- Sherwin Williams Macropoxy 646PW Light Blue applied at 4.0 to 6.0 dry mils, thin only with manufacturer approved thinner.

3rd Coat:

- Tnemec Series N140-15BL Tank White Pota-Pox Plus applied at 4.0 to 6.0 dry mils, thin only with approved thinner, Tnemec 41-4 Thinner; or
- Sherwin Williams Macropoxy 646PW Mill White applied at 4.0 to 6.0 dry mils, thin only with manufacturer approved thinner.

Total dry film thickness shall be a minimum of 12.0 mils per SSPC-PA 2 dry film inspection standards, with exception as noted in this specification.

For cold weather applications, substitute Tnemec Series Fast Cure Series.

2. TANK INTERIOR COATING SYSTEM – DRY AREAS

A. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard RP0178 designation "C" and herein.

B. Surface Preparation: SSPC-SP10 Near-White Metal Blast Cleaning on all bare metal areas (such as weld seams, etc.) and all abraded areas. Anchor profile shall be 1.5 to 2.5 mils as per ASTM D 4417, Method C or NACE Standard RP0287. All (100%) of shop-primed areas shall be uniformly and thoroughly prepared as per SSPC-SP7 Brush Off Metal Blast Cleaning and above.

C. Coating System

1st Coat:

- Tnemec Series 91-H2O Hydro-Zinc 2000 applied at 2.5 to 3.5 dry mils, thin only with approved thinner, Tnemec 41-2 or 41-3 Thinner; or
- Sherwin Williams Corothane I Galvapac I applied at 3.0 to 4.0 dry mils, thin only with manufacturer approved thinner.

2nd Coat:

- Tnemec Series N140-1255 Beige Pota-Pox Plus applied at 4.0 to 6.0 dry mils, thin only with approved thinner, Tnemec 41-4 Thinner; or
- Sherwin Williams Macropoxy 646PW Light Blue applied at 4.0 to 6.0 dry mils, thin only with manufacturer approved thinner.

3rd Coat:

- Tnemec Series N140-15BL Tank White Pota-Pox Plus applied at 4.0 to 6.0 dry mils,.thin only with approved thinner, Tnemec 41-4 Thinner; or
- Sherwin Williams Macropoxy 646PW Mill White applied at 4.0 to 6.0 dry mils, thin only with manufacturer approved thinner.

Total dry film thickness shall be a minimum of 12.0 mils per SSPC-PA 2 dry film inspection standards, with exception as noted in this specification.

For cold weather applications, substitute Tnemec Series Fast Cure Series.

3. TANK EXTERIOR COATING SYSTEMS

A. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard RP0178 designation "C" and herein.

B. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning on all bare metal areas (such as weld seams, etc.) and all abraded areas. Anchor profile shall be 1.5 to 2.0 mils as per ASTM D 4417, Method C or NACE Standard RP0287. All (100%) shop-primed areas shall be uniformly and thoroughly prepared as per SSPC-SP7 Brush Off Blast Cleaning and above.

C. Coating System:

1st Coat:

- Tnemec Series 90-97 Tnemec-Zinc applied at 2.5 to 3.5 dry mils, thin only with approved thinner, Tnemec 41-2 or 41-3 Thinner; or
- Sherwin Williams Corothane I Galvapac I applied at 3.0 to 4.0 dry mils, thin only with manufacturer approved thinner.

2nd Coat:

- Tnemec Series 73-Color Endura-Shield applied at 3.0 to 5.0 dry mils, thin only with approved thinner, Tnemec 41-2 Thinner for spray, 41-39 for brush or roller. (2 coats may be required if applied by roller.); or
- Sherwin Williams Acrolon 218 HS semi-gloss applied at 4.0 to 5.0 dry mils (color to contrast final finish coat), thin only with manufacturer approved thinner.

3rd Coat:

- Tnemec Series 700-Color Hydro-Flon applied at 2.0 to 3.0 dry mils, thin only with approved thinner, Tnemec 41-39 Thinner for spray, brush or roller; or
- Sherwin Williams FluoroKem applied at 2.5 to 3.0 dry mils, thin only with manufacturer approved thinner.

Total dry film thickness shall be a minimum of 9.5 mils for Tnemec coating system and 11.5 mils for Sherwin Williams coating system, per SSPC-PA 2 dry film inspection standards, with exception as noted in this specification.

PART 3 - EXECUTION

3.01 GENERAL

A. All surface preparation, coating and painting shall conform to applicable standards of the Steel Structures Painting Council, NACE International and the manufacturer's printed instructions. Materials applied to the surface prior to the

approval of the Engineer shall be removed and re-applied to the satisfaction of the Engineer at the expense of the contractor.

B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be coordinated with the Engineer.

C. The Contractor shall provide a supervisor at the work site during cleaning and application operations. The supervisor shall have the authority to coordinate work and make decisions pertaining to the fulfillment of the contract.

D. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the coating or paint must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.

E. Coating and painting systems include surface preparation, prime coating, stripe coating and finish coatings. Unless otherwise approved in writing by the Engineer, prime coating shall be field applied. The Contractor shall use repair procedures, which insure the complete protection of all adjacent primer. All repair procedures shall be in accordance with the coating manufacturer's written recommended methods. It is the responsibility of the CONTRACTOR to provide the ENGINEER and OWNER with the coating manufacturer's written recommended repair procedures. The specified repair method and equipment may include wire brushing, hand or power tool cleaning, or dry air blast cleaning. In order to prevent injury to surrounding painted surfaces, blast cleaning may require use of lower air pressure, smaller nozzle and/or abrasive blast particles, or shorter blast nozzle distances from surface shielding and masking. If damage is too extensive or uneconomical to touch-up, the entire item shall be blasted and then coated or painted as directed by the Engineer.

F. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Abrasive blast equipment shall be equipped with noise reducing devices, hose coupling safety devices, electrical grounding devices, fresh air hoods, and "Dead Man" switches on all blast hoses. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval of the Engineer. All equipment shall comply with current OSHA regulations.

G. Application of the first coat shall follow immediately after surface preparation and cleaning and stripe coat, before rust bloom occurs or the same day, whichever is less. Any cleaned areas not receiving first coat within this period shall be recleaned prior to application of first coat. All blasted surfaces shall be coated to within 6 inches of the edge of a blasted area. Dehumidification equipment shall be first reviewed by the Engineer and coatings manufacturer prior to deviating from this provision.

3.02 SURFACE PREPARATION

A. The latest revision of the following surface preparation specifications of the Steel Structures Painting Council (SSPC) shall form a part of this specification. The summaries listed below are for informational purposes; consult the actual SSPC specification for full detail.

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.
2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mil scale and other detrimental foreign matter to a degree specified by hand chipping, scraping, sanding and wire brushing.
3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mil scale and other detrimental foreign matter by power wire brushing, power impact tools or power sanders.
4. White Metal Blast Cleaning (SSPC-SP5/NACE No. 1): Air blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.
5. Commercial Blast Cleaning (SSPC-SP6 NACE No. 3): Air blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.

6. Brush-Off Blast Cleaning (SSPC-SP7 NACE No. 4): Air blast cleaning to remove loose rust, loose mil scale and other detrimental foreign matter to a degree specified.
7. Near-White Metal Blast Cleaning (SSPC-SP10 NACE No. 2): Air blast cleaning until at least 95% of each element of surface area is free of all visible residues.
8. Power Tool Cleaning to Bare Metal (SSPC-SP11): Differs from SSPC-SP3 in that it requires more thorough cleaning and a surface profile not less than 1 mil.

B. Slag, weld metal accumulation and spatters not removed by the Fabricator, Erector or Installer shall be removed by chipping and/or grinding. All sharp edges shall be peened, ground or otherwise blunted as required by the Engineer. All grinding and finishing of welds, edges, etc. shall be performed prior to solvent cleaning and abrasive blasting. Welds shall be prepared as per NACE Standard RP0178 for all interior and exterior surfaces:

1. Butt Welds: Shall be ground smooth and free of all defects, designation "C".
2. Lap Welds: Shall be ground smooth and blended, designation "C", excepting that visual imperfections and ripples are allowable.
3. Fillet Welded Tee Joint: Shall be ground smooth and blended, designation "C."

C. Field blast cleaning for all surfaces shall be by dry method unless otherwise directed. Blast nozzles shall be venturi-type nozzles with a minimum pressure at the nozzle of 90 psi.

D. Particle size of abrasives used in blast cleaning shall be that which will produce a 1.5 – 3.0 mil surface profile or in accordance with recommendations of the manufacturer of the specified coating or paint system to be applied.

E. Abrasive used in blast cleaning operations shall be new, and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved in writing by the Engineer.

F. Recycled Abrasive Blast Media: All metallic abrasive media that is recycled and reused shall be in accordance with SSPC-AB2 "Cleanliness of Recycled Ferrous Metallic Abrasives". A blend of shot and grit shall be utilized; in no case shall straight shot be allowed.

G. During blast cleaning operations, caution shall be exercised to ensure that existing coatings or paint are not exposed to abrasion from blast cleaning.

H. The Contractor shall keep the area of his work and the surrounding environment in a clean condition. He shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the accomplishment of the work, the operation of the existing facilities or to the surrounding environment. If blast abrasive is left on the tank floor while painting the ceilings and walls, no paint may be applied to walls within six feet of the floor.

I. Blast cleaned surfaces shall be cleaned prior to application of specified coatings or paint. All surfaces shall be free of dust, dirt, and other residue resulting from the abrasive blasting operation. No coatings or paint shall be applied over damp or moist surfaces.

J. All welds shall be neutralized with a suitable chemical compatible with the specified coating or paint.

3.03 APPLICATION, GENERAL

A. Coating and paint application shall conform to the requirements of the Steel Structure Painting Council Paint Application Specification SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting".

B. Thinning shall be permitted only as recommended by the manufacturer and approved by the Engineer.

C. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, bubbles, drips, waves, laps, unnecessary brush marks, over spray, environmental contaminants or other physical defects, including shadows, and be UNIFORM in color, texture and gloss. Thus, all coatings shall be applied in a professional manner to achieve the specified dry film thickness (DFT). Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes. Cleaning and coating shall be scheduled such that dust and other materials from adjoining work will not contaminate wet or newly coated surfaces.

The CONTRACTOR shall submit written detailed procedures for all surface preparation and application of coating, including touch-up procedures. The procedures shall be approved by the ENGINEER and OWNER, with no exceptions, before any surface preparation, application, or touch-up begins.

D. Protective coverings or drop cloths shall be used to protect floors, fixtures, piping, and equipment. Care shall be taken to prevent debris or any other foreign matter from entering water mains. The covers and plugs shall remain in place until just prior to filling the tank for disinfection. Care shall be exercised to prevent coatings or paints from being spattered onto surfaces which are not to be coated or painted. Report to the Engineer surfaces from which materials cannot be satisfactorily removed.

E. When two coats of coating or paint are specified, where possible, the first coat shall contain sufficient approved color additive to act as an indicator of coverage or the two coats must be of contrasting color. Should a third interior coating be used, it too shall be contrasting in color from the second interior coating.

F. Steel surfaces that have rusted or changed color shall be re-blasted in accordance with these specifications. No visible rust shall be overcoated under any circumstances.

Painting shall not take place when the atmospheric temperature is below or above the coating manufacturer's written instructions, or above 50°F or when the steel surface temperature is less than or equal to 5°F above the dew point, or when the relative humidity is above 85% unless approved by the Engineer/Owner and paint manufacturer. Painting shall not occur when the surface is damp due to rain, snow, fog or mist. Painting shall also not occur if the surface temperature is expected to drop below manufacturer's recommendations within 4 hours after coating application.

3.04 DISINFECTION

A. Disinfection of interior surfaces shall be performed in the presence of the Engineer in accordance with all the requirements of applicable AWWA Standards and regulatory agencies. CONTRACTOR shall furnish all labor, materials, tools, equipment and related items to seal and disinfect the reservoir. CONTRACTOR shall submit, for ENGINEER/OWNER approval all gasket and sealer materials necessary to seal all vents and manways. All bolts, nuts and washers shall be of stainless steel construction.

B. Disinfection shall be performed after protective coatings have been applied to the interior surfaces and allowed to thoroughly cure.

C. Prior to disinfecting, the complete interior shall be washed down with clean water and thoroughly flushed out.

D. Disinfection and sterilization of the tank shall be in accordance with AWWA C652. See Section 13225, 'Welded Steel Elevated Storage Tank – Single Pedestal Spheroid', Part 5 – Testing and Sterilization, for methods and requirements. Contractor shall submit for approval the proposed method of disinfection.

It is necessary that the CONTRACTOR schedule his activities such that the initial filling occurs entirely during a low use period as determined by the OWNER. Close coordination by the CONTRACTOR with the OWNER is mandatory prior to and during the filling of the reservoir and until the disinfection work is completed.

The CONTRACTOR and the OWNER shall have at least one representative present at the job site at all times during the filling of the reservoir regardless of the time of day. If the CONTRACTOR'S representative leaves the job site during the filling process, the filling will be stopped and be rescheduled for a later date. The CONTRACTOR shall pay all refilling and re-disinfection costs due to this inconvenience.

3.05 SOLVENT VAPOR REMOVAL

All solvent vapors will be exhausted both during and after coating application at a minimum rate of one air change every four hours to allow the proper curing of the coating material. High rates of production may require an increase in ventilation.

Forced ventilation as noted above shall be continued for 7 days or until such time as the coating has reached "full cure to immersion" as specified by the coating manufacturer.

Contractor shall submit ventilation calculations to the Engineer for approval prior to any blasting or coating.

Paint manufacturer or Owner's representative will be consulted concerning points not covered herein.

When dehumidification is used, blasting of all interior surfaces must be complete, cleaned and accepted prior to the application of any coating. All blasting media must be removed from the interior prior to the coating application.

It is the intent of the Owner to utilize the dehumidification equipment during the field blasting and coating of the interior wet surfaces of the tank. Therefore the tank must be erected and welded in place, with the roof structure completed, prior to the blasting and coating of the interior surfaces.

A. Humidity Control

Dehumidification equipment will be used to control the environment in the space 24 hours a day during blast cleaning, coating application, and coating cure. Equipment will conform to the following requirements:

Equipment

Desiccant dehumidifiers, as manufactured by Munters Corporation, will be a solid desiccant design having a single rotary desiccant wheel capable of fully automatic continuous operation. No liquid, granular, or loose lithium chloride drying systems will be accepted.

The use of direct expansion (DX) refrigeration type dehumidifiers with reheat may be considered if the expected ambient temperature will remain above 60° F. Below that, coils may not remove moisture and, as noted above, reheat alone will not change the dew point. Heating the space changes relative humidity only and does not change the dew point; therefore not a substitute for dehumidification, unless substrate temperature is high enough to meet dew point differential.

The dehumidification system may consist of a combination of desiccant and refrigerant equipment for year round use to maintain very low dew points in the space.

Internal Environment

During the blasting operation, dehumidification equipment will continuously maintain a lower dew point than outside ambient. A differential of 20° to 25° F between inside substrate surface temperature and inside space air dew point temperature shall be maintained. In addition, inside relative humidity should not exceed 40% to 45%. For most coatings, the above parameters would be advantageous, for coating application and cure (or coating manufacturer's recommendation should be followed). Occasional outside ambient conditions may result in temporary fluctuation in dew point spreads. In all cases the visual standard called for by the specification for the steel cleanliness will be adhered to.

Testing for Contaminants

Steel surfaces shall also be tested for pH and presence of chlorides and/or other non-visible contaminants.

Air Changes

The air changes rate for maintaining a differential of 20° to 25° F between inside surface temperature and inside space dew point temperature with a maximum relative humidity of 40% to 45% in the space, will depend upon the type of equipment to be used and the time of the year. Another consideration is length of time required to hold the blast. The volume of a given space is a major factor in determining equipment type and size. The rate of air changes per hour may be anywhere from 1 to 6.0 or more to hold the desired degree of cleanliness of the blast.

B. Temperature Control

Auxiliary heat, cooling and/or insulation may be necessary to maintain the surface temperature at an acceptable level for the coating manufacturer's application parameters. This auxiliary equipment must be approved for use by the supplier of the dehumidification equipment and will meet the following requirements.

1. Heaters and refrigerant type systems must be installed in the process air supply duct between, and/or blended with, the dehumidifier as close to the space as possible.
2. Only electric, indirect fired combustion, or steam coil auxiliary heaters will be used. No direct-fired space heaters will be allowed during the blasting, coating, and curing phrases.
3. Heaters will be equipped with controls that automatically turn the heater off if the airflow is interrupted or the internal temperature of the heater exceeds its design temperature or that of the supply duct.

The space to be controlled will be sealed off as well as possible, allowing air to escape the space away from the point where the dehumidified air is being introduced. Filter the air escaping the space; the filtration system must be designed so that it does not interfere with the dehumidification equipment's ability to control the dew point and relative humidity of space. Do not recirculate the air from the space or from filtration equipment back through the dehumidifier during coating application or when solvent vapors are present.

3.06 CONTAINMENT

Full or partial shroud of the entire structure may be required during sand blasting and painting of exterior.

Containment System: The Contractor shall design a containment system for the work area. The containment shall control environmental emissions and control the working environment within containment so all Federal, State and local regulations have been observed and that the method(s) of removal complies with the governing specifications. Nevertheless, in the instance of conflict between any Federal, State or local regulations and the governing specifications, the Federal, State or local regulations shall supersede any requirements contained herein.

The Contractor shall thoroughly examine the structure to be prepared to verify its ability to support a containment system including the wind loads that can be imparted by such a system.

The Contractor shall submit a sample and/or samples of wind screening material supported by technical data sheets for the proposed containment system, the technical data sheet to include:

- Wind Resistance
- Opacity
- Burst Strength
- Material Composition
- Color
- Fire Rating
- Thread Count
- Ultra-Violet Stabilized

The wind containment must comply with the principles of security, which are:

- Appropriate protection of the environment from abrasive blasting and painting debris.
- Pinhole ventilation (% for retention), allowing for cross-flow of air movement.
- Edgings as well as every internal seam are sewn.
- Alternate internal seams are reversed for additional strength.
- Grommets are spaced along all edges and seams for the wind load to be supported by the screens.
- Permeable to natural lighting, unless alternate lighting is to be provided (show that lighting is explosion-proof).
- A minimum of 6" tarp overlap will be required as to provide for a maximum possible containment of spent debris.

The windscreen containment system shall be maintained free of defects through the course of the project. Work shall be stopped until all defects are repaired.

Blasting inside a tank, tank column, or modular containment is considered working within a closed environment. OSHA, therefore, requires a clean, uncontaminated air source outside the enclosure with an appropriate backup such as another source of clean, uncontaminated air to be activated by merely switching a valve contained on the worker's body; air bottles strapped onto the worker; Scott Air Packs attached to the worker's body; or other OSHA approved and accepted air sources.

The Contractor shall employ negative air pressure inside the structure with the air vented to the outside, filtered, dewatered, and returned to the enclosed space at least as clean as native air.

3.07 CONFINED SPACE

The Contractor shall provide confined space training certificates of all persons who will be working on this project. Certificates shall be submitted to Engineer/Owner before work begins.

3.08 CLEAN UP

Upon completion of the work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the Engineer. Coating or paint spots or oil stains upon adjacent surfaces shall be removed and the jobsite cleaned. All damage to surfaces resulting from the work of this section shall be cleaned, repaired or refinished to the satisfaction of the Engineer at no cost to the Owner.

3.09 REPORTING/RECORDS

All work, including inspections, shall be recorded daily by the CONTRACTOR. A copy of each daily report shall be placed in a file kept on the job site. The reports shall include, but not necessarily limited to, the following information:

- Date
- CONTRACTOR and subcontractor name (where applicable),
- INSPECTOR name (where applicable),
- Work Identification including:
  -Type of work performed,
  -Location of work performed *(indicated on generalized drawings of the reservoir),
  -Time of day each portion of the work was begun and completed,
- Weather conditions, including corresponding time of day, before during and after work begins including:
  -Temperature (air and surface)

-Humidity/dew point

  -Wind velocity/direction,
- Remarks and results of work,
- CONTRACTOR signature,
- Generalized drawings shall include:
  -Plan view of reservoir,
  -Profile view of reservoir,
  -Plate location,
  -North arrow,
  -Any other drawings that will help to indicate location of work performed.

3.10 MAINTENANCE MATERIAL

At the end of the project before final payment, the CONTRACTOR shall provide the OWNER (5) five one gallon cans of each type and color of coating, primer, thinner, another coatings used in the field including multiple component materials. The material shall be delivered in unopened, typed-labeled cans, just as it comes from the factory. If the manufacturer does not package the material in one (1) gallon cans, and in the case of special colors, the materials may be delivered in new five (5) gallon containers, properly closed with typed, color, and batch numbers. The manufacturer's directions for use and literature describing the materials shall also be furnished to the OWNER in three bound copies and a typed inventory list shall be furnished at the time of delivery.

END OF SECTION

SECTION 13204 – Welded Steel Elevated Storage Tank – Single Pedestal Spheroid

City of Copperas Cove – Mountain Top North Water Improvements

PART 1: GENERAL

1.01 DESCRIPTION

1. SCOPE OF WORK:

The work to be performed under these specifications includes furnishing all labor, materials, tools and equipment necessary to design, fabricate, construct, and test a single pedestal spheroidal welded steel elevated water storage tank, including the design and construction of the foundation, concrete floor, and accessories as shown on the drawings and specified herein. The work shall also include all labor, materials and equipment necessary to clean, paint and disinfect the water storage tank as specified herein.

Except where otherwise noted, the latest revision of AWWA Standard D100-96 shall be followed for the tank design, construction and inspection; and the latest revision of AWWA Standard D102-97 shall be followed for the tank painting. Design shall meet requirements set forth by the Texas Commission on Environmental Quality (TCEQ).

All material used on this project shall be new and workmanship shall be of the best quality. Qualified and skilled workmen shall be employed for all phases of this project.

2. DESCRIPTION:

This project consists of a 300,000-gallon elevated water storage tank.

The tank and support structure shall be of the single pedestal spheroidal style as designed and constructed by Chicago Bridge and Iron Company (CB&I); Caldwell Tanks; Phoenix Fabricators & Erectors; Landmark; Maguire Iron; or approved other. The tank and support structure shall be of all welded steel design.

3. OPERATING PARAMETERS:

	Base Bid
Minimum capacity within operating range:	300,000-gal
Maximum fill rate:	3,000-gpm
Maximum withdrawal rate:	4,000-gpm
Overflow shall be sized for:	3,000-gpm
Elevation - Overflow:	1392.00 ft
Top of Foundation:	1254.00 ft
Nominal Operating Range:	30.0 ft

4. RELATED DOCUMENTS:

The Construction Drawings and the General Conditions, Supplemental Conditions, and Special Provisions of these Contract Documents apply to work in this Section.

1.02 FOUNDATION

The storage tank contractor shall design and install the tank foundation. The foundation design shall be sealed by a Registered Professional Engineer licensed to practice in the State of Texas. A copy of the Geotechnical Engineering Study is attached with the Contract Documents.

1.03 QUALITY ASSURANCE

1. Qualifications and Experience.

All tank work shall be performed by a company which specializes in the design and construction of single pedestal spheroid style welded steel elevated water storage tanks using the methods of fabrication which are capable of meeting all the requirements of these specifications. No company is considered qualified unless it has designed and built in its own name at least five (5) single pedestal spheroid style welded steel elevated water storage tanks, conforming to AWWA D 100, of equal or greater capacity in the last ten years.

2. Singular Responsibility.

It is the express intent of this Specification to create a singular responsibility for the design and construction of the single pedestal spheroid style welded steel elevated water storage tank. The design and construction of all aspects of the foundation, floor slab, wall and roof of the single pedestal spheroid style welded steel elevated water storage tank are the responsibility of the tank Contractor and shall not be otherwise assigned. Subcontractors may be employed for excavation, labor, mechanical and other aspects of the work, but overall responsibility for the storage tank remains with the tank Contractor.

1.04 REFERENCE STANDARDS

The latest edition of the following standards and specifications shall be used:

A. American Concrete Institute (ACI)
- 307 Standard Tolerances for Concrete Construction and Materials
- 301 Structural Concrete for Buildings
- 304 Guide for Measuring, Mixing, Transporting and Placing Concrete
- 305 Hot Weather Concreting
- 306 Cold Weather Concreting
- 318 Building Code Requirements for Structural Concrete
- 347 Guide to Formwork for Concrete

B. American Institute of Steel Construction (AISC)

S335 Specification for Structural Steel Buildings

C. American National Standards Institute (ANSI)

B16.5 Pipe Flanges and Flanged Fittings

D. American Petroleum Institute (API)

650 Welded Steel Tanks for Oil Storage

E. American Society for Testing Materials (ASTM)
- A 123 Zinc Coatings on Iron and Steel Products
- A 240 Stainless Steel Plate, Sheet and Strip for Pressure Vessels
- A 285 Pressure Vessel Plates, Carbon Steel

A 774 Welded Stainless Steel Fittings
A 778 Welded Stainless Steel Tubular Products

F. American Water Works Association (AWWA)

D100 Welded Steel Tanks for Water Storage
D102 Coating Steel Water Storage Tanks
C652 Disinfection of Water Storage Facilities

G. Federal Aviation Administration (FAA)

70/7460-1H Obstruction Marking and Lighting

H. National Association of Corrosion Engineers (NACE)

RP0178

I. National Fire Protection Association (NFPA)

NEC National Electric Code
780 Standard for the Installation of Lightning Protection Systems

J. National Sanitation Foundation (NSF)

61 Standard for Drinking Water System Components

K. Occupational Safety and Health Administration (OSHA)

29 CFR Part 1926 Safety and Health Regulations for Construction

L. Steel Structures Painting Council (SSPC)

VIS-89 Visual Standard for Abrasive Blast Cleaned Steel

M. Texas Commission on Environmental Quality (TCEQ)

290 Rules and Regulations for Public Water Systems

1.05 GEOTECHNICAL INVESTIGATION

A copy of the Geotechnical Engineering Study performed for this site is attached with the Contract Documents. Any further testing or information deemed necessary by the Contractor will be at the Contractor's expense.

1.06 SUBMITTALS

In addition to the requirements stated in Section 01330, Submittals, the following also apply:

1. A preliminary section view drawing of the tank proposed shall be included as part of the Bid Documents. The drawing shall include sufficient detail to illustrate tank geometry, primary dimensions, the elevation of low and high water levels and other information required to show compliance with the specification. If a Preliminary Section View Drawing is not included with the Bid Documents, or the proposed design does not comply with the specifications, the bid shall be rejected.

2. The elevated storage tank contractor shall submit detailed construction drawings of the elevated tank and foundation for approval by the Engineer prior to fabrication. Reinforced concrete details shall include construction joints, openings and inserts. Reinforcement shall be clearly indicated on the structural drawings and identified by mark numbers that are used on the fabrication schedule. Location, spacing and splice

dimensions shall be shown. Placement and fabrication details shall conform to ACI 318. Steel tank details shall include weld joints and a layout showing all primary and secondary shop and field welds. The drawings shall be signed and sealed by a Professional Engineer licensed to practice in the State of Texas. The Contractor shall supply a minimum of six (6) copies of the design for review. Two (2) of these copies will be returned to the Contractor. If the Contractor desires more than two (2) copies returned, they shall submit extra copies.

3. The elevated storage tank contractor shall submit a summary of the design for the foundation, support structure and the tank prior to fabrication. This shall include the design basis, loading and results showing conformance with the specifications and the reference codes and standards. The design shall by signed and sealed by a Professional Engineer licensed to practice in the State of Texas. The Contractor shall supply a minimum of six (6) copies of the design for review. Two (2) of these copies will be returned to the Contractor. If the Contractor desires more than two (2) copies returned, they shall submit extra copies.

4. Welder's certifications shall be submitted in accordance with AWWA D100.

5. Upon completion of construction, the elevated storage tank contractor shall provide a minimum of four (4) copies of an Operating and Maintenance Manual containing operating instructions, maintenance instructions, as-built construction drawings, a gage table, and catalog cut sheets of the equipment installed.

1.07 SEQUENCING AND SCHEDULING

1. Schedule: The Contractor shall provide a bar chart showing the anticipated schedule for design, submittals, site work and the major components of construction including foundation, support structure and tank. In addition, show tank painting, electrical installation and other significant activities. Update the schedule as required.

2. Notification: The Contractor shall provide notification of the intent to start work at least seven days prior to commencing each major phase of work.

1.08 CERTIFICATIONS

Prior to construction, provide certification from the engineer of record that the elevated tank has been designed in accordance with the requirements of the specification. Upon completion of construction the Contractor shall provide certification from the Professional Engineer of record that the elevated tank has been constructed according to the submitted and approved Construction Drawings and Design.

PART 2: PRODUCTS

2.01 GENERAL

Furnish an elevated water storage tank as shown on the drawings and as specified in this section. The design, materials, fabrication, construction, testing and inspection of the tank, support structure and foundation shall comply with the latest edition of AWWA D100, except as modified herein. Tank capacity, head range, height to TCL and top of foundation elevation shall be as shown on the drawings and as listed in Part 1.01 Description, No. 3 Operating Parameters, of this Section.

2.02 DESIGN CRITERIA

1. Dead load shall be the weight of all permanent construction and fittings.

2. Water load shall be the weight of all of the liquid when the tank is filled to the overflow.

3. Snow load shall be 25 pounds per square foot, in accordance with current AWWA D100 Standards.

4. Wind load shall be 100 miles per hour from any direction, in accordance with current AWWA D100 Standards.

5. The tank shall be designed for Zone 0 Earthquake resistance by the fixed percentage method in accordance with current AWWA D100 Standards.

6. The design for all sections of the steel tank shall be per the classes of materials and unit tension/compression stresses mentioned in the latest edition of AWWA D100.

7. All openings in the support structure shall be properly reinforced. Loads imposed by openings in the base of the support structure shall be accommodated in the foundation design.

8. The overturning moment used in designing the support structure and foundation shall include the moment due to eccentricity of the gravity loads caused by deflection of the structure under wind or seismic conditions (i.e. P-Delta effect).

9. Unless otherwise noted, at junctions in plates where meridional forces are discontinuous such as cone to cylinder junctions, a tension or compression ring may be required to resist the radial forces generated. In these regions, the allowable stresses shall not exceed those referred to in AWWA D100.

    A. Tension ring stresses shall not exceed the lesser of 15,000 psi or one half of the minimum specified yield of the plate material.

    B. Compression ring stresses shall not exceed 15,000 psi.

    C. To determine the stresses in the ring due to discontinuity forces, the tank plates immediately adjacent to the discontinuity may be assumed to participate for a distance of $0.78\sqrt{Rt}$.

10. There shall be a one sixteenth (1/16) inch minimum corrosion allowance for wetted areas only.

11. The concrete foundation(s) shall be designed by the Contractor using the recommendations given in the geotechnical report. As a minimum, the foundation shall be in accordance with American Concrete Institute (ACI) and American Water Works Association (AWWA) standards and shall safely support the structure.

12. Earth cover shall be a minimum of three (3) feet over top of pipe. Any pipe passing through the foundation which does not meet this minimum cover requirement, shall be properly insulated until such minimum cover is achieved.

2.03 TANK

The elevated tank shall be all welded construction and shall be designed in accordance with the applicable sections of the latest revision of AWWA D100 unless otherwise noted. The required capacity and dimensions are noted on the Drawings and in this Section of the specifications. All members shall be designed to safely withstand the maximum stress to which they may be subjected during erection and operation. The minimum thickness of any steel plate shall be 1/4-inch.

2.04 APPURTENANCES

1. GENERAL:

Appurtenances shall comply with the minimum requirements of the Specifications, Codes and Standards listed in Part 1.04, Reference Standards, of this Section and operating requirements of the structure.

2. TANK ENTRY:

One 36 inch, minimum, by 80 inch, minimum, plate access door, with vent, with flush threshold shall be provided and located in the base of the support structure complete with a handle and drip cover. The door shall be fabricated from steel plate with adequate stiffening and specifically designed for use with the tank. A step-over threshold is not acceptable. A 'Locknetics' programmable lock shall be installed on the door.

3. PIPING & PRESSURE RELIEF:

A. A 12-inch diameter outlet pipe shall be provided from the bottom of the tank to a flanged connection at the base of the support structure. The bottom capacity level of the tank's operating range shall be at or above the elevation of the top of the outlet pipe. The outlet pipe shall be welded steel and have a thickness not less than standard weight pipe. The outlet pipe shall have an expansion joint above the base bend. Piping below the grade slab shall be flanged cement lined ductile iron suitably restrained to resist movement.

B. A separate 12-inch diameter inlet pipe shall be provided that extends two-thirds (2/3) up the inside of the nominal operating range of the bowl. The inlet pipe shall be welded steel and have a thickness not less than standard weight pipe. The inlet pipe shall have an expansion joint above the base bend. Piping below the grade slab shall be flanged cement lined ductile iron suitably restrained to resist movement.

C. An overflow pipe equipped with an anti-vortex entrance detail shall be provided. The overflow pipe shall be sized to meet the overflow rate stated in Part 1.01 Description, No. 3 - Operating Conditions, of this Section. The overflow pipe shall be welded steel and have a thickness not less than 1/4 inch. The overflow shall extend down the inside of the access tube and support structure and discharge at a point approximately one (1) foot above grade. The end of the overflow shall discharge through a flap valve onto a concrete splash pad, as detailed in the Construction Plans. Flap valve shall fit tightly with no gap over 1/16th of an inch.

D. A minimum of one pressure-vacuum vent near the center of the roof shall be provided. The vent(s) shall be sized to handle pressure differential caused by water entering or leaving the tank at a maximum rate. The inlet and withdrawal rates shall be as stated in Part 1.01 Description, No. 3 - Operating Conditions, of this Section. The open area of the overflow shall not be considered as a venting area. The vent(s) shall have insect screens and shall be designed to relieve any pressure or vacuum in the event the screen frosts over or is otherwise clogged and shall be easily dismantled for cleaning. Screens shall be 16-mesh or finer and clamped into place with stainless or galvanized bands or wires and designed to withstand the winds of not less than the design criteria provided in this specification. The vent(s) shall be self-correcting. The pressure-vacuum vent may be mounted in the exhaust hatch cover plate.

E. Tank Drain Assembly: A tank drain assembly shall be provided, which shall include a minimum 4 in. pipe and 4 in. ball valve. The drain pipe entrance shall be on the tank floor, as low as possible, and be connected to the overflow pipe. The tank drain pipe shall be constructed of welded steel, with galvanized brackets, guides and hangers. The ball valve shall be installed in a location which is easily accessible from the walkway platform without the use of a ladder or other device.

F. Level Indication: A level transmitter and sampling tap shall be installed as shown on the Construction Plans.

4. ACCESS, LADDERS & PLATFORMS:

A. Provide a ladder system, which extends from grade to the upper shaft platform. This ladder shall be equipped with a ladder safety device meeting OSHA Standards. Ladders located in the support structure and access tube interior shall be galvanized steel. Tank interior ladders shall be coated in accordance with the tank interior coating system.

B. Provide a ladder on the interior of the access tube from the upper shaft platform to the tank roof. This ladder shall be equipped with ladder safety rail or cable, and a removable extension.

C. The ladder safety rail or cable shall be an OSHA approved galvanized system as manufactured by CB&I Industries, or equal. Provide a removable extension for each ladder. The owner shall be supplied with two (2) harnesses and two (2) sleeves.

D. Rest platforms shall be provided at maximum 40 foot intervals along the interior pedestal ladder. The platforms shall be 3 ft x 3 ft and the platform floor shall be grating. The platform shall be complete with handrails, mid rails and tow plates in accordance with OSHA requirements. Grating shall be used for the walking surface and shall be suitably hinged at the ladder penetration. Platform shall be arranged for straight run ladder and operable without removing fall prevention equipment. All components shall be galvanized steel.

E. A steel condensate ceiling with drain shall be supplied, located at the junction of the pedestal shaft and base bell. The condensate ceiling shall be equipped with a steel drain pipe connected to the overflow pipe.

F. An upper shaft platform shall be supplied, located at the top of the support structure.

G. Provide an access tube located on the vertical centerline of the tank. The access tube shall have a minimum diameter of 48 inches and shall provide access from the upper shaft platform to the tank roof.

H. A 42-inch tall handrail shall be installed on tank roof around the perimeter of the hatches, as shown and detailed on the Plans.

5. MANHOLES, HATCHES & VENTS:

D. At the top of the support structure, one 24-inch diameter painters access manhole shall be provided giving access to the painters rings.

E. One 30-inch and one 36-inch diameter hinged rain proof hatches shall be supplied. One shall be at the top of the access tube with chain, hook and inside handle. The other shall be adjacent to the access tube for entry into the tank and shall have a handle and hasp. The hatch openings shall have a curb four inches high and the cover shall have a downward overlap of two inches.

F. One 24-inch diameter flanged exhaust hatch shall be supplied, located adjacent to the access tube and so constructed that an exhaust fan may be connected for ventilation during painting.

G. Access hatches shall be provided in both the condensate ceiling and the upper platform. The access hatches shall have a minimum opening of 30”x30” with opening to allow ladder and safety device to continue 48” minimum above the platform floor.

H. All access openings shall have a raised curbing at least four (4) inches in height with lockable cover that overlaps the curbing at least two (2) inches

6. PAINTERS RAILS:

Provide painters rails as shown on the drawings and specified herein:

A. Interior Painters Rails. On tanks with a capacity greater than one million gallons, a rail shall be attached to the underside of the roof at the roof-to-shell junction.

B. Exterior Painters Rails. Two rails shall be located near the top of the support pedestal and be accessible from the upper shaft platform via the painters access manhole.

2.05 ELECTRICAL

1. Interior and exterior waterproof light fixtures with rigid conduit, wiring and switches as well as electrical outlets and other electrical appurtenances shall be provided as detailed on the Plans and in the Electrical Specifications, attached to these Contract Documents.

2. Obstruction lighting shall be provided on the roof of the tank near the apex. The lights shall be enclosed in aviation red obstruction light globes as approved by the FAA, complete with an automatic photo-electric cell type switch. The photo-electric cell shall be located at the base of the tank. The contractor shall install all conduit and wiring from the light to the electrical service panel.

3. Provide two 2 in. spare conduits and four 1 in. spare conduits, stubbed out through the tank floor and extending 5 feet past the foundation, for future use. Cap the ends.

PART 3: EXECUTION

GENERAL:

The project site shall be kept in a clean and safe condition at all times. The Contractor shall remove all construction equipment and debris at project completion.

3.01 FIELD QUALITY CONTROL

A. Inspection and testing shall be in accordance with AWWA D100, Section 11.

1. Radiographic inspection of full penetration butt welded joints shall be made by an independent inspection company provided by contractor.
2. Owner will retain the services of an independent AWS Certified Welding inspector and NACE Certified Coating Inspector for quality control of welding techniques, preparation of steel, and coatings application.
3. Contractor is responsible for providing access to tank, communicating work progress, and coordinating inspection services with Owner's independent consultant.
4. Tank Contractor shall be responsible for travel expenses for third party inspector to visit manufacturing facilities. Third party inspector shall inspect manufacturing process including but not limited to welds, quality and shop prime.

B. Concrete testing shall be as follows:

Concrete testing shall be as called for in Section 03000 – Concrete of the Technical Specifications.

C. Inspection of Painting Operations:

Testing and inspection of surface preparation and painting operations shall be as called for in Sections 09911 and 09913 of the Technical Specifications.

3.02 CONCRETE FOUNDATION

1. The foundation bearing surface and excavation shall be inspected by a representative of the geotechnical engineer prior to foundation construction. Verification of the applicable design and construction recommendations is required. The geotechnical engineer shall be retained by the Owner.

2. The inlet pipe, outlet pipe and electrical conduit extending outside the foundation wall shall be included as part of the foundation.

3. The interior of the support structure base shall be finished with a concrete floor. All excavated areas under the concrete floor shall be backfilled with suitable material and compacted as specified by the design engineer.

4. All concrete work, including concrete, formwork and reinforcing, shall comply with the applicable sections of the latest revisions of the ACI Standards.

3.03 STEEL TANK CONSTRUCTION

1. All welding shall comply with AWWA D100.

2. All welding procedures, welders and welding operators shall be qualified in accordance with ASME Section IX for the processes and positions utilized.

3. The edges or surfaces of the pieces to be joined by welding shall be prepared by flame cutting, plasma arc cutting, arc gouging, machining, shearing, grinding or chipping and shall be cleaned of detrimental oil, grease, scale and rust. The edges of the pieces may have a protective coating applied to them, which need not be removed before they are welded unless specifically prohibited by the welding procedures.

4. All welded connections not specifically designed to be full or partial penetration welds shall be seal welded including but not limited to underside roof plate laps, roof support system, ladder clips and etc.

5. Welding procedures and general welding requirements shall be in accordance with AWWA D100, Section 8, "Welding". Welding shall only be done by ASME qualified welders. No structural welding is permitted to any steel embedded in hardened concrete, unless the weld is at least 2 ft. from the embedment interface. Grinding of weld contour shall approximate condition of NACE Standard RPO178 designation "D".

6. Plates and component members of the tank shall be assembled and welded following erection methods, which result in a minimum of distortion from weld shrinkage. Surfaces to be welded shall be free from loose scale, slag, heavy rust, grease, paint and other foreign material.

PART 4: COATINGS & FINISHES

All tank painting and paint testing shall be in accordance with AWWA D102, the Steel Structures Painting Council Specification SSPC-PA1, the approved paint manufacturer specifications and as specified herein.

Each paint system shall be from a single manufacturer. The coatings and finishes for the elevated tank shall meet the requirements as stated in Sections 09911, 09912, and 09913 of these Technical Specifications.

PART 5: TESTING AND STERILIZATION

1. Sufficient cure, per the manufacturer's recommendations, of the final coat on the interior wet surface shall be allowed before the elevated tank is sterilized and filled with water.

2. The tank shall be sterilized per the requirements of AWWA C652. Acceptable forms of chlorine for disinfection shall be:
    a. Liquid chlorine as specified in AWWA C652
    b. Sodium hypochlorite as specified in AWWA C652
    c. Calcium hypochlorite (HTH) is *not* acceptable.

Acceptable methods of chlorination per AWWA C652:

a. Section 4.1.1
b. Section 4.1.2 – chemical feed pump only (4.1.2.1)
c. Section 4.3
d. Section 4.2 is *not* acceptable.

3. The Owner, free of charge to the Contractor, shall furnish sufficient water for testing and sterilization at a rate which will allow the Owner to adequately furnish water service to its existing customers. The water shall be at proper pressure to fill the tank to the maximum working level. Any leaks in the tank that are disclosed by this test shall be repaired by chipping, gouging, or oxygen gouging to remove any defective welds and re-welded. The method of repair shall be approved by the Owner's Representative prior to repair by the Contractor. No repair work shall be done on any joint unless the water in the tank is at least 2 feet below the joint being repaired. Any paint damaged by repairs shall be properly restored. Once repaired, the tank shall be retested for leaks and the additional water paid for by the Contractor.

4. Upon completion of the sterilization procedure, the Owner or his representative, shall arrange and bear the initial cost of any bacteriological testing of water samples from the tank that may be required. If the test results do not pass, the Contractor will pay for subsequent sterilization and testing. The tank shall not be placed in service until safe test results are obtained.

PART 6: GUARANTEE

The Contractor shall guarantee the structure, appurtenant equipment and accessories provided under this Section for a minimum period of one year from the date of substantial completion. Substantial completion is defined as the date when the tank is placed, or available to be placed, into service. The Contractor will repair any defects of which they are notified during that period which may appear because of faulty design, workmanship or materials furnished under the specifications. Defects caused by damaging service conditions such as electrolytic, chemical, abrasive or other damaging service conditions are not covered by this guarantee.

All guarantees obtained by the Contractor from the manufacturer or installer of paint, equipment or accessories not manufactured by the Contractor shall be obtained for the benefit of the Owner.

END OF SECTION

SECTION 15000

TECHNICAL SPECIFICATIONS - PIPING

PART 1: GENERAL

1.01 WORK INCLUDED

A. All labor and materials to complete all work as shown on the Plans and as specified herein.

1.02 CARE OF PIPE COATING AND LINING

A. Pipe shall be so handled that the coating or lining will not be damaged. If however, any part of the coating or lining is damaged, the pipe shall be subject to rejection.

1.03 GENERAL REQUIREMENTS FOR ALIGNMENT AND GRADE

A. The pipe shall be laid and maintained to the required lines and grades with fittings and valves at the required locations; spigots centered in bells; and all valve stems plumb.

B. The inside of the pipe wall at the bottom of the installed pipe shall slope continuously in the direction indicated and shall be located on the invert elevations indicated within 0.01 foot for gravity piping and within 0.03 foot for all other piping.

1.04 DEVIATIONS OCCASIONED BY OTHER STRUCTURES

A. Wherever obstructions not shown on the Plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plans is required, the Engineer shall have the authority to change the Plans as required, and order a deviation from the line and grade, or arrange with the Owners of the structures for the removal, relocation, or reconstruction of the obstructions. If the change in Plans results in a change in the amount of work by the Contractor, such altered work shall be done on the basis of payment to the Contractor for extra work under the requirements of the General Conditions, or credit to the Owner for less work. No deviations shall be made from the line and grade without the written consent of the Engineer.

1.05 EXCAVATIONS FOR PIPING

A. Excavation for piping shall be in accordance with the applicable requirements of Section 02300-Earthwork.

B. No drainage channel storm sewer, or other utility shall be put out of service without written approval of the Engineer and/or Owner.

1.06 SHOP DRAWINGS

A. The Contractor shall submit and obtain approval of shop and material details of pipe and fittings before the materials are manufactured. See Section 01300- Submittals included as part of these Specifications for items requiring approval.

1.07 THREADS

A. American Standard Pipe thread shall be used for I.P.S threaded work. No screwed pipe joints shall be caulked or screwed up with rope or packing of any kind. Burrs formed by cutting tools shall be reamed out and, before installation; each section of pipe shall be examined to see that it is clean and clear. Pipes shall be free from tool marks. When erecting plated, polished, or soft-metal piping, friction wrenches shall be used exclusively. In “marking up” screwed joints, Crane or Key White thread lubricant shall be used and applied to male threads only.

1.08 SUPPORTS AND ANCHORS

A. Pipe supports, unless otherwise shown on the Drawings, shall be provided at the base of all risers, at intervals not to exceed 5 feet on all runs of pipe 2 inches and smaller in diameter, and at intervals not exceeding pipe support manufacturer’s recommendations on runs of pipe over 2 inches in diameter. Pipe run in groups shall be spaced equally and kept parallel throughout the length of the run. Pipe abutting walks or ceilings shall be supported by Unistrut P1000 channels, Figure 650 pipe clamps and hanger rods if necessary.

B. For pipe over 2 inches, supports and hangers shall be as shown on the Mechanical Details of the Plans.

C. For pipe 2 inches and less, hangers shall be Grinnel Company No. 97. All items shall be galvanized.

D. Expansion bolts and inserts driven into concrete slabs for pipe hangers shall be installed without injury to the structure.

E. Anchorage shall be provided for fittings where there is danger of pulling joint when under pressure.

PART 2: MATERIALS

2.01 GENERAL

A. All codes, standards, and ASTM Standards referred to in the following specification shall be in accordance with the latest revision of the standards at the time of bidding.

B. Piping material shall be as herein specified unless otherwise shown on the Plans. Standard Specification designations shall be the latest published designations. Coatings shall be as specified in Section 3.

2.02 STEEL PIPE

A. Standard Weight steel pipe shall be ASTM A 53, Schedule 40. Extra Heavy Weight shall be Seamless ASTM A 53, Schedule 80.

B. Encasement Pipe: For direct-bury installations, pipe shall conform to ASTM A134 with minimum thickness of 3/8 inch (9.5 mm). For jacked installations, pipe shall conform to requirements on drawings.

C. Fittings: Nipples and fittings extra strong Federal Specification WW-N 351 or WW-P 521.

D. Coatings: Black or galvanized as indicated.

2.03 WELDED STEEL PIPE AND FITTINGS FOR WATER PIPE

A. General Reference Standards Specification

Specifications of the American Water Works Association (AWWA) listed below shall apply to this Section.

C-200 Steel Water Pipe 6 inches and larger.

C-205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 inches and larger, Shop Applied.

C-206 Field Welding of Steel Water Pipe.

C-207 Steel Pipe Flanges for Waterworks Services, Sizes 4 inches through 144 inches.

C-208 Dimensions for Steel Water Pipe Fittings.

C-602 Cement-Mortar Lining of Water Pipelines, 4 inches and larger in Place.

B. Submittals

Furnish Shop Drawings, product data, design calculations and test reports as described below:

1. Certified copies of mill tests confirming the type of materials used in steel plates, mill pipe flanges and bolts and nuts to show compliance with the requirements of the applicable standards.

2. Complete and dimensional working drawings of all pipe layouts. Shop Drawings shall include the grade of material, size, wall thickness of the pipe and fittings, type and location of fittings and the type and limits of the lining and coating systems of the pipe and fittings.

3. Product data to show compliance of all couplings, supports, fittings, coatings and related items.

C. Job Conditions

1. The internal design pressure of all steel pipe and fittings shall be as indicated.

2. The interior of all steel pipe for potable water, 4 inches and larger, shall be cement-mortar lined.

D. Manufacturing

1. Pipe shall comply with AWWA C-200.

(a) Circumferential deflection of all pipe in-place shall not exceed 2.0 percent of pipe diameter.

(b) Nominal pipe diameter shall be the inside diameter of lining or pipe barrel, unless otherwise designated in Job Conditions.

2. Wall Thickness

Steel pipe wall thickness shall be designed for the internal and external loads specified in this section. The cylinder thickness needed to resist internal pressure shall be based on an allowable stress in the steel equal to 1/2 the minimum yield stress of the material used.

E. Fittings

Welded - Fabricated steel fittings shall be of the same material as pipe and shall comply with AWWA C-208.

F. Flanges

1. Flanges shall comply with the requirements of AWWA C-207, Class D or Class E. The class shall be based on operating conditions and mating flanges of valves and equipment.
2. Gaskets shall be cloth-inserted rubber, 1/8 inch thick.
3. Flanges shall be flat faced with a serrated finish.

G. Pipe Joints

1. Lap Joints for Field Welding
   a. Lap joints for field welding shall conform to AWWA C-206. This item applies only to pipes 72 inches in diameter and larger.
   b. The bell ends shall be formed by pressing on a hydraulic expander or a plug die. After forming, the minimum radius of curvature of the bell end at any point shall not be less than 15 times the thickness of the steel shell. Bell ends shall be formed in a manner to avoid impairment of the physical properties of the steel shell. Joints shall permit a lap at least 1 1/2 inches when assembled. The longitudinal or spiral weld on the inside of the bell end and the outside of the spigot end on each section of pipe shall be ground flush with the plate surface. The inside edge of the bell and the outside edge of the spigot shall be scarfed or lightly ground to remove the sharp edges or burrs.
2. Bell and Spigot Joints with O-Ring Gasket
   a. Bell and spigot joints with rubber gasket shall conform to AWWA C-200.
   b. The bell and spigot ends shall be so designed that when the joint is assembled, it will be self-centered and the gasket will be confined to an annular space in such manner that movement of the pipe or hydrostatic pressure cannot displace it. Compression of the gasket when the joint is completed shall not be dependent upon water pressure in the pipe and shall be adequate to ensure a watertight seal when subjected to the specified conditions of service. Bell and spigot ends shall be welded on preformed shapes. The bell and spigot ends shall conform to the reviewed Shop Drawings.

H. Interior and Exterior Protective Surface Coatings

1. Exterior Surface to be mortar coated shall conform to AWWA C-205 for shop application and AWWA C-602 for field application. Pipe materials shall be the product of an organization, which has had not less than 5 years successful experience manufacturing pipe materials, and the design and manufacture of the pipe, including all materials, shall be the product of one company.
2. All surfaces except as noted in 3.) and 4.) below shall receive shop application of mortar lining and coating.
3. Field Welded Joints. After installation, clean, line and coat unlined or uncoated ends adjacent to welded field joints, including the weld proper, as specified for pipe adjacent to the weld.
4. Machined Surfaces. Shop coat machined surfaces with a rust preventative compound. After jointing surfaces, remaining exposed surfaces shall be coated per 1.) and 2.) above.

2.04 DUCTILE IRON PIPE (DIP)

A. General

1. Ductile iron push-on and mechanical joint pipe shall meet all requirements of AWWA C-151.

2. Flanged pipe shall meet all requirements of AWWA C-115. Barrels shall have a nominal thickness required by Table 1 of AWWA C-115, which thickness corresponds to Special Class 53 in sizes through 54 inch, and Class 350 in 60 and 64-inch sizes. Flanges shall be ductile iron (gray iron is not acceptable); they shall be as shown in ANSI/AWWA C115/A21.15 and shall conform to dimensions shown in Table 2 and Figure 1 of AWWA C115. Flanges shall be fabricated and attached to the pipe barrels by U.S. fabricators using flanges and pipe barrels of U.S. manufacture. If fabrication is to be by other than the pipe barrel manufacturer, a complete product submittal and approval by the Engineer will be required. Additionally, such fabricator shall furnish certification that each fabricated joint has been satisfactorily tested hydrostatically at a minimum pressure of 300 psi.

3. Linings and Coating: Interior surfaces of all iron water pipe shall be cement-mortar lined and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater line and force main pipe shall be coated with a non-corrosive epoxy lining, Protecto 401 Epoxy Lining by Induron Protective Coatings, or equal. Pipe exteriors shall be coated as required by the applicable pipe specification. The type and brand of interior lining shall be clearly marked on the outside of the pipe and fittings. Except as authorized by the Engineer, only one type and brand of pipe lining shall be used on a given project.

B. Ductile Iron Fittings

Fittings shall be push-on, flanged or mechanical joint as indicated or approved and shall meet all requirements of standards as follows:

1. Sizes 4 inch through 24 inch: AWWA C-110 or AWWA C-153

2. Sizes larger than 24 inch: AWWA C-110.

3. Lining and Coating - Interior surfaces or all iron water pipe fittings shall be lined with cement- mortar and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater and force main fittings shall be coated with a non-corrosive epoxy lining, Protecto 401 Epoxy Lining by Induron Protective Coatings, or equal. Fitting exteriors shall be coated as required by the applicable pipe specification.

C. Joint Materials

1. Gaskets for mechanical joints shall conform to ANSI/AWWA A21.11/C-111. Joining of slip joint iron pipe shall, without exception, be accomplished with the natural or synthetic rubber gaskets of the manufacturer of that particular pipe being used. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.

2. Gaskets for flanged joints shall be continuous full face gaskets, of 1/8 inch minimum thickness of natural or synthetic rubber, cloth-reinforced rubber or neoprene material, preferably of deformed cross section design and shall meet all applicable requirements of ANSI/AWWA A21.11/C-111 for gaskets. They shall be manufactured by, or satisfy all recommendations of, the manufacturer of the pipe/fittings being used and be fabricated for use with Class 125 ANSI B16.1 flanges.

3. Tee-head bolts, nuts and washers for mechanical joints shall be high strength, low alloy, corrosion resistant steel stock equal to "COR-TEN A" having UNC Class 2 rolled threads or alloyed ductile iron conforming to ASTM A 536; either shall be fabricated in accordance with ANSI/AWWA A21.11/C-111.

4. Hex head bolts and nuts shall satisfy the chemical and mechanical requirements of ASTM A449 SAE Grade 5 plain, and shall be fabricated in accordance with ASTM B 18.2 with UNC Class 2 rolled threads.

5. Either Tee-Head or Hex-Head bolts, nuts and washers as required, shall be protected with bonded fluoro-polymer corrosion resistant coating where specifically required by the Engineer.

6. All threaded fasteners shall be marked with a readily visible symbol cast, forged or stamped on each nut and bolt, which will identify the fastener material and grade. The producer and the supplier shall provide adequate literature to facilitate such identification; painted markings are not acceptable.

D. Polyethylene Film Wrap

All iron pipe, fittings and accessories shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4-mil (minimum) cross laminated high-density polyethylene conforming to AWWA C-105, with all edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the piping and the surrounding backfill. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling.

E. Marking

Each pipe joint and fitting shall be marked as required by the applicable AWWA specification. This includes in all cases: Manufacturer's identification, Country where cast, year of casting, and "DUCTILE" or "DI". Barrels of flanged pipe shall show thickness class; others shall show pressure class. The flanges of pipe sections shall be stamped with the fabricators identification; fittings shall show pressure rating, the nominal diameter of openings and the number of degrees for bends. Painted markings are not acceptable.

2.05 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

A. General

1. All polyvinyl chloride (PVC) pressure pipe shall be of the rigid (UNPLASTICIZED) type and must bear the National Sanitation Foundation seal of approval for potable water pipe. All PVC pressure pipe less than 4" in nominal diameter shall be schedule 80 PVC, unless noted otherwise. All PVC pressure pipe between 4" and 12" in nominal diameter shall be C900 PVC, DR-14, unless noted otherwise. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable.

2. Pipe shall have push-on, rubber gasket joints of the bell and spigot type with thickened integral bells with rubber gasket joints. The wall thickness of each pipe bell and joint coupling must be greater than the standard pipe barrel thickness. Clearance must be provided in every gasket joint for both lateral pipe deflection and for linear expansion and contraction. Concrete thrust blocking shall be placed behind bends and tees. Concrete support cradles or blocking shall be required for support of all fire hydrants, valves and AWWA C110 fittings; such support shall be provided for AWWA C153 fittings when required by the Engineer.

B. Applicable Specifications

1. Except as modified or supplemented herein, PVC pipe shall meet the following standards:

   AWWA C-900, DR 14 for PVC Pressure Pipe, in 4, 6, 8 and 12 inch nominal sizes, having Cast Iron Pipe size outside diameters.

2. Fittings used with PVC Pressure pipe shall be AWWA C-110 or AWWA C-153 compact ductile iron fittings.

3. All pipe 4 inches and larger must be approved Underwriter's Laboratories for use in buried water supply and fire protection systems.

C. Material Requirements

All pipe and fittings shall be made from clean, virgin, NSF certified, Class 12454B PVC. Clean reworked materials generated from the manufacturers own production may be used within the current limits of the referenced AWWA C-900.

D. Marking

1. Potable water lines shall be blue in color, reuse/reclaimed water lines shall be purple in color, and wastewater lines shall be either green in color or white in color with 'forcemain' marking on each joint or on tracer tape.

2. Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

   Nominal pipe size and OD base (e.g., 4 CIPS).
   Type of plastic material (e.g., PVC 12454B).
   Standard Dimension Ratio and the pressure rating in psi for water at 73 F (e.g., DR 14, 200 psi).
   AWWA designation with which the pipe complies (e.g., AWWA C-900).
   Manufacturer's name or code and the National Sanitation Foundation (NSF) mark.

E. Tracer Tape

Inductive Tracer Detection Tape shall be placed directly above the centerline of all non-metallic pipe a minimum of 12 inches below subgrade or, in areas outside the limits of pavement, a minimum of 18 inches below finished grade. The tracer tape shall be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape shall be placed according to manufacturer's recommendations. Manufacturers must be listed on SPL WW-597.

2.06 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE AND FITTINGS

A. General

1. PVC sewer and wastewater, non-pressure, pipe and fittings 6 through 15 inch diameter shall conform to ASTM D 3034. Pipe shall have minimum cell classification of 12364 or 12454. Fittings shall have cell classification of 12454 or 13343. Pipe stiffness shall be at least 115 psi as determined by ASTM D 2412. Pipe manufacturers shall be on SPL WW-227, and fitting manufacturers shall be on SPL WW-227B.

2. PVC sewer and wastewater, non-pressure, pipe and fittings 18 through 27 inch diameter shall conform to ASTM F 679. Pipe shall have minimum cell classification of 12364 or 12454. Pipe stiffness shall be at least 72 psi as determined by ASTM D 2412. Pipe manufacturers shall be on SPL WW-227A, and fitting manufacturers shall be on SPL WW-227B.

B. Joints

PVC pipe and fitting shall have elastomeric gasket joints conforming to ASTM D 3212. Gaskets shall conform to ASTM F 477.

C. Pipe Markings

1. Wastewater pipe shall be green in color.

2. Pipe meeting ASTM D 3034 shall have permanent marking on the pipe that includes the following at intervals of not more than 5 feet:
   Manufacturer's name and/or trademark and code.
   Nominal pipe size.
   PVC cell classification per ASTM D 1784
   The legend “SDR-_ _ PVC Sewer Pipe” (SDR 26, 23.5. or less is required)
   The designation “ASTM D 3034”

3. Pipe meeting ASTM F 679 shall have permanent marking that includes the following at intervals of not more than 5 feet:
   Manufacturer’s name or trademark and code
   Nominal pipe size
   PVC cell classification per ASTM D 1784
   Pipe stiffness designation “PS _ _ PVC Sewer Pipe” (PS of at least 72 is required
   The designation “ASTM F 679”

D. Fitting Markings

1. Fittings meeting ASTM D 3034 shall have permanent marking that includes the following:
   Manufacturer's name or trademark,
   Nominal size
   The material designation "PVC"
   The designation, "ASTM D 3034"

2. Fittings meeting ASTM F 679 shall have permanent marking that includes the following:
   Manufacturer’s name or trademark and code
   Nominal size
   The material designation “PVC”
   The designation “ASTM F 679”

E. Tracer Tape

Inductive Tracer Detection Tape shall be placed directly above the centerline of all non-metallic pipe a minimum of 12 inches below subgrade or, in areas outside the limits of pavement, a minimum of 18 inches below finished grade. The tracer tape shall be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape shall be placed according to manufacturer’s recommendations. Manufacturers must be listed on SPL WW-597.

2.07 CONCRETE PIPE

A. General

Pipe shall conform to ASTM C 76 for Circular Pipe. Concrete pipe smaller than 12 inches in diameter shall conform to ASTM C 14, Extra Strength. All pipe shall be machine made or cast by a process which will provide uniform placement of the concrete in the form and compaction by mechanical devices, which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed

concrete shall not be acceptable for use in precast pipe. The pipe shall be Class III or the class indicated. Storm sewer pipe shall be of the tongue and groove or 0-ring joint design. Wastewater pipe shall be of the 0-ring joint design; it shall be acceptably lined for corrosion protection.

B. Marking

Each joint of pipe shall be marked with the pipe class, the date of manufacture, the manufacturer's name or trade mark, diameter of pipe and orientation, if required.

C. Minimum Age for Shipment

Pipe shall be considered ready for shipment when it conforms to the tests specified in ASTM C 76.

D. Joint Materials

1. When constructing storm sewers, the Contractor shall have the option of making joints with one of the following materials:

a. Mortar

b. Cold Applied Preformed Plastic Gaskets

Cold Applied Plastic Gaskets shall be suitable for sealing joints of tongue and groove concrete pipe. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength and shall be supplied in extruded rope form of suitable cross section. The size of the plastic gasket joint sealer shall be in accordance with the manufacturer's recommendations and sufficient to obtain squeeze-out around the joint. The gasket joint sealer shall be protected by a suitable removable wrapper that may be removed longitudinally without disturbing the joint sealer to facilitate application.

The chemical composition of the gasket joint sealing compound as shipped shall meet the following requirements:

Composition (% by weight)	Test Method	Typical Analysis
Bitumen (petroleum plastic content)	ASTM D 4	50-70
Ash-inert Mineral Water	Tex-526-C	30-50
Volatile Matter (at 325 F)	Tex-506-C	2.0 Maximum

The gasket joint sealing compound when immersed for 30 days at ambient room temperature separately in 5 percent solution of caustic potash, a mixture of 5 percent hydrochloric acid, a 5 percent solution of sulfuric acid and a saturated H_2S solution shall show no visible deterioration.

The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:

Property	Test Method	Typical Analysis	
		Minimum	Maximum
Specific Gravity at 77 F	ASTM D 71	1.20	1.35
Ductility at 77F (cm) Minimum	Tex-503-C	5.0	

Softening point	Tex-505-C	275 F	
Penetration:			
32 F (300 g) 60 sec	Tex-502-C	75	
77 F (150 g) 5 sec	Tex-502-C	50	120
115 F (150 g) 5 sec	Tex-502-C		150
Flashpoint C.O.C. F	Tex-504-C	600 F	
Fire Point C.O.C. F	Tex-504-C	625 F	

2. When constructing wastewater lines, the Contractor shall use 0-ring gasket joints conforming to ASTM C 443. Just before making a joint, the ends of the pipe shall be clean, dry, free of blisters or foreign matter and shall be wire brushed. For O-ring joints, the gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound to facilitate assembly of the joint. The rubber O-ring gasket shall be stretched uniformly in the joint. Wedge seal type ("Forsheda" pre-lubricated) gaskets may be used if joint details submitted are approved; installation of such gaskets shall be in strict accordance with the manufacturer's recommendations, and shall be the sole element depended upon to make the joint flexible and watertight.

   In wastewater lines no horizontal or vertical angles in the alignment of pipes shall be permitted unless indicated. The spigot shall be centered in the bell, the pipe pushed uniformly home and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint.

E. Bends

1. When horizontal or vertical angles in the alignment of storm sewers are indicated, the bend or angle shall be constructed by cutting on a bias one or both pipes as may be required for the alignment indicated. The pipe cut shall be sufficiently long to allow exposing the reinforcement, which shall be bent, welded and incorporated into the pipe bend and reinforced concrete collar to maintain the structural integrity. The collar shall be 6 inches minimum, reinforced with #4 bars on a 1 foot center both directions. Builder's hardware cloth may be used on the outside of the joint to aid in holding cementing materials in place. Plywood, fiberboard or other materials placed on the inside of the pipe as formwork shall be removed as soon as the joint materials have obtained initial set, after which the inside surface of the pipe joint shall be finished smooth and true to the line and grade established. The Contractor may use prefabricated bends meeting the specification requirements in lieu of field fabricated bends. All bends shall be watertight, have a smooth flow line and be equal or greater in strength to the adjacent pipe.

2. Horizontal or vertical changes in alignment in wastewater lines shall be accomplished by use of manholes. With the E/A's approval, horizontal changes in alignment may be made by the "Joint Deflection" method. Joint deflection is limited by regulations of the Texas Commission on Environmental Quality (TCEQ) to 80 percent of the maximum recommended by the manufacturer; such deflection may not exceed 5 degrees at any joint. Changes in alignment using pipe flexure shall not be allowed.

F. Sulfide and Corrosion Control

All concrete pipe used for wastewater installations shall be protected from sulfide and corrosion damage by using limestone aggregate.

2.08 CONCRETE STEEL CYLINDER (CSC) PIPE

A. General Requirements

1. The Contractor shall submit to the E/A for approval along with other required data a tabulated layout schedule with reference to the stationing and grade lines to be used.

2. The manufacturer shall furnish all fittings and special pieces required for closures, bends, branches, manholes, air valves, blow offs and connections to main line valves and other fittings as indicated.

3. Each pipe length, fitting and special joint shall have plainly marked on the bell end of the pipe, the head condition for which it is designed. In addition, marking shall be required to indicate the location of each pipe length or

special joint in the line and such markings will be referenced to the layout schedules and drawings and submitted for approval.

4. Concrete steel cylinder fittings shall be tested as required by the applicable AWWA Standards.

B. Design and Inspection

1. Where not otherwise indicated, concrete steel cylinder pipe shall be Class 150, designed to withstand a vacuum of not less than 28 feet of water. Valve reducers, tees and outlets from a pipe run shall be designed and fabricated so that all stresses are carried by the steel forming the fitting or outlet.

2. Concrete steel cylinder pipe shall meet one of the following specifications:

   AWWA C-301 - Any Size
   AWWA C-303 - 24-inch maximum size

3. All pipe flanges shall conform to AWWA C-207, requirements for standard steel flanges of pressure classes corresponding to the pipe class.

4. Pipe to be installed in a tunnel or encasement shall be manufactured with 1 inch thick by 24-inch wide skid bands of mechanically impacted mortar in addition to the normal coating.

5. All concrete steel cylinder fittings shall be constructed of steel plate of adequate strength to withstand both internal pressure and external loading. Rod reinforcing shall not be used to figure the required steel area. The fittings shall have a concrete lining and 1 inch minimum coating of cement mortar, except that centrifugally spun lining need not be reinforced.

6. Minimum lining thickness shall be 1/2 inch for 16-inch pipe and 3/4 inch for sizes larger than 16-inch pipe. Where it is impractical to place such concrete protection on interior surfaces of small outlets, 2 coats of "Bitumastic Tank Solution" shall be applied.

7. No fitting shall be made by cutting of standard pipe, except that outlets of less than 75 percent of the pipe diameter may be placed in a standard pipe. Beveled spigots may be placed on standard pipe.

C. Joint Materials

Joints shall be of the rubber gasket type conforming to the applicable standards. The inside and outside recesses between the bell and spigot shall be completely filled with Cement Grout in accordance with the pipe manufacturer's recommendations. Grout materials for jointing such pipe, unless otherwise indicated, shall be as described herein.

2.09 POLYETHYLENE (PE) TUBING

A. General

All polyethylene (PE) tubing shall be high density, high molecular weight plastic tubing meeting ASTM D 2737; it shall be pressure rated at 200 psi working pressure and must bear the National Sanitation Foundation seal of approval for potable water service. Pipe manufacturers shall be listed on SPL WW-65.

B. Materials

Polyethylene plastics shall be Designation PE3408 (Grade P34 with hydrostatic design stress of 800 psi). PE tubing shall be standard copper tube size outside diameter, with Standard Dimension Ratio (SDR) of 9, unless noted otherwise.

C. Markings

1. Permanent marking on the tubing shall include the following at intervals of not more than 5 feet:

   Nominal tubing size.
   Type of plastic material, i.e., PE 3408.
   Dimension Ratio (DR) and pressure rating in psi for water at 73.4 F (e.g., SDR-9, 200 psi).
   ASTM D 2737 designation.
   Manufacturer's name or trademark, code and seal of approval (NSF mark) of the National Sanitation

Foundation.

2. Polyethylene tubing for reclaimed service lines shall be purple.

2.10 COPPER TUBING

All copper service tubing shall be annealed seamless Type K water tube meeting ASTM B88 and rated at 150 psi working pressure. The tubing shall be homogenous throughout and free from cracks, holes, crimping, foreign inclusions or other defects. It shall be uniform in density and other physical properties. Copper tubing for reclaimed water shall be wrapped in purple polyethylene film wrap. Pipe manufacturers shall be listed on SPL WW-613.

PART 3: EXECUTION

3.01 GENERAL

A. Underground piped utilities shall be constructed in an open cut in accordance with Federal regulations, applicable State Statutes and with trench width and depth requirements.

B. Excavation will not be considered or paid for as a separate item of Work, so excavated material will not be classified as to type or measured as to quantity. Full payment for all excavation required for the construction shall be included in the various unit or lump sum Contract prices for the various items of Work installed, complete in place. No extra compensation, special treatment or other consideration will be allowed due to rock, pavement, caving, sheeting and bracing, falling or rising water, working under and in the proximity of trees or any other handicaps to excavation.

C. Adequate temporary support, protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the Work shall be furnished by the Contractor, at his expense and as approved by the Engineer.

D. Where traffic must cross open trenches, the Contractor shall provide suitable bridges. For trenches less than 2 feet in width, sheet steel plates having a minimum thickness of 1/2 inch shall be used. For trenches up to 4 feet in width, sheet steel plates having a minimum thickness of 3/4 inches shall be used. In all cases, the plates shall overlay the top of the trench a minimum of 18 inches on both sides and secured by asphalt. Adequate provisions shall be made for the flow of sewers; drains and watercourses encountered during construction and any structures, which may have been disturbed, shall be satisfactorily restored upon completion of Work.

3.02 INSTALLATION OF PRESSURE LINES

A. All pipe and fittings shall be carefully examined for defects and no piece shall be installed which is shown to be defective. Special care shall be taken to avoid leaving bits of wood, dirt and foreign particles in the pipe.

B. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. In the trench without getting earth into it, the Engineer may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.

C. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer.

D. Pipe shall be laid with the bell ends or coupling ends facing in the direction of the laying unless directed otherwise by the Engineer or specifically indicated on the Drawings.

E. All pipe shall be carefully placed and supported at the proper line and grade, and shall be sloped to permit drainage. Minor adjustment may be necessary to avoid architectural and structural features. Major relocations shall be approved by the Engineer. Minimum earth cover shall be 36 inches, unless otherwise shown on the Drawings. Sufficient Screw Unions, flanges, joints, or flexible couplings shall be used to allow the convenient removal of any run of pipe without removing of any run of pipe without removing adjacent runs or equipment. Where practicable, make-up joints have been indicated on the Drawings; however, omission of these joints from the Drawings does not excuse the Contractor from their installation. Whenever a pipe larger than 3-inches in diameter is cast or grouted in place and passes from concrete to earth, a flexible coupling must be used on the earth side. Bare metal pipe passing from concrete to earth shall be wrapped with Scotch Wrap 50 for 3-inches each side of the Concrete face on the earth side.

3.03 INSTALLATION OF GRAVITY LINES

A. Wherever possible, the Contractor shall avoid the distribution of pipe to the trench site too far in advance of the laying operations. The Contractor shall exercise care in the unloading of the pipe so as to avoid damage caused by the unloading operations.

B. Immediately preceding the laying of a length of sewer pipe, it shall be visually checked for damage, defects, and to ensure that the inside of the pipe is clean and free from debris.

C. Both bell and spigot shall be clean before the joint is made, and care shall be taken that nothing but the joint-making material enters joint.

D. If water is encountered in the trench, it shall be kept below the bottom of the bell of the pipe. Should the water, through neglect or otherwise, rise in the trench before the jointing operation is completed, the annular space in all pipe so affected shall be freed of all water and foreign matter and thoroughly cleaned before completing the jointing operation.

E. When pipe laying is not in progress, the forward end of the pipe shall be kept effectively closed with an approved temporary barricade.

3.04 JOINTS

A. Mortar (Storm Drain joints only)

Pipe ends shall be clean, free of asphalt or other contaminants, which will inhibit the bond of the mortar to the pipe. The pipe ends shall be moistened immediately prior to placing the mortar in the joint.

B. Cold Applied Preformed Plastic Gaskets (Storm Drain joints only)

The pipe ends shall be clean and the joint material applied to the dry pipe. In cold weather, the joint material shall be heated to facilitate the seal of the joint.

C. O-Ring and Push-on Joints

Just before making a joint the ends of the pipe shall be clean, dry, free of any foreign matter, lump blisters, excessive coal tar coating and grease or oil and shall be wire brushed. The gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound (Flax Soap) to facilitate telescoping the joints. The rubber gasket if not factory installed shall be stretched uniformly as it is placed in the spigot groove to insure a uniform volume of rubber around the circumference of the groove. The spigot shall be centered in the bell, the pipe pushed home uniformly and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint. Care should be taken to prevent dirt or foreign matter from entering the joint space.

D. Bolted Joints

All flanged, mechanical or other bolted joints shall be joined with nuts and bolts and be coated as indicated above in Iron Pipe.

3.04 PIPE ANCHORAGE, SUPPORT AND PROTECTION

A. General

Pressure pipeline tees, plugs, caps and bends shall be securely anchored by suitable concrete thrust blocking and by approved metal harness.

B. Concrete Thrust Blocking

1. Concrete for use as reaction or thrust blocking shall be 4 sacks per cubic yard with a minimum 28 day compressive strength of 2,000 psi.

2. Concrete blocking shall be placed between solid ground and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as indicated or directed by the Engineer. The blocking shall, unless otherwise indicated, be so placed that the pipe, fittings and joints will be accessible for repair.

3. The trench shall be excavated at least 6 inches outside the outermost projections of the pipe or appurtenance and the trench walls shaped or undercut according to the detail Drawings or as required to provide adequate space and bearing area for the concrete.

4. The pipe and fittings shall be adequately weighted and laterally braced to prevent floating, shifting or straining of the pipeline while the concrete is being placed and taking initial set. The Contractor shall be solely responsible for the sufficiency of such restraints.

C. Metal Thrust Restraint

Fabricated thrust restraint systems such as those described below shall be approved for use in conjunction with concrete blocking. To obtain approval, the project Drawings must include sufficient drawings, notes, schedules, etc., to assure that the proposed restraints as installed will be adequate to prevent undesirable movement of the piping components.

1. Thrust Harness

A metal thrust harness of tie rods, pipe clamps or lugs, turnbuckles, etc., may be approved. All carbon steel components of such systems, including nuts and washers, shall be hot-dip galvanized; all other members shall be cast ductile iron. After installation, the entire assembly shall be wrapped with 8-mil polyethylene film, overlapped and taped in place with duct tape to form a continuous protective wrap.

2. Restrained Joints

Piping or fitting systems utilizing integral mechanically restrained joints may be approved. All components of such systems shall be standard manufactured products fabricated from cast ductile iron, hot-dip galvanized steel, brass or other corrosion resistant materials and the entire assembly shall be protected with a continuous film wrap as described for 1. above. Manufacturers of pipe with restrained joints integral to the pipe shall be listed on SPL WW-27F.

Location, configuration and description of such products shall be specifically detailed on the Drawings. (Add-on attachments such as retainer glands, all-thread rods, etc., are not acceptable.)

D. Concrete Encasement, Cradles, Caps and Seals

1. When trench foundation is excessively wet or unstable or installation of water or wastewater pipe will result in less than 30 inches of cover, Contractor shall notify Engineer. Engineer may require Contractor to install a concrete seal, cradle, cap, encasement or other appropriate action.

2. All concrete cap, etc., shall be continuous and begin and end within 6 inches of pipe joints. Concrete cap, cradle and encasement shall conform to “Concrete Trench Cap” standard detail. The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

E. Anchorage Bulkheads

Concrete bulkheads keyed into the undisturbed earth shall be placed as indicated to support and anchor the pipe and/or backfill against end thrust, slippage on slopes, etc. Concrete material and placement shall be 5 sacks per cubic yard with a minimum 28 day compressive strength of 3,000 psi.

F. Trench Caps, Concrete Rip-Rap and Shaped Retards

Where called for by the Contract or as directed by the Engineer, concrete trench caps, concrete rip-rap and/or shaped retards shall be placed as detailed by the Drawings as protection against erosion. Concrete material and placement shall be 4 sacks per cubic yard with a minimum 28-day compressive strength of 2,000 psi.

3.05 CLEANING, TESTING AND DISINFECTION

A. General

1. Following the installation of any new pipleline, all newly laid pipe or any valved section thereof shall be subject to a hydrostatic pressure test.

2. Pressure and gravity lines shall be cleaned of all foreign matter and tested in the presence, and to the satisfaction, of the Engineer. Leakage shall be corrected.

3. The Contractor shall furnish the necessary pumps, labor, equipment, and materials, and shall perform testing of the completed system before the system is placed in operation or connected to other lines. Owner shall provide water for the testing and disinfecting of the lines.

4. The gravity and pressure lines shall be flushed clean prior to testing or disinfection.

B. Disinfection

Potable water systems shall be cleaned and disinfected in accordance with AWWA C-651 "Procedure for Disinfecting Water Mains." Pipelines shall be flushed following completion of disinfection procedures. Disposal or neutralization of disinfection water shall comply with applicable regulations.

C. Testing of Water Mains

All testing of pipe shall be done under the supervision of the Owner, and the Contractor shall furnish all equipment and materials for the testing and shall perform such tests as described as follows:

1. Cleaning – Prior to filling, testing, and disinfecting the installed line, the Contractor shall ensure that the line is clean in conformance with ANSI/AWWA C651.

2. Filling and Flushing – Lines shall be filled slowly with potable water at a maximum velocity of 1 ft/sec (0.3 m/sec) while venting air. Precautions shall be taken to prevent entrapping air in the lines. After filling, lines shall be flushed at blowoffs and dead ends at a minimum velocity of 3 ft/sec (0.9 m/sec). A minimum of three changes of treated water shall be used in flushing operations. Valves shall be closed slowly to prevent excessive surges while maintaining positive pressure at all times throughout the new line. Flushing water shall be discharged without causing erosion damage, nuisance, or interruption of traffic. Disposal of flushing water shall be in accordance with AWWA C605-05 Section 4.1.1.2. Discharge of flushing water shall be conveyed to natural drainage channels, storm sewers, or proper reservoirs as approved by regulatory authorities having jurisdiction. Such discharges shall be in a manner that prevents property damage, erosion, or siltation. A special pipeline pig may be required when the required flushing velocity cannot be achieved or when needed to conserve water. The Contractor shall make provisions for launching and retrieving the pig.

   Maximum filling rates in gallons per minute equivalent to filling velocities of one foot per second, for pipes flowing full.

Nominal Size	Flow Rate (gpm)
4	9.8
6	14.7
8	19.6
10	24.5
12	29.4
14	34.3
16	39.2
18	44.1
20	49.0
24	58.8
27	66.1
30	73.4
33	80.8
36	88.1
42	102.8
48	117.5

3. Hydrostatic Testing - The Contractor shall provide measurement gauges and recording devices for the test, including pump, pipe, connections, and other necessary apparatus and shall provide necessary assistance to conduct the test. Testing shall be carried out after backfilling has been completed but before placement of permanent surfacing. The Contractor shall verify that thrust-blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the pipeline.

a. Cross-Connection Control – When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check-valve assembly between the test and supply main or by other means approved by the Owner. Prior to pressure and leakage testing, the temporary backflow protection should be removed and the main under test isolated from the supply main.

b. Procedure – Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of air. The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe in a manner satisfactory to the Owner. The test pressure shall not exceed the design pressure of the pipe, fittings, valves, or thrust restraint. If necessary, the test pressure shall be maintained by additional pumping for the specified time. During tests, the system and exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. Visible leaks shall be stopped. Defective elements shall be repaired or removed and replaced and the test repeated until the test requirements have been met.

c. Pressure Water Mains – All pressure water mains shall be hydrostatically tested in accordance with ANSI/AWWA C605-05 and as described below.

   i. Pressure Test – The entire project or each valved section shall be tested at a constant pressure of 200 psi for a period of approximately 10 minutes to discover defective materials or workmanship. The Contractor assumes all risks associated with the testing against valves. Repairs shall be made by the Contractor to correct any defective materials or workmanship.

   ii. Leakage Test – A leakage test will follow the pressure test. The Contractor assumes all risks associated with the testing against valves. Repairs shall be made by the Contractor to correct any defective materials or workmanship.

   iii. Test Duration – The duration of the hydrostatic leakage test shall be 2 hours.

   iv. Test Pressure – The hydrostatic test pressure shall not be less than 1.25 times the maximum anticipated sustained working pressure at the highest point along the test section and not less than 1.5 times the stated working pressure at the lowest elevation along the test section. The test pressure shall not be less than 150 psi. In no case shall the test pressure exceed the design pressure limit for any pipe, thrust restraint, valve, fitting, or other appurtenance of the test section.

   v. Test Allowance – The testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within ±5 psi of the specified hydrostatic test pressure. No installation will be accepted if the quantity of makeup water is greater than that determined by the formula:

$$Q = \frac{LD\sqrt{P}}{148{,}000}$$

Where:

Q = quantity of makeup water, in gallons per hour

L = length of pipe section being tested, in feet

D = nominal diameter of the pipe, in inch

P = average test pressure during the hydrostatic test, in pounds per square inch

D. Force Main and Pressure Sewer Lines

Force Main and Pressure Sewer installations shall be tested in accordance with TCEQ standards as presented in 30 TAC 217.68, utilizing a hydrostatic test. The hydrostatic test shall be performed for a minimum duration of 4 hours. Leakage in the force main/pressure sewer hydrostatic test shall be defined as the quantity of water that must be supplied into the pipe or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled. Minimum test pressure shall be the maximum design pressure of the line plus 50 pounds per square inch (psi).. The maximum allowable leakage shall be calculated using the formula below. If the quantity of leakage exceeds the maximum amount calculated, remedial action shall be taken to reduce the leakage to an amount within the allowable limit as follows:

$$Q = \frac{LD}{12{,}672}$$

Where:

Q = quantity of makeup water, in gallons per hour

L = length of pipe section being tested, in feet

D = nominal diameter of the pipe, in inches

E. Air Piping

Air piping shall be tested for a period of four (4) hours at 100 psi or 1.5 times the operating pressure. There shall be no drop in pressure allowed.

F. Chlorine Solution Piping

Chlorine solution piping shall be tested with air for a period of four (4) hours at a pressure of 100 psi. There shall be no leakage allowed.

G. Gravity Lines

1. All gravity lines shall be tested in accordance with TCEQ requirements, given in the Texas Administrative Code Title 30 Part 1 Chapter 217.57. Testing shall include either a low pressure air test or an infiltration/exfiltration test.
2. Low Pressure Air Test
    a. Lines with an inside diameter of less than 36-inch shall be air tested between manholes. Lines with an inside diameter of 36-inch or greater shall be air tested at pipe joints. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses. Manholes shall be plugged so they are isolated from the pipe.
    b. The low pressure air test must conform with the procedures given in TAC Title 30 Part 1 Chapter 217.57.a.1
3. Infiltration/Exfiltration
    a. An infiltration test shall be performed if the lines are installed below the groundwater level, otherwise an exfiltration test shall be performed. The infiltration test must conform with the procedures given in TAC Title 30 Part 1 Chapter 217.57.a.2.
    b. The exfiltration test must conform with the procedures given in TAC Title 30 Part 1 Chapter 217.57.a.2.
        i. The section of pipe to be tested shall be filled with water and allowed to stand for such time as is required for the pipeline to absorb such water as it will and for the escape of all air from the line. The sections undergoing test shall be carefully examined for leakage. All known leaks shall be repaired, regardless of these test requirements.
        ii. The line shall then be filled to a reference level in manhole or in a reservoir of sufficient capacity to allow for a reference level to be established. The reservoir must be of sufficient capacity as to not allow the water level to drop below the crown of the pipe during the 24-hour test period. If the water level drops below the crown of the pipe, the test shall be voided and run again or until such time the water level is maintained above the crown throughout the duration of the test.
        iii. At the end of a 24-hour period, water, if needed, shall be added to the line to bring the water level back to the referenced line. All water added shall be accurately measured by an approved water meter so that any exfiltration rate can be established.
        iv. Leakage during the above test shall not exceed a rate equal to 50 gallons per inch of internal diameter per mile per 24 hours.

3.06 MARKING TAPE

Detectable mylar marking tape will be installed over all non-metallic pipe lines. Care will be taken to insure that the buried marking tape is mylar encased aluminum foil. Test data for the tape shall be provided on request.

3.07 PIPE INSULATION

A. Piping

1. All exposed chemical feed, water supply, wash down and copper valve pipelines 2 inches and smaller shall be insulated as shown on the Plans. Split 1/2-inch round insulation shall be used with a split PVC pipe covering utilizing galvanized metal straps as required. For piping that is not straight run, the insulation shall be pre-molded sectional urethane with aluminum wrap.

2. Valves and flanges which are an integral part of insulated lines shall be insulated with prefabricated urethane insulation covers as manufactured by Southwest Insulators, Inc. Covers shall be wired in place. All voids shall be made solid by pouring liquid urethane in the valve and flange covers. The covers shall be finished with black glass fab and sealed with a coat of Foster 60-26 weatherproofing. Refer to Plans for those valves larger than 2 inches that require insulation.

3.08 MEASUREMENT AND PAYMENT

A. Non-Linear Projects

No separate payment for work performed under this item. Include cost of same in Contract prices bid for item of which this work is a component part, or include in yard piping.

B. Linear Projects

Pipe:

For linear projects, payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot complete-in-place as designed and represented in the Drawings and other Contract documents. Unless otherwise provided herein, as separate pay item(s), subsidiary items to the bid price per linear foot of pipe shall include the following:

a. clearing
b. constructing any necessary embankment
c. excavation
d. disposal of surplus or unusable excavated material
e. furnishing, hauling and placing pipe
f. fittings larger than 24 inch
g. field constructed joints, collars, temporary plugs, caps or bulkheads
h. all necessary lugs, rods or braces
i. pipe coatings and protection
j. connections to existing systems or structures, concrete blocking and thrust blocks and restrained joints
k. preparing, shaping, pumping for dewatering, and shoring of trenches
l. bedding materials
m. backfill materials
n. hauling, placing and preparing bedding materials
o. particle migration measures
p. hauling, moving, placing and compacting backfill materials
q. temporary and permanent pavement repairs and maintenance
r. temporary and permanent removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction
s. cleanup
t. vertical stack on deep wastewater services
u. all other incidentals necessary to complete the pipe installation as indicated.

No separate payment will be made for thrust restraint measures.

Concrete Cradles and Seals:

When called for in the Bid, concrete cradles and seals will be paid for at the unit Contract price bid per linear foot for the size of pipe specified, complete in place.

Concrete Retards:

When called for in the Bid, Concrete retards will be paid per each unit.

Wet Connections to Water Mains:

When called for in the bid, wet connections will be paid at the unit price bid per each, complete in place, according to the size of the main that is in service and shall be full compensation for all Work required to make the connection and place the pipe in service.

Fittings:

Ductile iron fittings of the class indicated, furnished in accordance with these specifications will be paid for at the unit price bid per ton, complete in place, according to scheduled weights for mechanical joint fittings furnished, including glands, bolts and gaskets, as published in the following standards:

AWWA C-153 for all fittings 4-inch through-24 inch sizes, regardless of whether AWWA C-110 or AWWA C-153 fittings are furnished or the type of end connections supplied.

AWWA C-110 for all fittings larger than 24-inch size.

Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be paid for separately. The Contractor shall include these in his bid for pipe.

Concrete Trench Cap and Encasement:

Where the distance between the top of the concrete encasement and the top of the trench cap is less than 36 inches, the concrete cap and encasement shall be poured as one unit and paid for under this bid item at the Contract price bid per linear foot. When the distance above is greater than 36 inches or when the trench cap is placed separately, the trench cap shall be paid for as a separate item, per linear foot, complete in place.

Cement-Stabilized Backfill:

Cement-stabilized backfill will be paid for at the unit price bid per linear foot and shall be full payment to the Contractor for furnishing and installing the required material, mixed, placed and cured complete in place.

Pressure Taps:

Pressure taps will be paid for at the unit price bid, complete in place, according to the size tap made and the size main tapped and shall be full payment for furnishing all necessary materials, including tapping sleeve and valve, making the tap, testing and placing the connection in service.

Excavation Safety Systems:

When called for in Bid, Trench Safety Systems shall be paid at the unit price per linear foot or lump sum as noted.

END OF SECTION

SECTION 15100

TECHNICAL SPECIFICATIONS – VALVES, GATES AND APPURTENANCES

PART 1: GENERAL

1.01 SCOPE

A. Work Included: The Contractor shall furnish and install the valves and all appurtenances required for the proper functioning of each section of pipeline concerned.

1.02 STANDARD REQUIREMENTS

A. In general, all valves 2-1/2" and larger in diameter shall have flanged or bell ends unless otherwise indicated on the Plans or in these Specifications. Flanges shall be dimensioned, faced, and drilled to the 125-pound "American Standard". All mechanical joints shall conform to ASA Specifications A-10 and A-11 to fit the piping. The dimensions of the sockets of hub and gate valves shall conform to the dimensions of Class "D" special castings as required by the AWWA Standard Specifications for cast iron pipe and special castings. All necessary caulking materials, gaskets, bolts and nuts shall be provided.

B. Valves shall be carefully installed in their respective positions, accessible for operation and repair. Unless shown on the plans, valves shall be of the same sizes as the pipelines in which they are installed and stems shall not be installed pointing down. Valves shall be left in satisfactory operating condition, free from all distortion and strain. The valves or gates shall be connected to floor stands where required. All stem guides shall be accurately aligned and secured.

C. Valves shall be supplied with suitable operating keys, levers, handwheels, or chain operators as required.

D. All valve operators shall turn in a counterclockwise direction to open the valve.

E. All valves shall have a graduated dial for accurate metering.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 1300-Submittals. Information shall include the following:

1. Complete dimensional data and installation instructions for the valve assembly as it is to be installed, including the operator.

2. Complete data including:

   a. The operator, including type and size, number of turns to open, model number, etc.
   b. The manufacturer's name and address of their nearest service facility.
   c. Parts list and material types and specifications.
   d. Detailed instructions for calibrating the limit stops for open and closed positions.

3. Complete description, in sufficient detail to permit a thorough comparison with the appropriate specification section(s).

4. Complete replacement parts lists and drawings.

PART 2: MATERIALS

2.01 GATES VALVES (AWWA C-500 Latest Revision)

A. General

1. All gate valves to be resilient-seated gate valves, unless noted otherwise. All gate valves shall be from the same manufacturers. Unless noted otherwise, all gate valves shall have a minimum working pressure rating of 250 psi for bubble tight shut-off. All operators shall be from the same manufacturers. All valves and operators shall be of new construction.

B. Resilient-seated gate valves, including tapping valves, shall conform to AWWA C-509.

C. Reduced-wall, resilient-seated gate valves, shall conform to AWWA C-515. Reduce-wall, resilient-seated gate valves to be used only when specified.

D. Metal-seated gate valves for shall conform to AWWA C-500. Metal-seated gate valves to be used only when specified.

E. Stem Seals: All valves shall have approved O-ring type stem seals. At least two O-rings shall be in contact with the valve stem where it penetrates the valve body.

F. Operation: All valves shall have non-rising stems with a 2" square operating nut, or with a spoke type handwheel, turning clockwise to close. Unless noted otherwise, all valves located above ground or in a vault shall have a non-rising stem and be operated with a handwheel. Where the centerline of the side mounted handwheel for the manual operators is greater than 6 feet above finished floor, a chainwheel operator shall be provided instead of the handwheel. Unless noted otherwise, all valves located underground shall have a non-rising stem equipped with a 2" square operating nut. Gate valves installed below ground shall be provided with valve boxes and removable covers.

G. Gearing: Gate valves in 24 inch and larger sizes shall be geared and, when necessary for proper bury depth and cover, shall be the horizontal bevel-geared type enclosed in a lubricated gear case.

H. Bypass: Unless otherwise indicated on the Drawings, 16 inch and larger gate valves shall be equipped with a bypass of the non-rising stem type which meets the same AWWA standard required for the main valve.

I. Valve Ends: Valve ends shall be push-on, flanged or mechanical joint, as indicated or approved. Unless noted otherwise, all buried valves shall be mechanical joint and all exposed valves to have flanged joints.

1. Tapping valves shall have inlet flanges conforming to MSS SP-60, with boltholes drilled per ANSI B16.1 Class 125. Seat rings and body casting shall be over-sized as required to accommodate full size cutters; the outlet end shall be constructed and drilled to allow the drilling machine adapter to be attached directly to the valve

J. Gear Case: All geared valves shall have enclosed gear cases of the extended type, attached to the valve bonnet in a manner that makes it possible to replace the stem seal without disassembly and without disturbing the gears, bearing or gear lubricant. Gear cases shall be designed and fabricated with an opening to atmosphere so that leakage past the stem seal does not enter the gear case.

K. Valve Body: Gate valves in 16 inch and larger sizes installed in the horizontal position shall have bronze rollers, tracks, scrapers, etc. For reclaimed water valves, the body shall be manufactured in purple, factory painted purple, or field painted purple.

L. Coatings: The interior and exterior of the valve shall be coated with an ANSI/NSF 61 approved fusion bonded epoxy protective coating having a minimum thickness of 10 mils. The coating shall be suitable for field over-coating and touch-up without sanding or special surface preparation. See Part 2.20 for field coating.

2.02 BUTTERFLY VALVES

A. General

1. Unless otherwise indicated, all valves shall conform to the current "AWWA" Standard C-504, "Rubber-Seated Butterfly Valves", Class 150B, except as modified or supplemented herein. Valves shall be the short body design, unless otherwise called for. All butterfly valves shall have a minimum working pressure rating of 150 psi, for bubble tight shut-off. Valves shall be capable of pressurized shut-off from either direction. Valves shall be factory pressure tested. Operators shall be in accordance with AWWA C504-80 and valve schedule on plans. All butterfly valves shall be from the same manufacturers. Also, all operators shall be from the same manufacturers. All valves and operators shall be of new construction.

B. Valves shall be of such design that the valve discs will not vibrate or flutter when operated in a throttled position. Valve discs shall be secured to the shafts by means of keys or pins so arranged that the valve discs can be readily removed without damage thereto. All keys and pins used in securing valve discs to shafts shall be stainless steel or monel. Valve discs shall be stainless steel or ductile iron, ASTM A 536, Grade 65-45-12 (448-310-12); seating edge shall be 316 stainless steel.

C. Valve seats shall be a full circle 360 seat, located in the body only and not penetrated by the valve shaft and shall be of a synthetic rubber compound such as Buna N. Valve seats for 30" and larger valves shall be easily field adjustable around the full circle 360 with standard tools and replaceable without dismantling operator, disc or shaft and without removing the valve from the line. Manufacturers shall certify that rubber seat is field replaceable.

D. Valve shafts shall be constructed of wrought stainless steel or monel. The ends of the shaft shall be permanently marked to indicate the position of the disc on the shaft.

E. Valves shall have approved manufacturer's O-ring type or split V type "Chevron" shaft seals. When O-ring seals are used, there shall be at least two O-rings in contact with the valve shaft where it penetrates the valve body.

1. On 24 inch (635 mm) and larger valves, the seat shall be completely replaceable and/or adjustable with common hand tools without disassembling the valve from the pipeline.

F. Valve Ends: Valve ends shall be push-on, flanged or mechanical joint, as indicated or approved. Unless noted otherwise, all buried valves shall be mechanical joint and all exposed valves to have flanged joints.

G. Coatings: The interior and exterior of the valve shall be coated with an ANSI/NSF 61 approved fusion bonded epoxy protective coating having a minimum thickness of 10 mils. The coating shall be suitable for field over-coating and touch-up without sanding or special surface preparation. See Part 2.20 for field coating.

H. Manual Operators:

1. Unless otherwise indicated, all buried, manually operated butterfly valves shall be provided with vertical stems and 2 inch square operating nut turning clockwise to close. All keys or pins shall be stainless steel or monel. Buried valves shall have the valve stems extended or adjusted to locate the top of the operating nut no more than 24 inches below finish grade. Butterfly valves installed below ground shall be provided with valve boxes and removable covers.

2. Unless otherwise indicated, manually operated butterfly valves which are exposed or located in a vault, shall be provided with a handwheel operator turning clockwise to open and equipped with a valve disc position indicator. All keys or pins shall be stainless steel or monel. Where the centerline of the side mounted handwheel for the manual operators is greater than 6 feet above finished floor, a chainwheel operator shall be provided instead of the handwheel.

3. When a lever operator is specified the valve shall be installed with a manual operator of the worm gear type or traveling-nut type, which are designed for 90 rotation. The operators shall be self-locking to prevent valve creep and flutter. Lever operators shall latch in the open, closed, and several intermediate positions. Gear actuators shall have adjustable open and closed position stops. The units shall be furnished in accordance with AWWA Specifications C504-80. The worm gear type operators shall be Limitorque HBC Series, or approved equal.

I. Motorized Operators

1. The electric motor operator shall consist of motor, reduction gearing, position limit switches and torque limiting switches mounted in a NEMA IV housing. Actuators shall be rated for 50 PSI working pressure. Actuators shall be manufactured by Rotork, Limitorque, EIM, or approved equal.

2. The motor shall be of the high-torque type, designed for continuous duty rating. Motors and wiring shall have Class "B" or better insulation. Overload protection shall be provided by auto-reset thermal trip circuit breakers embedded in the motor windings. All motor leads shall be terminated at an internal terminal strip. The motor will operate on an AC power supply of 120 volts, single phase, 60 cycle for butterfly valves 16" and smaller / plug valves 12" and smaller; and 460 volts, three phase, 60 cycle for butterfly valves 18" and larger / plug valves 14" and larger. Actuators shall be provided with integral motor starters (if required).

3. Motorized valve motors shall be capable of producing at least 140 percent of the torque required to operate the valves under conditions of maximum non-shock shutoff pressure without exceeding a permissible temperature rise of 131^0F over 104^0F ambient (55 degrees Celsius over 40 degrees Celsius ambient); they shall have a duty rating of not less than 15 minutes and shall be capable of operating the valve through 4 1/2 cycles against full unbalanced pressure without exceeding the permissible temperature rise. Motors shall be suitable for operating the valve under maximum differential pressure when voltage to motor terminals is 80 percent of nominal voltage. Motor bearings shall be permanently lubricated and sealed.

4. Provide Local/Off/Remote switch and Open and Close push buttons for all actuators.

5. The blower inlet throttling valve actuator shall be positioned by a 4-20mA signal.

6. The integral self-locking power gearing shall be compound epicyclic of combined helical and worm gear type only. Motor breakers are unacceptable. Gearing shall be grease or oil lubricated with high-speed parts running on anti-friction bearings. Motor shall operate from open to full close in 60 seconds. Disassembly of gears shall not be required to remove the motor.

7. The handwheel shall not rotate during electrical operation. When the unit is being operated manually, it shall automatically return to electric operation when the handwheel is released. The transfer from electrical operation to manual operation shall be accomplished by a declutching mechanism, which will disengage the motor mechanically. The unit shall be capable of being clutched or declutched while the motor is energized with no damage to the clutch or gear mechanism. Clockwise rotation of the handwheel shall close the valve. If the motor is energized during manual operation, the unit shall remain in manual mode without endangering personnel operating the unit. Failure of the motor or motor gearing shall not hinder manual operation. Two limit switches set at the open and close positions shall be provided and are to be geared directly to the valve to follow its position at all times, including during manual operation. Additional switches shall be provided, if required.

8. A double-acting torque limiting switch shall be provided, which is responsible to the mechanical torque developed by seating or an obstruction.

2.03 PLUG VALVES

A. General

1. Unless otherwise indicated, all valves shall conform to the current "AWWA" Standard C-517, except as modified or supplemented herein. Plug valves shall be the quarter-turn, non-lubricated, eccentric type with resilient faced plug. All Plug valves shall have a minimum working pressure rating of 175 psi for bubble tight shut-off. Valves shall be factory pressure tested. All plug valves shall be from the same manufacturers. Also, all operators shall be from the same manufacturers. All valves and operators shall be of new construction.

B. Port Area

1. For plug valves 4" and smaller the port area shall not be less than 100% of the pipe area.
2. For plug valves larger than 4" and up to 16" in size the port area shall not be less than 85% of the pipe area.
3. For plug valves larger than 16" and up to 24" in size the port area shall not be less than 80% of the pipe area.
4. For plug valves larger than 24" the port area shall not be less than 75% of the pipe area.

C. The valve body and cover shall be constructed of ASTM A126 Class B cast iron or ductile iron for working pressures up to 175 psi. The words "seat end" shall be cast on the exterior of the body seat end.

D. The plug shall be of one-piece construction and made of ASTM A126 Class B cast iron or ASTM A536 Grade 65-45-12 ductile iron and fully encapsulated with resilient facing per ASTM D2000-BG and ANSI/AWWA C517 requirements.

E. The valve seat shall be a welded overlay of a minimum 95% pure nickel applied directly to the body on a pre-machined, cast seating surface and machined to a smooth finish.

F. Shaft seals shall consist of V-type packing in a fixed gland with an adjustable follower designed to prevent over compression of the packing and to meet design parameters of the packing manufacturer. Removable, slotted shims shall be provided under the follower flanges to provide for adjustment and prevent over tightening.

G. Permanently lubricated, radial shaft bearings shall be supplied in the upper and lower bearing journals. Thrust bearings shall be provided in the upper and lower journal areas. Radial shaft bearings shall be constructed of self-lubricating type 316 stainless steel. The top thrust bearing shall be Teflon. The bottom thrust bearing shall be Type 316 stainless steel. For exposed valves cover bolts shall be either corrosion resistant with zinc plating or type 316 stainless steel. For buried valves cover bolts shall be type 316 stainless steel.

H. Both the packing and bearings in the upper and lower journals shall be protected by a Buna-N shaft seal located on the valve shaft to minimize the entrance of grit into the bearing journal and shaft seal areas.

I. Valve Ends: Valve ends shall be push-on, flanged or mechanical joint, as indicated or approved. Unless noted otherwise, all buried valves shall be mechanical joint and all exposed valves to have flanged joints.

J. Coatings:

1. The exterior of the valve shall be coated with a fusion bonded epoxy protective coating having a minimum thickness of 10 mils. The coating shall be suitable for field over-coating and touch-up without sanding or special surface preparation. See Part 2.20 for field coating.

2. The interior of the valve shall be coated with an ANSI/NSF 61 approved two-part epoxy protective coating suitable for use with sewage and/or sludge.

K. Manual Operators:

1. All plug valves 4" and larger shall include a totally enclosed and sealed worm gear actuator. The worm segment gear shall be ASTM A536 Grade 65-45-12 ductile iron with a precision bore and keyway for connection to the valve shaft. Bronze radial bearings shall be provided for the segment gear and worm shaft. Alloy steel roller thrust bearings shall be provided for the hardened worm.
2. Unless otherwise indicated, all buried, manually operated plug valves shall be provided with vertical stems and 2 inch square operating nut turning clockwise to close. Buried service actuators shall be packed with grease and sealed for temporary submergence to 20 feet of water. All keys or pins shall be stainless steel or monel. Buried valves shall have the valve stems extended or adjusted to locate the top of the operating nut no more than 24 inches below finish grade. Plug valves installed below ground shall be provided with valve boxes and removable covers.
3. Unless otherwise indicated, manually operated plug valves which are exposed or located in a vault, shall be provided with a handwheel operator turning clockwise to open. The actuator shall include a position indicator and externally adjustable open and closed stops. All keys or pins shall be stainless steel or monel. Where the centerline of the side mounted handwheel for the manual operators is greater than 6 feet above finished floor, a chainwheel operator shall be provided instead of the handwheel.

L. Motorized Operators:

1. The electric motor operator shall consist of motor, reduction gearing, position limit switches and torque limiting switches mounted in a NEMA IV housing. Actuators shall be rated for 50 PSI working pressure. Actuators shall be manufactured by Rotork, Limitorque, EIM, or approved equal.

2. The motor shall be of the high-torque type, designed for continuous duty rating. Motors and wiring shall have Class "B" or better insulation. Overload protection shall be provided by auto-reset thermal trip circuit breakers embedded in the motor windings. All motor leads shall be terminated at an internal terminal strip. The motor will operate on an AC power supply of 120 volts, single phase, 60 cycle for butterfly valves 16" and smaller / plug valves 12" and smaller; and 460 volts, three phase, 60 cycle for butterfly valves 18" and larger / plug valves 14" and larger. Actuators shall be provided with integral motor starters (if required).

3. Motorized valve motors shall be capable of producing at least 140 percent of the torque required to operate the valves under conditions of maximum non-shock shutoff pressure without exceeding a permissible temperature rise of 131^0F over 104^0F ambient (55 degrees Celsius over 40 degrees Celsius ambient); they shall have a duty rating of not less than 15 minutes and shall be capable of operating the valve through 4 1/2 cycles against full unbalanced pressure without exceeding the permissible temperature rise. Motors shall be suitable for operating the valve under maximum differential pressure when voltage to motor terminals is 80 percent of nominal voltage. Motor bearings shall be permanently lubricated and sealed.

4. Provide Local/Off/Remote switch and Open and Close push buttons for all actuators.

5. The integral self-locking power gearing shall be compound epicyclic of combined helical and worm gear type only. Motor breakers are unacceptable. Gearing shall be grease or oil lubricated with high-speed parts running on anti-friction bearings. Motor shall operate from open to full close in 60 seconds. Disassembly of gears shall not be required to remove the motor.

6. The handwheel shall not rotate during electrical operation. When the unit is being operated manually, it shall automatically return to electric operation when the handwheel is released. The transfer from electrical operation to manual operation shall be accomplished by a declutching mechanism, which will disengage the motor mechanically. The unit shall be capable of being clutched or declutched while the motor is energized with no damage to the clutch or

gear mechanism. Clockwise rotation of the handwheel shall close the valve. If the motor is energized during manual operation, the unit shall remain in manual mode without endangering personnel operating the unit. Failure of the motor or motor gearing shall not hinder manual operation. Two limit switches set at the open and close positions shall be provided and are to be geared directly to the valve to follow its position at all times, including during manual operation. Additional switches shall be provided, if required.

7. A double-acting torque limiting switch shall be provided, which is responsible to the mechanical torque developed by seating or an obstruction.

2.04 CHECK VALVES

A. Check valves for ductile iron and steel pipelines shall be swing type and shall meet the material requirements of AWWA Specification C508-76 Swing-Check Valves for ordinary waterworks service. The valves shall be iron body, bronze mounted, single disc, 150 psi working water pressure, nonshock, and hydrostatically tested at 300 psi. Ends shall be 125lb ANSI B16.1 flanges.

1. When there is no flow through the line the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway.
2. Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers.
3. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and weights.
4. Check valves of 1-in or larger shall be equipped with an air cushion chamber. The air cushion chamber shall be attached to the side of the valve body externally and be so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any Hammering action. The air cushion chamber shall be so arranged that the valve closing speed shall be adjustable to meet the service requirements.
5. The check valves shall be Fig. 250-D as manufactured by G-A Industries Inc. or equal.

B. Check valves 2-in and smaller for installation in copper and steel pipes shall be bronze, swing type, 125 lb WSP with soder or screwed ends.

C. Check valves for PVC pipe shall be of PVC Type 1, Series BC with union, socket, threaded or flanged ends as required. PVC ball check valves shall be as manufactured by Celanese Piping Systems, Inc., Wallace and Tiernan Inc., or equal.

D. Coatings:

1. The exterior of the valve shall be coated with a fusion bonded epoxy protective coating having a minimum thickness of 10 mils. The coating shall be suitable for field over-coating and touch-up without sanding or special surface preparation. See Part 2.20 for field coating.
2. For potable water use the interior of the valve shall be coated with a fusion bonded epoxy protective coating having a minimum thickness of 10 mils. For sewage use the interior of the valve shall be coated with an ANSI/NSF 61 approved two-part epoxy protective coating suitable for use with sewage and/or sludge.

2.05 GLOBE VALVES

A. Valves for air lines shall have threaded ends, bronze body, renewable composition disc, 300 lb cold water non-shock working pressure, Jenkins Fig. 106A or 1200. Valves shall open left or counterclockwise. As far as possible, all globe valves shall be mounted as indicated on the Drawings or as directed by the Engineer.

2.06 BALL VALVES

A. Ball valves shall be brass, bronze, stainless steel or PVC as indicated on the Plans or Details or as approved by the Engineer.

2.07 SOLENOID VALVES

A. Solenoid valves shall be packless piston type direct acting, 2-way, valves and shall be ASCO Valve Red Hat as manufactured by Automatic Switch Co., an equal by Atkomatic Valve Co., or equal.

B. All valves shall be of the normally closed type.

C. Except as otherwise specified herein, valves shall have stainless steel bodies (not brass), NEMA 4 solenoid enclosures, shall be suitable for operation on a 120V, 60Hz, single phase power supply, and shall be provided with a continuous duty Class F coil and a manual operator.

D. Valves located in hazardous areas, as noted on the Drawings, shall be furnished with explosion proof enclosures suitable for Class I, Division I, Group D. locations.

2.08 CORPORATION STOPS

A. Corporation stops shall be of bronze or brass and shall be designed and manufactured in accordance with AWWA Standard C800, excepts as modified herein. Corporation stops shall have Mueller inlet threads except that corporation stops for use with service clamps shall have IPS threads. Where corporation stops are used with plastic pipe, a brass companion flange shall be provided on the outlet of each corporation stop.

2.09 AIR AND/OR AIR/VACUUM VALVES - GENERAL AND SEWAGE USE

A. Valves shall be combination air-release, air-vacuum units having small and large orifice units contained and operating within a single body or assembled unit. All air and/or Air/Vacuum valves shall be manufactured by ARI.

1. The small orifice system shall automatically release small volumes of air while the pipe is operating under normal conditions. The large air-vacuum orifice system shall automatically exhaust large volumes of air while the pipe is being filled and shall permit immediate re-entry of air while being drained.
2. Valves shall be rated for at least 150 psi (1 megapascal) {maximum} normal service pressure.

B. Valves shall be supplied with shutoff gate or ball valves with operator handle or lever removed. Valves shall be properly vented and piped to drain.

C. Material Requirements

1. Valve exterior bodies and covers shall be cast iron or reinforced nylon.
2. Internal bushings, hinge pins, float guide and retaining screws, pins, etc., shall be stainless steel, bronze, nylon or Buna-N rubber.
3. Orifice seats shall be Buna-N rubber.
4. Floats shall be stainless steel, nylon or Buna-N rubber, rated at 1000 psi.

2.10 HOSE HYDRANTS

A. Hose hydrants shall have 1-in outlet connections.

2.11 FLUSH-TYPE HYDRANTS

A. Flush-type hydrants shall have 1-in inlet and 1-in outlet connections.

B. Flush-type hydrants shall be Model No. @-8609 as manufactured by Wade Division/Tyler Pipe Co., Tyler, TX or equal as detailed on the Drawings.

C. Proper back flow prevention devices shall be provided in accordance with local regulations.

2.12 HOSE END VALVES

A. Hose end valves shall be globe pattern valves, equal to Fairbanks Fig. 074; Jenkins Fig. 112 or equal. Furnish cap and chain.

2.13 PRESSURE RELIEF VALVES

A. Pressure relief valves shall be iron body, with Type 304 stainless steel trim and spring, 2-in size, with a relieving capacity equal to the pump capacity. Valve setting shall be adjustable in the range of 50 to 100 psi.

2.14 WATER PRESSURE REGULATING VALVS (PRV)

A. Shall be Watts Muesco Regulator Co. Series 115 for 1 ¼-in and larger and Model 223-S for units small than 1 ¼-in or equal with strainer and of size noted on the Drawing. Shall be diaphragm type, pressure reducing globe valves.

B. Provide a three valve full size bypass around each PRV.

C. Smaller PRV shall have pressure setting 10 psi less than main valve.

D. Pressure regulators and components shall be securely anchored to wall or floor at a height as directed by Engineer.

E. Provide an adjustable pressure relief valve downstream of each PRV station.

2.15 MUD VALVES

A. The mud valves shall be of the rising stem type, with cast iron body. The stem, stem nut, stop collar, disc ring and seat ring shall be bronze. Bolts and nuts shall be corrosion resistant. Valve shall be equipped with extension stem and removable tee wrench. Stop nut and shaft supports (stem guides) shall be provided as recommended by the manufacturer to prevent damage to the valve or shaft, but at no greater spacing than 10-feet.

B. The mud valve shall be flanged Clow Style F3075 or equal model as manufactured by Mueller, Waterman, or equal.

C. Unless specified otherwise, the valve shall be supplied so that the stem nut does not extend above the surface of any walkway when the mud valve is open. The stem nut shall not be more than 12-inches below the walkway surface when the valve is in the closed position.

2.16 PINCH VALVES

A. Manually operated pinch valves for use on the carbon slurry piping shall be provided as shown on the Drawings.
   1. Valves shall have an open-frame cast iron body with natural rubber lined neoprene sleeve. The sleeve shall be as required for the installation location.
   2. The mechanism and stem shall be constructed of Type 304 stainless steel.
   3. Valves shall be suitable for operating pressure of approximately 100 psi.
   4. Valves shall be Series 70 sleeve pinch valve as manufactured by Red Valve Company or equal.

2.17 HOSE VALVES (Hose Bib)

A. Hose valves shall be ¾ inch in size, unless noted otherwise on the Plans, and shall be rough brass and bronze composition disc Crane No. 58, or approved equal.

2.18 CHLORINE VALVES

A. Valves for dry chlorine gas service shall be ball valves rated for 300 pounds, carbon steel body in accordance with ASTM A-105, screwed-end connection, monel ball and stem, Teflon seating, and seals per Chlorine Institute Pamphlet No. 6. Valves shall be as manufactured by WKM Division of ACF Industries, Jamesbury Corporation, Grineel, or Wallace & Tierman.

B. Valves for chlorine solutions shall be thermoplastic ball valves, true union design of PVC material with Teflon seats and viton seals manufactured by Cabot Piping Systems or Grinnel-Saunders diaphragm valves supplied by the Grinnel Company.

2.19 VALVE BOXES

A. Valve boxes shall be furnished and installed on all buried valves. Boxes shall be either cast iron or precast as shown on the Plans.

B. Cast iron valve boxes shall be firmly supported, centered, and plumb over the operating nut and upper portion of the valve box cover flush with the finished grade. Cast iron valves boxes shall be Iowa F-2450 of Mueller H-10360, or approved equal, with extension pieces required.

C. The concrete box and extension shall be firmly supported, centered, and plumb over the valve. The box and extension shall be a Model 3 RT as manufactured by Brooks Products, or approved equal.

2.20 PROTECTIVE COATINGS

A. Valves, gates, floor stands and operators shall be protected at all times, both before and after erection until the completion of the work, from rust or other damage.

B. For exposed valves and appurtenances, or those located in a vault: All surfaces of the valves shall be cleaned, dry and free from grease before painting. After installation all valves except bronze and stainless steel valves and those underground shall be painted in accordance with Section 9902 – Finish Painting matching the painting requirements of the pipelines of which they are a part, and the same color as the pipe. Bright or rubbing parts shall not, however, be painted, but shall be protected with an approved lubricant.

C. For buried valves and appurtenances: Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel component shall be coal tar coated and shall be wrapped with standard minimum 8-mil (0.2 mm) low density polyethylene film or a minimum 4-mil (0.1 mm) cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105-current, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling. For reclaimed water piping, the polyethylene shall be purple

D. Each valve shall be provided with a stainless steel tag permanently attached to the valve body. Valve number shall be imprinted on tag in accordance with valve schedules on Plans.

PART 3: EXECUTION

3.01 INSTALLATION

A. All valves and appurtenances shall be installed according to manufacturer's recommendations.

B. Unless otherwise indicated, valves shall be set at the locations shown on the Drawings and such that their location does not conflict with other appurtenances. Valves shall be installed so that the tops of operating stems will be at the proper elevation required for the piping at the location indicated above. Valve boxes and valve stem casings shall be firmly supported and maintained, centered and aligned plumb over the valve or operating stem, with the top of the box or casing installed flush with the finished ground or pavement.

3.02 MEASURMENT AND PAYMENT

A. No separate payment for work performed under this item. Include cost of same in contract price bid for all items of which this work is component.

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SECTION 15955

TECHNICAL SPECIFICATIONS – PIPING SYSTEMS TESTING

PART 1: GENERAL

1.01 SCOPE OF WORK

A. This Section covers all labor, materials and appurtenances for testing piping systems.

1.02 RELATED SECTIONS

A. Section 15250 – General Piping and Methods

1.03 SUBMITTALS

A. Testing Schedule: Provide notification to Owner and Engineer a minimum of 48-hours prior to scheduled tests.

1.04 REQUIREMENTS

A. General

1. When testing with water, the specified test pressure is considered to be the pressure at the highest point of the piping section under test. Lower test pressure, or divide piping section being tested, as necessary to prevent testing the lowest point above a safe test pressure.
2. Test plumbing in accordance with the Uniform Plumbing Code and UL requirements.

B. Furnish all necessary personnel, materials and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges and other means and facilities required to perform tests.

C. Test new pipe sections prior to making final connections to existing piping. Do not use existing valves as test plug or bulkhead, unless authorized.

D. If any tests are unsuccessful Contractor shall correct defects or remove defect piping and appurtenances and re-install piping and appurtenances. Repeat testing until tests are successful.

PART 2: PRODUCT – NOT USED

PART 3: EXECUTION

3.01 GENERAL

A. Following the installation of any new pipleline, all newly laid pipe or any valved section thereof shall be subject to a hydrostatic pressure test.

B. Pressure and gravity lines shall be cleaned of all foreign matter and tested in the presence, and to the satisfaction, of the Engineer. Leakage shall be corrected.

C. The Contractor shall furnish the necessary pumps, labor, equipment, and materials, and shall perform testing of the completed system before the system is placed in operation or connected to other lines. Owner shall provide water for the testing and disinfecting of the lines.

D. The gravity and pressure lines shall be flushed clean prior to testing or disinfection.

3.02 DISINFECTION

A. Potable water systems shall be cleaned and disinfected using the Continuous-Feed Method in accordance with AWWA C-651 "Procedure for Disinfecting Water Mains." Pipelines shall be flushed following completion of disinfection procedures. Disposal or neutralization of disinfection water shall comply with applicable regulations.

3.03 TESTING OF WATER MAINS

All testing of pipe shall be done under the supervision of the Owner, and the Contractor shall furnish all equipment and materials for the testing and shall perform such tests as described as follows:

A. Cleaning – Prior to filling, testing, and disinfecting the installed line, the Contractor shall ensure that the line is clean in conformance with ANSI/AWWA C651.

B. Filling and Flushing – Lines shall be filled slowly with potable water at a maximum velocity of 1 ft/sec (0.3 m/sec) while venting air. Precautions shall be taken to prevent entrapping air in the lines. After filling, lines shall be flushed at blowoffs and dead ends at a minimum velocity of 3 ft/sec (0.9 m/sec). A minimum of three changes of treated water shall be used in flushing operations. Valves shall be closed slowly to prevent excessive surges while maintaining positive pressure at all times throughout the new line. Flushing water shall be discharged without causing erosion damage, nuisance, or interruption of traffic. Disposal of flushing water shall be in accordance with AWWA C605-05 Section 4.1.1.2. Discharge of flushing water shall be conveyed to natural drainage channels, storm sewers, or proper reservoirs as approved by regulatory authorities having jurisdiction. Such discharges shall be in a manner that prevents property damage, erosion, or siltation. A special pipeline pig may be required when the required flushing velocity cannot be achieved or when needed to conserve water. The Contractor shall make provisions for launching and retrieving the pig.

Maximum filling rates in gallons per minute equivalent to filling velocities of one foot per second, for pipes flowing full.

Nominal Size	Flow Rate (gpm)
4	9.8
6	14.7
8	19.6
10	24.5
12	29.4
14	34.3
16	39.2
18	44.1
20	49.0
24	58.8
27	66.1
30	73.4
33	80.8
36	88.1
42	102.8
48	117.5

C. Hydrostatic Testing - The Contractor shall provide measurement gauges and recording devices for the test, including pump, pipe, connections, and other necessary apparatus and shall provide necessary assistance to conduct the test. Testing shall be carried out after backfilling has been completed but before placement of permanent surfacing. The Contractor shall verify that thrust-blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the pipeline.

1. Cross-Connection Control – When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check-valve assembly between the test and supply main or by other means approved by the Owner. Prior to pressure and leakage testing, the temporary backflow protection should be removed and the main under test isolated from the supply main.

2. Procedure – Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of air. The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe in a manner satisfactory to the Owner. The test pressure shall not exceed the design pressure of the pipe, fittings, valves, or thrust restraint. If necessary, the test pressure shall be maintained by additional pumping for the specified time. During tests, the system and exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. Visible leaks shall be stopped. Defective elements shall be repaired or removed and replaced and the test repeated until the test requirements have been met.

3. Pressure Water Mains – All pressure water mains shall be hydrostatically tested in accordance with ANSI/AWWA C605-05 and as described below.
   a. Pressure Test – The entire project or each valved section shall be tested at a constant pressure of 200 psi for a period of approximately 10 minutes to discover defective materials or workmanship. The Contractor assumes all risks associated with the testing against valves. Repairs shall be made by the Contractor to correct any defective materials or workmanship.
   b. Leakage Test – A leakage test will follow the pressure test. The Contractor assumes all risks associated with the testing against valves. Repairs shall be made by the Contractor to correct any defective materials or workmanship.
   c. Test Duration – The duration of the hydrostatic leakage test shall be 2 hours.
   d. Test Pressure – The hydrostatic test pressure shall not be less than 1.25 times the maximum anticipated sustained working pressure at the highest point along the test section and not less than 1.5 times the stated working pressure at the lowest elevation along the test section. The test pressure shall not be less than 150 psi. In no case shall the test pressure exceed the design pressure limit for any pipe, thrust restraint, valve, fitting, or other appurtenance of the test section.
   e. Test Allowance – The testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within ±5 psi of the specified hydrostatic test pressure. No installation will be accepted if the quantity of makeup water is greater than that determined by the formula:

$$Q = \frac{LD\sqrt{P}}{148{,}000}$$

Where:

Q = quantity of makeup water, in gallons per hour

L = length of pipe section being tested, in feet

D = nominal diameter of the pipe, in inch

P = average test pressure during the hydrostatic test, in pounds per square inch

3.04 FORCE MAIN AND PRESSURE SEWER LINE TESTING

Force Main and Pressure Sewer installations shall be tested in accordance with TCEQ standards as presented in 30 TAC 217.68, utilizing a hydrostatic test. The hydrostatic test shall be performed for a minimum duration of 4 hours. Leakage in the force main/pressure sewer hydrostatic test shall be defined as the quantity of water that must be supplied into the pipe or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled. Minimum test pressure shall be the maximum design pressure of the line plus 50 pounds per square inch (psi). The maximum allowable leakage shall be calculated using the formula below. If the quantity of leakage exceeds the maximum amount calculated, remedial action shall be taken to reduce the leakage to an amount within the allowable limit as follows:

$$Q = \frac{LD}{12{,}672}$$

Where:

Q = quantity of makeup water, in gallons per hour

L = length of pipe section being tested, in feet

D = nominal diameter of the pipe, in inches

3.05 AIR PIPING

Air piping shall be tested for a period of four (4) hours at 100 psi or 1.5 times the operating pressure. There shall be no drop in pressure allowed.

3.06 CHLORINE SOLUTION PIPING

Chlorine solution piping shall be tested with air for a period of four (4) hours at a pressure of 100 psi. There shall be no leakage allowed.

3.07 WASTEWATER GRAVITY LINES

A. All gravity lines shall be tested in accordance with TCEQ requirements, given in the Texas Administrative Code Title 30 Part 1 Chapter 217.57. Testing shall include either a low pressure air test or an infiltration/exfiltration test.

B. Low Pressure Air Test

1. Lines with an inside diameter of less than 36-inch shall be air tested between manholes. Lines with an inside diameter of 36-inch or greater shall be air tested at pipe joints. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses. Manholes shall be plugged so they are isolated from the pipe.

2. The low pressure air test must conform with the procedures given in TAC Title 30 Part 1 Chapter 217.57.a.1

C. Infiltration/Exfiltration

1. An infiltration test shall be performed if the lines are installed below the groundwater level, otherwise an exfiltration test shall be performed. The infiltration test must conform with the procedures given in TAC Title 30 Part 1 Chapter 217.57.a.2.

2. The exfiltration test must conform with the procedures given in TAC Title 30 Part 1 Chapter 217.57.a.2.

    a. The section of pipe to be tested shall be filled with water and allowed to stand for such time as is required for the pipeline to absorb such water as it will and for the escape of all air from the line. The sections undergoing test shall be carefully examined for leakage. All known leaks shall be repaired, regardless of these test requirements.
    b. The line shall then be filled to a reference level in manhole or in a reservoir of sufficient capacity to allow for a reference level to be established. The reservoir must be of sufficient capacity as to not allow the water level to drop below the crown of the pipe during the 24-hour test period. If the water level drops below the crown of the pipe, the test shall be voided and run again or until such time the water level is maintained above the crown throughout the duration of the test.
    c. At the end of a 24-hour period, water, if needed, shall be added to the line to bring the water level back to the referenced line. All water added shall be accurately measured by an approved water meter so that any exfiltration rate can be established.
    d. Leakage during the above test shall not exceed a rate equal to 50 gallons per inch of internal diameter per mile per 24 hours.

END OF SECTION

ELECTRICAL
INSTRUMENTATION AND CONTROL
SPECIFICATIONS

PREPARED BY
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TBPE FIRM NO. F-9357

THIS DOCUMENT IS RELEASED
UNDER THE AUTHORITY OF
JOHN A. CLEARY, P.E. 51130
3/23/2016

ELECTRICAL

PART 1: GENERAL

1.01 GENERAL

A. The General Conditions and Requirements, Special Provisions, are hereby made a part of this section.

B. The Electrical Drawings and Specifications under this section shall be made a part of the contract documents. The Drawings and specifications of this contract, as well as supplements issued thereto, information to bidders and pertinent documents issued by the Owner's representative are a part of these drawings and specifications and shall be complied with in every respect. All of the above documents will be on file at the office of the Owner's representative and shall be examined by all bidders. Failure to examine all documents shall not relieve the responsibility or be used as a basis for additional compensation due to omission of details of other sections from the electrical documents.

C. Furnish all work, labor, tools, superintendence, material, equipment, and operations necessary to provide for a complete and workable electrical system as defined by the contract documents.

D. Be responsible for visiting the site and checking the existing conditions. Ascertain the conditions to be met for installing the work and adjust bid accordingly.

E. It is intent of the contract document that upon completion of the electrical work, the entire system shall be in a finished, workable condition.

F. All work that may be called for in the specifications but not shown on the drawings; or, all work that may be shown on the drawings but not called for in the specifications, shall be performed by the Contractor as if described in both. Should work be required which is not set forth in either document, but which work is nevertheless required for fulfilling of the intent thereof; then, the contractor shall perform all work as fully as if it were specifically set forth in the current documents.

G. The definition of terms used throughout the contract documents shall be as specified by the following agencies:

1. Underwriters Laboratories
2. National Electrical Manufacturers Association
3. American National Standard Institute
4. Insulated Power Cable Engineers Association
5. National Electrical code
6. National Fire Protection Association

1.02 PERMITS, CODES AND UTILITIES

A. Secure all permits, licenses, and inspections as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, rules, regulations and contract requirements bearing on the work.

B. The minimum requirements of the electrical system installation shall conform to the latest edition of the National Electrical Code as well as state and local codes.

C. Codes and ordinances having jurisdiction and specified codes shall serve as minimum requirements; but, if the Contract Documents indicate requirements which are in excess of those minimum requirements then the requirements of the Contract Documents shall be followed. Should there be any conflicts between the Contract Documents and codes, or any ordinances, report these with bid.

D. Determine the exact requirements for the utility service connections and metering facilities as set forth by the utilities that will serve the project, and pay for and perform all work as required by those utilities.

1.03 STANDARDS

A. All materials and equipment shall conform to the requirements of the Contract Documents. They shall be new, free from defects, and they shall conform to the following standards where these organizations have set standards:

1. Underwriters Laboratories, Inc. (UL)
2. National Electrical Manufacturer's Association. (NEMA)
3. American National Standards Association. (ANSI)
4. Insulated Cable Engineers Association. (ICEA)

B. All material and equipment, of the same class, shall be supplied by the same manufacturer unless specified to the contrary.

C. All products shall bear UL labels where standards have been set for listing.

1.04 SHOP DRAWINGS AND SUBMITTALS

A. Shop drawings shall be taken mean detailed drawings with dimensions, schedules, weights, capacities, installation details and pertinent information that will be needed to describe material or equipment in detail.

B. Submittals shall be taken to mean catalog cuts, general descriptive information, catalog numbers and manufacturer's name.

C. Submit for review in sextuplet within sixty (60) days after notice to proceed, all shop drawings and submittals as hereinafter called for. If shop drawings and submittals are not received in sixty (60) days, the Owner's representative reserves the right to go directly to the manufacturer for the information and any expense incurred shall be borne by the contractor.

D. Review of submittals or shop drawings shall not remove the responsibility for furnishing materials or equipment of proper dimensions, quantity and quality; nor will such review remove the responsibility for error in the shop drawings or submittals.

E. Failure to process submittals or shop drawings on any item and/or items specified shall make the Contractor responsible for the suitability of the item and/or items, even though the item and/or items installed appear to comply with the Contract Documents.

F. Assume all costs and liabilities which may result from the ordering of any material or equipment prior to the review of the shop drawings or submittals, and no work shall be done until the shop drawings or submittals have been reviewed. In case of correction or rejection, resubmit until such time as they are accepted by the Owner's representative and such procedures will not be cause for delay. After final review, supply up to six (6) copies, if requested.

G. Submittals and shop drawings shall be compiled from the manufacturer's latest product data. Should there be any conflicts between this data and the Contract Documents, report this information for each submittal and/or shop drawing.

H. Shop drawings and submittals will be returned and unchecked if the specific items proposed are not clearly marked, or if the general contractor's approval stamp is omitted.

I. When requested, furnish samples of materials for acceptance review. If a sample has been reviewed and accepted, then that item of material or equipment installed on the job shall be equal in quality to the sample; if it is found that the installed item is not equal then replace all such items with the accepted sample equivalent.

J. Materials to be submitted are as follows:

1. Motor control center, controls system
2. Wiring devices
3. Wire
4. Conduit and Fittings
5. Disconnect switches
6. Instruments

1.05 ACCEPTANCE AND SUBSTITUTIONS

A. All manufacturers named are a basis as a standard of quality and substitutions of any equal product will be considered for acceptance. The judgement of equality of product substitution shall be made by the Engineer.

B. Substitutions after award of contract shall be made only within sixty (60) days after the notice to proceed. Furnish all required supporting data. The submittal of

substitutions for review shall not be cause for time extensions.

C. Where substitutions are offered, the substituted product shall meet the product performance as set forth in the specified manufacturer's current catalog literature, as well as meeting the details of the Contract Documents.

D. The details on the drawings and the requirements of the specifications are based on the first listed item of material or equipment; if any other than the first listed materials or equipment is furnished, then assume responsibility for the correct function, operation, and accommodation of the substituted item. In the event of misfits or changes in work required, either in this Section or other Sections of the Contract, or in both; bear all costs in connection with all changes arising out of the use of other than the first listed item specified.

1.06 EXCAVATION AND BACKFILLING

A. Do all excavating and backfilling necessary for the installation of the work. This shall include shoring and pumping in ditches to keep them dry until the work in question has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed.

B. All excavations shall be made to the proper depth, with allowances made for floors, forms, beams, piping, finished grades, etc. Ground under conduits shall be well compacted before conduits are installed.

C. All backfilling shall be made with selected soil; free of rock and debris and shall be pneumatically tamped in six (6") inch layers to secure a field density ratio of 90%.

D. All excavated material not suitable and not used in the backfill shall be removed offsite at the Contractors expense.

E. Field check and verify the locations of all underground utilities prior to any excavating. Avoid disturbing these as far as possible. In the event existing utilities are broken into or damaged, they shall be repaired so as to make their operation equal to that before the trenching was started.

F. Where the excavation requires the opening of existing walks, drives, or other existing pavement, these facilities shall be cut as required to install new lines and to make connections to existing lines. The sizes of the cut shall be held to a minimum consistent with the work to be installed. After installation of new work is completed and the excavation has been backfilled in accordance with above, repair existing walks, drives or other existing pavement to match existing installation.

1.07 CUTTING AND PATCHING

A. Cutting and patching required under this section shall be done in a neat

workmanlike manner. Cutting lines shall be uniform and smooth.

B. Use concrete saws for large cuts in concrete and core drills for small round cuts in concrete.

C. Where openings are cut through masonry walls, provide lintel or other structural supports to protect the remaining masonry. Adequate support shall be provided during the cutting operation to prevent damage to masonry.

D. Where large openings are cut through metal surfaces, attach metal angles around the opening.

E. Patch concrete openings that are to be filled with non-shrinking cementing compound. Finish concrete patching shall be troweled smooth and shall be uniform with surrounding surfaces.

1.08 WATERPROOFING

A. Provide waterproof flashing for each penetration of exterior walls and roofs.

B. Flashing for conduit penetrations through built-up roofs shall be made with pitch pans filled with pitch. Conduit penetrations through poured concrete roofs shall be made with sleeves and annulus caulked.

C. Penetrations through walls at below ground elevations shall be waterproofed by conduit sealing fittings or other methods as indicated.

D. Interiors of raceways that are likely to have water ingress such as runs from handholes into below-grade installations shall have waterstops installed to prevent water from entering into installations.

1.09 EQUIPMENT PROTECTION

A. Provide suitable protection for all equipment, work and property against damage during construction.

B. Assume full responsibility for material and equipment stored at the site.

C. Conduit openings shall closed with caps or plugs during installation. All outlet boxes and cabinets shall be kept free of concrete, plaster, dirt, and debris.

D. Equipment shall be and tightly sealed against entrance of dust, dirt, and moisture.

1.10 CLEAN-UP

A. Remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work, clean equipment and the entire installation so as to present a first class job suitable for occupancy. No loose parts or scraps

or equipment shall be left on the premises.

B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer, or with an approved paint.

C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt, and debris.

1.11 TESTS

A. All equipment shall put through a trial run-in test to ascertain the performance complies with the intent of the specifications. All-in tests shall be made in the presence of the Engineer. All cables shall have an insulation test performed using 600 volt megger.

B. Cables installed with an insulation reading less than 50 Megohms shall be removed and new cable installed and retested at no additional cost to the owner.

1.12 RECORD DRAWINGS

A. At the start and during the progress of the job, keep one separate set of blue-line prints for making construction notes and mark-ups.

B. Show conduit routing and wiring runs as constructed and identify each.

C. Record all deviations from the Contract Documents.

D. Submit set of marked-up drawings for review.

1.13 OPERATIONS AND MAINTENANCE MANUALS

A. Six (6) weeks prior to the completion of the project, compile an operations and maintenance manual on each item of equipment. These manuals shall include detailed instructions and maintenance, as well spare parts lists.

B. Submit six (6) copies for review.

PART 2 PRODUCTS

2.01 RACEWAYS

A. Above ground conduit shall be schedule 40 aluminum and shall comply with Article 346 of NEC and U.L. standard UL-6.

B. Below grade conduit shall be non-metallic rigid PVC Schedule 40, rated 90 degrees Celsius and conform to NEMA TC-2 and UL-651 Standards, transitions to above ground to be made with PVC coated hot dipped rigid steel conduit.

C. Connections to motors shall be made using liquid tight flexible conduit and shall consist of galvanized flexible interlocking steel core with thermoplastic cover.

2.02 CONDUIT FITTINGS

A. NEMA 1 lock nuts for indoor rigid metallic conduit shall be galvanized steel.

B. Outdoor field applied hubs for sheet metal enclosures shall be galvanized steel ring, nylon throat, threaded NPT insert and shall be MYERS "SCRU-TITE", or equal.

C. Conduit hubs for non-metallic enclosures shall be fiberglass polyester reinforced with galvanized steel core, complete with lockout and grounding bushing and shall be Square D Type NH, or equal.

D. Rigid metallic conduit chase nipples, slip fittings, unions, reducers shall be hot dipped galvanized steel.

E. Rigid metallic conduit grounding bushings shall be hot dipped galvanized steel with threaded hub, nylon insulated throat, and ground lug.

F. Liquid tight flexible conduit fittings shall be hot dipped galvanized steel body with internal locking ring.

2.03 CONDUIT BODIES AND BOXES

A. Conduit bodies such as "C", "LB", "T" and the like pulling fittings shall be sand-cast copper free aluminum. Covers shall be gasketed cast metal with stainless steel cover screws and clamp style attachment. Furnish Crouse-Hinds Form 7, or equal.

B. Conduit bodies such as "GUA", "GUAT", "GUAL", and the like pulling/splicing fittings shall be copper free aluminum with cast metal covers. All such conduit bodies shall be Crouse-Hinds GU/EA series, Appleton "GR" series, equal.

C. Cast metal outlet boxes, pullboxes, and junction boxes whose volume is smaller than 100 cubic inches, and cast metal device boxes, shall be sand-cast copper free aluminum. All boxes shall have threaded hubs. Furnish Crouse-Hinds "FD" style Condulets, Appleton "FD" style Unilets, or equal.

D. Covers for cast metal boxes shall be gasketed cast metal covers with stainless steel screws.

2.04 WIRE AND CABLE

A. All conductors shall be soft-drawn, stranded annealed copper that meets ANSI 44, ASTM B3-74/38-72.

B. Insulation for all 480V and 120/240V conductors shall be type THWN. For wet and dry locations, maximum operating temperature shall be 75 degrees C. UL listed as gasoline and oil resistant. PVC insulation with nylon outer jacket. Meet UL 83 and federal spec J-C-30B.

D. All power signal-conductor cables shall be factory pigmented black insulation.

D. Multiconductor shielded cables shall be polyethylene insulated tinned copper conductors within an aluminum-polyester shield tinned copper drain wire and a chrome PVC jacket. Shield shall provide 100% coverage. Cables shall be UL style 2092 and shall be Beldon Beldfoil #8760 or equal, with number of conductors shown.

E. Multiconductor signal cables shall consist of twisted pairs of insulated copper conductors, size and number of pairs as indicated, with a petroleum-polyethylene compound which fills all cable interstices, a non-hygroscopic core tape, .005" copper shield and a polyethylene jacket. Cable shall be manufactured to REA Specification PE-39 for REA designation BJCF cables and shall be Okonite type KTC-F or equal.

F. Multiconductor cords shall consist of rubber insulated high-strained copper conductors contained within a neoprene jacket. Furnish type SJO/300V class for 120/240V class applications.

2.05 CONNECTORS

A. Power connectors shall be insulated tap connectors. Furnish NSI Polaris connectors with no equals.

B. Insulated spring-wire connectors, "wire-nuts", for small building wire taps and splices shall be plated spring steel with thermoplastic jacket. Connector shall be rated at 150 degrees Celsius continuous. Furnished 3M "Hyflex", T&B "PT" or equal.

C. Insulated set-screw connectors shall consist of copper body with flame-retardant plastic insulated shield. Furnished Ideal, T&B, or equal.

D. Connectors for control conductor connections to screw terminals shall be crimp-type with vinyl insulated barrel and tin-plated copper ring-tongue style connector. Furnish T&B "Sta-kon", 3M "Scothlok", or equal.

2.06 INSULATING PRODUCTS

A. Tape products shall be furnished as hereinafter specified and shall be Plymouth, Okonite, F.E., 3M, or equal.

B. General purpose electrical tape shall be 7 mil thick stretchable vinyl plastic, pressure adhesive type, "slipknot Grey", 3M Scotch 33+, or equal.

C. Insulating void-filling tape and high voltage bedding tape shall be stretchable ethylene propylene rubber with high-tack and fast fusing surfaces. Tape shall be rated for 90 degrees Celsius continuous, 130 degrees Celsius overload, and shall be moisture-proof void filling tape shall be "plysafe", 3M Scotch 23, or equal.

D. High temperature protective tape shall be rated 180 degrees Celsius continuous indoor/outdoor, stretchable, self-bonding silicone rubber. High temperature tape shall be "Plysil #3445", 3M Scotch 70, or equal.

E. Insulation putty filler-tape shall be Plymouth #2074, 3M, or equal.

2.07 LABELS

A. Colored banding tape shall be 5 mil stretchable vinyl with permanent solid color. Color shall be as hereinafter specified. Tape shall be Plymouth "Slipknot 45", 3M Scotch #35, or equal.

B. Numbered marking labels shall be colored vinyl markers, T&B, Brady, or equal.

C. Cable identification labels shall be water resistant polyester with blank write-on space, T&B, Brady, or equal.

D. Buried conduit marking tape for marking path of buried conduits shall be a four (4") inch nominal width strip of polyethylene with highly visible, repetitive marking "BURIED CONDUIT", or similar language, along its length.

E. Nameplates shall be micarta lamicoid material, 1/6" thick, black background with white engraving. Attachment means shall be self-tapping stainless steel screws.

2.08 GROUNDING DEVICES

A. Exothermally welded joints shall be made with Enrico "cadweld", Burndy "Thermweld", or equal kits.

B. Ground bus connectors shall be Square D type "LU", OZ Type "XLH", or equal.

C. Conduit grounding bushings shall be as specified under CONDUIT FITTINGS.

2.09 SUPPORTING DEVICES

A. Mounting hardware, nuts, bolts, lock washers, and washers, shall be grade 304 stainless steel.

B. Unless otherwise indicated, slotted channel framing and supporting devices shall be manufactured of ASTM 6063, T-6 grade aluminum; 1-5/8"wide x 3-1/4" deep

(double opening type). Clamp nuts for use with slotted channels shall be grade 304 stainless steel.

C. Conduit straps for use with slotted channels shall be aluminum with stainless steel hardware.

D. After-set concrete inserts shall consist of stainless steel expansion bolts, 1/4: minimum diameter, 500 lbs. minimum pull-out resistance. Furnish Phillips, Wej-it, or equal.

E. Hanger rod shall be 3/8": minimum diameter galvanized steel all-thread.

F. Nest-back or clamp-back conduit supports shall be two-piece hot-dip galvanized malleable iron devices. Furnish Crouse-Hinds "MW + CB", Gedney 140 series, or equal.

G. One-hole conduit clamps shall be hot-dipped galvanized malleable iron type, Crouse-Hinds type "MW", T&B 1270/1280 series, or equal.

H. Conduit "U" bolts shall be hot-dip galvanized steel with galvanized hex-head bolts.

I. Plastic saddles for supporting buried conduits shall be interlocking type that provides separation between conduits vertically and laterally and between bottom of conduits and trench floor.

2.10 MISCELLANEOUS MATERIAL

A. Double bushing for insulating wiring through sheet metal panels shall consist of mating male and female threaded phenolic bushings. Phenolic insulation shall be high-impact "ABB", Gedney type "ABB", or equal.

B. Cable grips shall be stainless steel, grip-type wire mesh with machined metal support. Furnish Kellems, Appleton, or equal products.

C. Conduit pull-cords for use in empty raceways shall be glass-fiber reinforced tape with foot-marked along its length. Furnish Thomas, Greenlee, or equal products.

D. Conduit thread coating compound shall be conductive, non-galling, and corrosion-inhibiting. Furnish Crouse-Hinds type "STL", Appleton type "ST", or equal.

E. Wire pulling compound shall be non-injurious to insulation and to conduit and shall be lubricating, non-crumbling, and non-combustible. Furnish Gedney "Wire-Quick", Ideal "Yellow", or equal.

F. Plastic compound for field-coating of ferrous material products shall be PVC in liquid form that sets-up semi-hard upon curing. Furnishing Rob Roy "rob Kote",

Sedco "Patch Coat", or equal.

G. Zinc spray for coating electro-galvanized steel products shall be Research Laboratory type "LPS", Mobil "Zinc-spray", or equal.

H. Splicing kit shall be provided with insulating and sealing compound to provide a moisture-tight splice. Provide Scotchcast Series 82 or equal splicing kit.

2.11 LIGHTING

A. Fixture lamps shall be furnished.

B. Each fixture shall be complete with its appropriate hardware, finish trim, and appurtenances as required for a finished installation.

2.12 WIRING DEVICES

A. All wiring devices shall be specification grade and shall meet NEMA WD 1-1971 requirements. Furnish following types unless otherwise indicated.

B. Two-pole, 3-wire grounding, 15A/125V, NEMA 5-15R duplex receptacle shall be Arrow-Hart #5662-S, Hubbel #5262, or equal.

C. Two-pole, 3-wire grounding, 20A/125V, NEMA 5-20R duplex receptacle shall be Arrow-Hart #5739-S, Hubbell #5362, or equal.

D. GFI receptacle shall be duplex receptacle in a duplex body containing reset and test push-buttons. Furnish Square D "GFSR", or equal.

E. Two-pole, 3-wire grounding, #20A/250V NEMA 6-20R single receptacle shall Arrow-Hart #5861, Hubbell #5461, or equal.

F. Single-pole, single throw, 20A toggle switch shall be Arrow-Hart #1791, Hubbell #1221, or equal.

G. Single-pole, double throw (three-way) 20A toggle switch shall be Arrow-Hart #1994, Hubbell #1224, or equal.

H. Double-pole, double-throw (four-way) 20A toggle switch shall be Arrow-Hart #1994, Hubbell #1224, or equal.

I. Double-pole, single-throw 29A toggle switch shall be Arrow-Hart #1992, Hubbell #1222, or equal.

J. Single-pole, double-throw, momentary/centeroff, 20A toggle switch shall be Arrow-Hart #1995, Hubbell #1556, or equal.

K. Door switch, single-throw pressure sensitive shall be Pass & Seymour #1205, or

equal.

2.13 PANELBOARDS

A. Panelboards shall have voltage, over-current devices and features as indicated.

B. Breakers shall be plug-on type, trip-free. Multi-pole breakers shall be provided with a common internal trip which opens all poles simultaneously and with a single operating handle for all poles. Handle ties between breakers are not acceptable.

C. Breakers for 480V distribution panels shall be rated at least 14000 amps I.C., and breakers for 120/240V panels shall be rated at least 10,000 amps I.C.

D. Provide ground bus inside each cabinet.

E. Enclosures shall be NEMA 4X stainless steel surface mounted cabinet with gasketed, hinged door, inside gutter trim and with door mounted directory pocket

2.14 DRY-TYPE TRANSFORMERS

A. Dry-type transformers shall have continuous KVA and voltage characteristics as shown.

B. Enclosures shall be indoor-type.

C. Coils shall be provided with NEMA standard taps in high voltage windings.

D. Furnish Square D or equal dry-type transformers.

2.15 SAFETY SWITCHES

A. Safety switches shall be fused or non-fused as indicated. Each fused type switch shall be equipped with class R refection clips.

B. Switch mechanism in each safety switch shall be quick-make, quick-break, heavy-duty type that meets Federal Specification W-S-865C.

C. Enclosures shall be NEMA types as indicated. NEMA 4X types shall be stainless steel with gasketed door and stainless steel hardware.

D. Conduit hubs for NEMA 4X enclosed safety switches shall be steel body type with fiberglass reinforced polyester covering and with grounding bushing inside.

E. Conduit hubs for NEMA 3 and NEMA 4 enclosures shall be water-tight threaded hubs with grounding bushing inside.

F. Each enclosure shall be equipped with ground lug.

G. where indicated furnish disconnect mechanism with auxiliary control disconnect contact rated 10 amp make, 6 amp break 120V A. C., 35% p.f.

H. Where indicated furnish NEMA 4X safety switches with integrally mounted pilot operators.

I. NEMA 1,3,4, or 12 enclosed safety switches shall be Square D or equal.

J. NEMA 4X safety switches shall be stainless steel.

PART 3: INSTALLATION

3.01 RACEWAYS

A. Install the conduit system to provide the facility with the utmost degree of reliability and maintenance free operation. The conduit system shall have the appearance of having been installed by competent workmen. Kinked conduit, conduit inadequately supported or carelessly installed, do not give such reliability and maintenance free operation and will not be accepted.

B. Raceways shall be installed for all wiring runs except as otherwise indicated.

C. Conduit sizes, where not indicated, shall be N.E.C. code-sized to accommodate the number and diameter of wires to be pulled into the conduit. Unless otherwise indicated, 3/4" trade-size shall be minimum size conduit.

D. Unless otherwise noted, conduit runs shall be installed exposed. Such runs shall be made parallel to the lines of the structure. Where aluminum conduit or supporting devices come in contact with concrete, the conduit and or supporting devices shall be coated with zinc chromate or other suitable coating to prevent galvanic action.

E. Unless otherwise indicated, conduit runs installed below-grade in earth shall be PVC. Use manufacturer's approved cement for joining couplings and adapters. Runs shall be installed so that tops of conduits are at least twenty-four (24") inches below finished grade. Support runs on plastic spacers and backfill to three (3") inches above topmost conduits with washed sand. Wash down all sand backfill with water so as to completely fill interstices and to compact sand. Complete backfill to finished grade with selected soil that is free from clods, debris, rocks and the like. Pneumatically tamp backfill in six (6") inches to eight (8") inches below finished grade, install continuous run of "BURIED CABLE" marking taped.

F. Below-grade to above-grade upturns in non-metallic runs shall be made with PVC coated rigid metallic conduit.

G. Rigid metallic conduit runs shall have their couplings and connections made with screwed fittings and shall be made up wrench-tight. Check all threaded conduit joints prior to wire pull.

H. All conduit runs shall be watertight over their lengths of run except where drain fittings are indicated. In which cases, install specified breather-drain fittings.

I. Plastic jacketed flexible steel conduit shall be used to connect wiring to motors, limit switches, bearing thermostats, and other devices that may have to be removed for servicing. Unless otherwise indicated, maximum lengths of flex shall be six (6') feet.

J. Each flex connector shall be made-up tightly so that the minimum pull-out resistance is at least 150 lbs.

K. Empty conduits shall have pull-tape installed. Identify each terminus as to location of other end. Use blank plastic waterproof write-on label and write information on each label with waterproof ink. Cap exposed ends of empty conduit with plastic caps.

L. Conduit runs into boxes, cabinets, and enclosures shall be set in a neat manner. Vertical runs shall be set plumb. Conduits set cocked or out of plumb will not be acceptable.

M. Conduit entrances into equipment shall be carefully planned. Cutting away of enclosure structure, torching out sill or braces, and removal of enclosure structural members, will not be acceptable.

N. Use approved hole cutting tools for entrances into sheet metal enclosure. Use of cutting torch or incorrect tools will not be acceptable. Holes shall be cleanly cut and they shall be free from burrs, fagged edges, and torn metal.

O. All raceways shall be swabbed clean after installation. There shall be no debris left inside. All interior surfaces shall be smooth and free from burrs and defects that would injure wire insulation. All conduits shall be sealed after cable installation with electrical insulation putty.

3.02 CONDUIT BODIES AND BOXES

A. Conduit bodies such as "LB", "T", etc., shall be installed in exposed runs of conduit wherever indicated and where required to overcome obstructions and to provide pulling access to wiring. Covers for such fittings shall be accessible and unobstructed by the adjacent construction.

B. Covers for conduit bodies installed shall be gasketed cast metal type.

C. All conduit boxes installed shall be cast metal type. Covers for all such boxes

shall be gasketed cast metal type.

3.03 RACEWAY SUPPORT

A. All raceway systems shall be adequately and safely supported. Loose, sloppy and inadequately supported raceways will not be acceptable. Supports shall be installed at intervals not greater than those set forth under Article 300 of N.E.C., unless shorter intervals are otherwise indicated, or unless conditions require shorter intervals of supports.

B. Surface mounted runs of conduit on concrete or masonry surfaces shall be supported off the surface by means of aluminum slotted channels and conduit clamps. Attach each slotted channel support to concrete surface by means of two (2) 1/4" diameter stainless steel bolts into drilled expansion shields. Coat surface contacting concrete or masonry with zinc chromate.

C. Conduit runs that are installed along metallic structures shall be supported by means of beam clamps or other methods as may be indicated. Coat each beam clamp with PVC prior to installation.

D. Below-grade conduits shall be supported with plastic saddles.

3.04 WIRING

A. Conductors shall be sized as shown and where no size is indicated, the conductor size shall be size #12 AWG.

B. All power and control wiring and insulated equipment grounding conductors shall be type THWN insulated stranded copper conductors.

C. Branch circuits may be spliced for receptacle, lighting and small appliances load inside appropriate junction boxes. All control and power cables shall be run continuous without splices except where approved by the engineer.

D. Except as otherwise specified, taps and splices for receptacle, lighting and small appliances shall be made with insulated spring wire connectors. Such connectors in damp or wet locations shall be further insulated with an envelope of stretched piece of EPR tape around each wire to fill the interstices between the wires. Then, apply one-half lapped layer of electrical tape over all.

E. Motor connections and all taps and splices other than for receptacle, lighting and small appliances shall be made with the appropriate NSI Polaris series connectors.

F. Control wiring connections to stud type and screw type terminals shall be made with ring-tongue type crimp connectors. Label each terminal jacket with wire marking label at each connection.

G. Each wire connection shall be made up tightly so that resistance of connection is

as low as equivalent length of associated conductor resistance.

H. Phase label black pigmented power wires with color banding tape. Color of tape applies shall be that specified below.

CONDUCTOR	120/240V SYSTEMS	480V SYSTEMS
Phase A	Black	Brown
Phase B	Red	Yellow
Phase C	Blue	Purple
Neutral	White	Gray
Equipment Ground	Green	Green

I. Numbered labels shall be installed to identify circuit numbers from panel boards. Install labels on each wire in each panelboard, junction, and pullbox, and device connection.

J. Label each wiring run with write-on waterproof labels inside each motor control center and in service switchboard. Install write-on label ties around wire group at conduit entrance and write-on label the wire size, and service.

K. Install numbered marking on each control wiring termination at each terminal strip and at each device. Do this in motor control center, terminal cabinets, safety switches, remote controllers, pilot operators, and instrumentation equipment. Number selected shall correspond to number on terminal strip.

L. All wiring inside enclosures will be neatly trained and laced with nylon tie-wraps.

M. All wiring shall be installed in raceways unless otherwise noted; however, no wire shall be drawn into a conduit until all work of a nature which may cause injury is completed. Do not exceed wire and cable manufacturer's recommended pulling tensions. A cable pulling compound shall be used as a lubricant and its composition shall not affect the conductor or its insulation.

3.05 WIRING DEVICES

A. Install wiring devices where indicated. Wiring devices shall be type as indicated.

B. Each wiring device shall be set with axis plumb and installed with yoke screw so as to adequately support device yokes to the box.

C. Device boxes shall be cast metal Condulets or equal.

D. Use ganged boxes for ganged devices.

E. Each device box shall be equipped with specified cast metal cover.

3.06 GROUNDING

A. Each item of equipment shall be adequately and thoroughly grounded. Comply with Article 250 of N.E.C., except where higher standards of grounding have been specified.

B. Equipment grounding conductors (EGC) shall be installed where indicated. These wires shall be green colored in sizes #6 AWG and smaller and green banded in larger sizes.

C. EGC runs into equipment and shall be grounded to equipment bus where available, or to equipment ground lugs.

D. Where grounding type bushings are installed, bond EGC thereto and furthermore ground each bushing lug to equipment ground bus or ground lug, or ground rod.

E. In each motor terminal box, install equipment ground lug and connect EGC thereto.

F. In each floodlight pole, install ground connector to pole and bond to conduit bushing and to EGC in branch circuit.

3.07 LABELING

In addition to requirements for labeling as specified throughout this section, install as follows:

A. Phase bank each power wire and cable with colored banding tape. Do this at each termination.

B. Apply numbered wire marking labels to control wires; power wiring in panelboards, pull and junction boxes, and at outlets to identify circuit numbers. Each control wire shall be labeled at each connection.

C. Apply write-on identification labels to wiring sets in each hand-hole to identify function. Use waterproof labels.

D. Apply write-on identification labels to empty conduits to identify each with information as to terminus of other end and also trade size of conduit.

E. Install micarta nameplates with engraving to identify function and/or load served for the following:

1. Panelboards
2. Overcurrent Devices
3. Safety Switches
4. Pumps Control Panel
5. SCADA System

Micarta nameplates shall be attached with stainless steel screws, use two (2) per each nameplate.

Submit for review a schedule for engraving along with size for each proposed micarta nameplate. Do not fabricate nameplate until review has been completed.

F. Type circuit directory information on circuit directory cards on all panelboards.

END OF SECTION

CONTROL & INSTRUMENTATION

PART 1: GENERAL

1.01 SCOPE

A. Furnish and install instrumentation and control systems as indicated on the plans.

B. Products and installations shall comply with the electrical section specifications.

1.02 EQUIPMENT FIELD SERVICE

A. Provide the services of factory trained personnel to assist in the installation and start- up of the control system.

B. Provide at least eight (8) hours on site time of factory trained personnel for training plant personnel on the operation and maintenance of the equipment.

PART 2 PRODUCTS

2.01 PRESSURE AND LEVEL TRANSMITTERS

a. Furnish and install pressure transmitters as indicated.
B. Pressure transmitter shall be of a strain gage based design with internal signal conditioning to provide a 4-20mADC full scale output signal in direct proportion to the differential pressure input. It shall be a true two wire device operating on 12-36VDC excitation. Lead reversal or shorting shall not harm the circuitry. The transducer shall operate in conjunction with the existing telemetry system RTU's. The units furnished shall be compatible with the span and pressure ranges of the application. The units shall be of stainless steel construction.
C. All components shall be contained in a NEMA 4X enclosure.
D. Accuracy shall be within +/-1% of span.
E. Pressure transmitters shall be NEW YORK LTD GP:50 or approved equal.

END OF SECTION

ATTACHMENT A – GEOTECHNICAL ENGINEERING REPORT

TERRACON PROJECT NO. 96085172

SEPTEMBER 18, 2008

Terracon

GEOTECHNICAL ENGINEERING REPORT

MESA VERDE ELEVATED AND GROUND STORAGE TANKS
COPPERAS COVE, TEXAS

Terracon Project No. 96085172
September 18, 2008

Prepared for:

RIVER CITY ENGINEERING
Austin, Texas

Prepared by:

TERRACON CONSULTANTS, INC.
Geotechnical Engineering Division
Austin, Texas

Terracon
Consulting Engineers & Scientists

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Phone 512.442.1122
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www.terracon.com

September 18, 2008

River City Engineering
3801 South First Street
Austin, Texas 78704

Attention: Mr. John Muras, P.E.
512-442-3008
jmuras@rcetx.com

Re: Geotechnical Engineering Report
Mesa Verde Elevated and Ground Storage Tanks
Copperas Cove, Texas
Terracon Project No. 96085172

Dear Mr. Muras:

Enclosed is our geotechnical engineering report for the above referenced project. We trust that this report is responsive to your project needs. Please contact us if you have any questions or if we can be of further assistance.

Terracon Consultants, Inc. (Terracon) appreciates the opportunity to work with you on this phase of the project, and we look forward to the opportunity to provide additional geotechnical, environmental, and/or construction materials testing services as the project progresses.

Sincerely,
TERRACON CONSULTANTS, INC.

Rob W. Archer
Senior Project Manager

Bryan S. Moulin, P. E.
Principal, Geotechnical Department Manager

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Copies To: Addressee (3)

Terracon

TABLE OF CONTENTS

Terracon

GEOTECHNICAL ENGINEERING REPORT

MESA VERDE ELEVATED AND GROUND STORAGE TANKS
COPPERAS COVE, TEXAS

Terracon Project No. 96085172
September 18, 2008

INTRODUCTION

This report presents the results of our geotechnical engineering services for the proposed Mesa Verde Elevated and Ground Storage Tanks in Copperas Cove, Texas. This project was authorized by Mr. John Muras of River City Engineering, through signature of our "Agreement for Services" on August 5, 2008. The scope of services for this project was generally performed as outlined in Terracon Proposal No. 9608G1821, dated June 24, 2008. Coordinates for the proposed tank locations were provided on August 20, 2008.

Our scope of services for this project consisted of:

1. Drilling test borings at selected and accessible locations within the project site to evaluate subsurface stratigraphy and groundwater conditions.

2. Performing geotechnical laboratory tests on recovered samples to evaluate the physical and engineering properties of the strata encountered.

3. Engineering analyses to develop design and construction recommendations with respect to:
   - Foundation design and construction;
   - Slope excavations;
   - Availability of on-site soil for re-use during fill placement; and
   - Site, subgrade, and fill preparation considerations.

PROJECT DESCRIPTION

The subject site is located south of FM 1113, just west of downtown Copperas Cove, Texas. The site is currently undeveloped with scattered trees.

The project includes the construction of a 300,000 gallon elevated storage tank, a 1.2 million gallon ground level storage tank, and a pump station. The elevated storage tank will be constructed near existing grades at a base elevation of 1257 feet-MSL. The ground level storage tank will require cuts on the order of 10 to 20 feet to achieve the proposed base elevation of 1238 feet-MSL.

Structural information was not available at this time. However, based on our experience with similar structures, we anticipate that the storage tanks will be supported by a either a mat foundation or a ring-wall foundation.

SITE EXPLORATION PROCEDURES

Field Exploration

Subsurface conditions were evaluated by drilling a total of 4 test borings (B-1 through B-4) to depths ranging from about 30 to 45 feet below the ground surface. The borings were drilled with truck-mounted rotary drilling equipment at the approximate locations shown on Figure 2 of the Appendix. Boring depths were measured from the existing ground surface at the time of our field activities.

The Logs of Boring, which include the soil/rock descriptions, types of sampling used, and additional field data for this study, are presented on Figures 3 through 6 of the Appendix. Criteria for the "Unified Soil Classification System", "General Notes", and "Description of Rock Properties" defining terms, abbreviations and descriptions used on the boring logs are presented on Figures 7 through 9.

When possible, the surficial soils were sampled by means of the Standard Penetration Test (SPT). This test consists of measuring the number of blows required for a 140-pound hammer free falling 30 inches to drive a standard split-spoon sampler 12 inches into the subsurface material after being seated 6 inches. This blow count or SPT "N" value is used to evaluate the engineering properties of the stratum.

Once rock was encountered, the borings were advanced with Nx coring equipment. Visual classifications of all of the samples were performed in the field and percentages of Recovery and Rock Quality Designation (RQD) were calculated from recovered rock cores. Recovery is defined as the percentage of core recovered as a function of the length of core run drilled. The RQD is a modified measurement of core recovery which indirectly takes into account fractures and/or softening in the rock mass by summing up only pieces of sound core which are 4 inches or greater in length as a percentage of the total core run.

Samples were removed from the samplers in the field, visually classified, and appropriately sealed in sample containers to preserve the in-situ moisture contents. Samples were then placed in core boxes for transportation to the laboratory.

Laboratory Testing

Samples obtained during the field program were visually classified in the laboratory by a geotechnical engineer. A testing program was conducted on selected samples, as directed by the geotechnical engineer, to aid in classification and evaluation of engineering properties required for analyses.

Results of the laboratory tests are presented on the Logs of Boring in the Appendix, and/or are discussed in the following section. Laboratory test results were used to classify the soils encountered as generally outlined by the Unified Soil Classification System.

Sample Disposal

All samples were returned to our laboratory in Austin, Texas. Samples not tested in the laboratory will be stored for a period of 30 days subsequent to submittal of this report and will be discarded after this period, unless we are notified otherwise.

SITE CONDITIONS

Surface Conditions

The subject site is currently undeveloped and grassed with scattered trees. Based on a review of the provided Conceptual Site Plan, site topography slopes down from the south at an approximate elevation of 1260 feet-MSL towards the north at an elevation of approximately 1250 feet-MSL along the northern edge of the tank site.

Site Geology

Based on available geologic literature[1] and our review of the samples, the site lies within an area characterized by Edwards Limestone of Lower Cretaceous Age. The limestone is described as massive to thin bedded, hard, and brittle. In weathered zones, the limestone is often honeycombed and cavernous, forming aquifers. Flat areas and plateaus bordered by scarps are formed from the formation. The formation ranges in thickness from 15 to 60 feet in the area of the subject site.

Subsurface Conditions

The generalized subsurface stratigraphy at the site, as evaluated from our field and laboratory programs, is tabulated below. We should note that stratification boundaries shown below and on the enclosed boring logs represent approximate locations of changes in material types; in-situ, the transition of materials may be gradual.

Stratum	Range In Depth (ft) [1]	Soil/Rock Description And Classification
I	0 – 5½[2]	Very stiff to hard dark brown and tan sandy clay (CL - CH) and medium dense to dense clayey sand (SC).
II	0 – 45	Edwards Formation – Tan to gray limestone.

1 Approximate depth below the existing ground surface.
2 Not encountered in boring B-4.

The Stratum I clayey and sandy soils were encountered in borings B-1 through B-3 to depths of up to 5½ feet below the existing ground surface. These soils generally exhibit a low shrink/swell potential, as indicated by measured plasticity indices ranging from 12 to 13 percent. In-situ

[1] "Geologic Atlas of Texas – Waco Sheet", Bureau of Economic Geology, The University of Texas at Austin, 1970.

moisture contents were approximately 6 to 7 percent dry of the corresponding plastic limit. SPT "N" values ranged from 20 blows per 12 inches to 50 blows for 1 inch of penetration.

The Stratum II limestone is of the Edwards Formation. Recovery and RQD values ranged from about 16 to 100 percent and 0 to 92 percent, respectively. We note that the driller experienced some difficulty during the coring process due to significant water loss and the hardness of the Edwards Formation Limestone. These difficulties likely impacted the reported Recovery and RQD values. Measured uniaxial compressive strengths of intact rock cores varied from about 197 ksf to 654 ksf.

Groundwater Conditions

The borings were dry augered to depths of about 2 to 5½ feet below existing grade. Groundwater was not encountered during the dry augering operations within the upper portions of these borings. Once rock was encountered, the borings were drilled to completed depths using wet rotary techniques to facilitate rock coring, making subsequent groundwater readings difficult to obtain. However, groundwater was noted at a depth of approximately 27 feet below the ground surface at the time of drilling.

Groundwater seepage is possible at the site, particularly along pervious seams of the on-site soils, in fissures/fractures in the limestone, and/or along the soil/limestone interface. During periods of wet weather, zones of seepage may appear and isolated zones of "perched water" may become trapped (or confined) by zones possessing a low permeability. Groundwater conditions should be evaluated immediately prior to construction.

ENGINEERING RECOMMENDATIONS

Geotechnical Considerations

The following recommendations are based upon the data obtained in our field and laboratory programs, information provided to us, and our experience with similar subsurface and site conditions.

As previously discussed, we understand that the proposed development will include the construction of a 1.2 million gallon Ground Storage Tank, a 300,000 gallon Elevated Storage Tank, and a pump station. Based on the field and laboratory data available, along with our previous experience, several foundation options are available to support the planned structures. Recommendations for these foundation support options are presented in the following subsections, along with other geotechnical engineering considerations for this project.

Foundation Design Recommendations

Drilled Pier Foundation System

The proposed structures may be supported on drilled piers (straight-sided) embedded at least 4 feet into competent Stratum II Edwards Formation limestone. The piers should be designed for a net allowable total load bearing pressure of 50,000 pounds per square foot (psf). In addition, a net allowable side friction of 4,000 psf (for both compressive and tensile forces) may be utilized for pier embedments extending beyond the 4-foot minimum penetration into limestone.

Bearing pressures of piers founded in rock are dependent upon the secondary structure of the rock, as well as the compressive strength. Although these secondary features are taken into account in our recommendations, a pier should not be terminated on a clay layer, severely weathered zone (residual soils), or a void within the limestone. At locations where the design embedment results in the pier terminating on one of these secondary features, the pier should be extended to bear upon competent limestone.

Based on our boring information, the subgrade preparation outlined in this report, and the planned below-grade cuts, soil-related uplift does not appear to be a concern at this site. However, we recommend that the minimum percentage of reinforcing steel be no less than 0.5 percent of the gross shaft area and extend over the full length of the pier.

Although pier shaft diameters will vary depending on the design loading criteria, we recommend a minimum shaft diameter of 18 inches based on constructability issues. For adjacent piers, we recommend a minimum edge-to-edge spacing of at least 1 pier diameter (or 2 pier diameters center-to-center) based on the larger diameter of the two adjacent piers. In locations where this minimum spacing criterion cannot be accomplished, Terracon should be contacted to evaluate the locations on a case-by-case basis.

Maximum post-construction total settlements of properly constructed drilled piers bearing in the Stratum II limestone should be about ½ inch, provided proper construction practices are used. Differential settlements between piers may approach the total settlement value given above. The settlement response of the piers will be more dependent upon the quality of construction than upon the response of the limestone to the foundation loads.

Spread Footings

Principal loads for the elevated tank structure may be supported on shallow spread or continuous (strip) footings embedded a minimum of 18 inches into the Stratum II limestone. The footings should extend through any zones that are disturbed or highly fractured during excavation operations. A net allowable total load bearing pressure of 10,000 psf may be utilized for footings designed as stated above. In the case that below-grade excavations do not expose the underlying limestone, soils should be over excavated and removed from all footing areas such that the footing embedment into limestone is achieved. Footings should not bear on soils.

Post-construction settlements of footings bearing in the limestone should be about ½ inch, assuming proper construction practices are maintained. Differential settlements between footings may approach the total settlement value given above. The settlement response of the footings will be more dependent upon the quality of construction than upon the response of the limestone to the foundation loads.

Mat Foundations

As previously discussed cuts on the order of 10 to 20 feet will be required to achieve the ground storage tank base elevation of 1238 feet-MSL. A mat foundation system bearing on undisturbed Stratum II limestone may be utilized to support this structure and the pump station. Based on the subsurface data obtained during this exploration, we recommend that the mat foundation be designed for a net allowable total load contact pressure of 10,000 psf.

Maximum post-construction settlement of the mat foundation indicated above is anticipated to be less than ½ inch, assuming proper construction and site preparation. Differential movements may approach the estimated total settlement values.

Ring Wall Foundation

As an alternative to a mat foundation, the ground storage tank can be supported by a perimeter ring wall. The ring wall should extend at least 36 inches below final grade and bear on competent undisturbed Stratum II limestone. The ring wall may be designed for a maximum net allowable total load bearing pressure of 10,000 psf. If a ring wall foundation is utilized, we recommend that a minimum 12-inch layer of compacted select fill be placed beneath the tank slab to provide more uniform support conditions and to reduce the impact of "hard points" at the wall backfill and naturally occurring limestone interface.

The ring wall will experience hoop stress due to lateral pressure exerted on the wall from the fill soils and surcharge from the weight of the basin. The structural engineer should consider these lateral forces when designing the foundation. Fill material within the ring wall and below the basin should consist of properly compacted select fill.

Post construction settlements of the ring footing foundation bearing in limestone should be ½ inch or less, assuming proper construction practices. Settlement response of the foundation system will be influenced more by the quality of construction than soil-structure interaction.

Foundation Construction

Drilled Pier Foundations

Drilled pier foundations should be augered and constructed in a continuous manner. Concrete should be placed in the pier excavations following drilling and evaluation for proper bearing stratum, embedment, and cleanliness. The piers should not be allowed to remain open overnight before concrete placement. Surface runoff or groundwater seepage accumulating in the excavation should be pumped out and the condition of the bearing surface should be evaluated immediately prior to placing concrete. The drilling equipment utilized should be readily capable of excavating the Edwards Formation limestone observed at this site. Drilling equipment with insufficient torque and/or augers/bits/core barrels that are not suited for hard rock conditions will likely result in poor production rates.

Zones of groundwater inflow and/or sloughing soils are a possibility during pier construction. Therefore provisions should be incorporated into the plans and specifications to utilize casing to control sloughing and/or groundwater seepage during pier construction, should it occur. If casing is utilized, removal of the casing should be performed with extreme care and under proper supervision to minimize mixing of the surrounding soil and water with the fresh concrete. Concrete should be placed with a tremie and should exhibit a six-inch slump with a $\pm$ one inch tolerance. Under no circumstances should loose soil be placed in the space between the casing and the pier sidewalls.

The use of casing should help to minimize groundwater inflow into the pier excavation. If seepage persists even after casing installation, the water should be pumped out of the excavation immediately prior to placing concrete. If groundwater inflow is too severe to be controlled by pumping, the concrete should be tremied to the full depth of the excavation to

effectively displace the water. In this case, a "clean-out" bucket should be utilized to remove loose soil and/or rock fragments from the pier bottom before placing steel and concrete.

Due to the karstic nature of the Edwards limestone, there is a potential to encounter voids and/or solution cavities during pier excavation. If a significant void and/or solution feature is observed, Terracon should be notified immediately to evaluate the feature from a geotechnical standpoint. In some cases, the Texas Commission on Environmental Quality (TCEQ) may need to be notified and a Void Mitigation Plan may need to be prepared. If large voids are encountered during pier excavations, there is a potential for loss of significant volumes of concrete during pier construction. One method of reducing such concrete loss would be to the case the void area (although the casing could not be removed and side friction loss would result for cased portions of the pier, which would have to be compensated for by extending the pier accordingly).

Spread Footings/Mat and Ring Wall Foundations

Foundations embedded into the Stratum II limestone should be excavated with rock-trenching equipment or similar equipment capable of excavating the Austin Group limestone. Loose rock fragments and debris in the bottom of the excavation should be removed prior to steel placement. Any zones consisting of soils or weathered rock should be excavated to competent limestone. Over-excavated areas can be backfilled with lean concrete to the design bearing elevation. If groundwater seepage in excess of one inch accumulates at the bottom of the foundation excavation, it should be collected, removed, and not allowed to adversely affect the quality of the bearing surface. Once the footings have been poured, the footing excavations should be backfilled with lean concrete, flowable fill, or properly compacted crushed limestone base select fill material.

Foundation Construction Monitoring

The performance of the selected foundation system for the proposed structures will be highly dependent upon the quality of construction. Thus, we recommend that the foundation installation be monitored by Terracon to identify the proper bearing strata and depths and to help evaluate foundation construction. We would be pleased to develop a plan for foundation monitoring to be incorporated in the overall quality control program.

Groundwater Control

Although groundwater was not encountered above the planned base elevation of 1238 feet-MSL, the presence of groundwater should be anticipated, particularly during wet weather conditions, in the form of seepage through the exposed limestone in the cut slopes around the ground storage tank. We recommend that trench drains be installed along the toe of the cut slopes. The gravel-packed trenches should extend to a depth of at least 18 inches below the ground tank elevation with a minimum width of 18 inches. Perforated collector pipes with a minimum diameter of 4 inches should be provided within all trench drains. The trenches should be sloped toward a common sump area or gravity drained to a lower elevation on the southern portion of the site.

Groundwater conditions should be re-evaluated at the time of construction. Depending on actual conditions, additional trench drains may be required.

Lateral Earth Pressures

Presented below are at-rest, active, and passive earth pressure coefficients for various backfill types adjacent to below-grade walls or site retaining walls. At-rest earth pressures are recommended in cases where little wall yield is expected (such as structural below-grade walls). Active earth pressures may be utilized in cases where the walls can exhibit a certain degree of horizontal movement (such as cantilevered retaining walls). The recommendations in this section apply to those walls which are installed in open cut or embankment fill areas such that the backfill extends out from the base of the wall at an angle of at least 45 degrees from vertical for the entire height and length of the wall.

Backfill Type	Estimated Total Unit Weight (pcf)	Lateral Earth Pressure Coefficients		
		At Rest (Ko)	Active (Ka)	Passive (Kp)*
Crushed Limestone	140	0.45	0.3	3.5
Clean Sand	120	0.5	0.35	3.0
Clean Gravel	120	0.45	0.3	3.5

* Passive coefficients represent ultimate values. Appropriate safety factors should be applied.

The above values do not include a hydrostatic or ground-level surcharge component. The effect of surcharge loads, where applicable, should be incorporated into wall pressure diagrams by adding a pressure component equal to the applicable lateral earth pressure coefficient times the surcharge load to the full height of the wall.

The compactive effort should be controlled during backfill operations. Overcompaction can produce lateral earth pressures in excess of at-rest magnitudes. Compaction levels adjacent to below-grade walls should be maintained between 95 and 100 percent of the ASTM D 698 maximum dry density.

For retaining walls bearing on natural soil or properly compacted select fill, a coefficient of sliding resistance of 0.4 (up to a maximum allowable sliding resistance of 500 psf) and a maximum footing bearing capacity of 3,000 psf should be considered. For site retaining walls bearing on Stratum II limestone subgrade, a sliding coefficient of 0.7 (maximum resistance of 1,500 psf) and a maximum footing bearing capacity of 5,000 psf may be utilized. All retaining walls should be checked against failure due to overturning, sliding, and overall slope stability. Such an analysis can only be performed once the dimensions of the wall are known.

A wall drain is recommended for collection and removal of surface water percolation along the base of the walls. Proper control of surface water percolation will help to prevent buildup of higher wall pressures. In unpaved areas, the final 12 inches of backfill should preferably consist of clayey soils to help to reduce percolation of surface water into the backfill.

The lateral earth pressure recommendations given above are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls. These walls are typically subcontracted as design-build structures, since design details are often manufacturer specific. Recommendations covering these types of wall systems are beyond the scope of services for this assignment. However, we would be pleased to develop recommendations for the design of such wall systems upon request. An additional exploration and laboratory testing program may be required in order to provide soil-strength parameters for use in design of modular wall systems.

Cut Slope Recommendations

For any cut slopes into the natural on-site Stratum I soils, we recommend that permanent slopes be cut no steeper than 3(H):1(V). In Stratum II limestone, permanent cut slopes should be no steeper than 1(H):1(V) due to the weathered nature of the upper portions of this limestone and its tendency to undergo further weathering when exposed. In our opinion, cut slopes at the inclinations discussed above should be stable against a large-scale slide, although the potential for sloughing of loose soil zones exists.

To allow for some sloughing to occur, we recommend that a "buffer zone" at least 5 feet wide in pavement and other general areas and at least 10 feet wide adjacent to structures be provided between the proposed construction areas and the cut slopes (both at the toe and at the crest). This should help reduce the possibility of sloughing soils/rock from contacting the adjacent improvements on the downhill side and from undermining the improvements on the uphill side.

The faces of the completed rock slopes should be evaluated by a geotechnical engineer or geologist upon completion of the cut slopes for evidence of the potential for unstable rock wedges or other potentially unstable conditions which may exist. We should note that portions of the exposed rock face may require preparation to reduce the potential for sloughing. Preparation of the rock face may include removing those areas susceptible to sloughing and replacing them with concrete or gunnite.

Exposed cut slopes may be susceptible to further erosion. Installation of erosion control measures in such areas would be beneficial in reducing potential slope instability which could result from excessive erosion. In addition to initial erosion control measures, the cut slopes should be periodically checked for erosion (particularly after heavy rainfall events) and maintenance performed on areas exhibiting erosion.

Excavation

Below-grade excavation operations for the proposed ground storage tank should be expected to penetrate into the Stratum II limestone. Zones of limestone with significant compressive strength were observed at this site, which could require sawcutting, jackhammering, milling, hoe-ramming, or similar techniques to excavate.

Our comments on excavation are based on our experience with the rock formation and examination of the core samples. Rock excavation depends on not only the rock hardness, weathering, and fracture frequency, but also the contractor's equipment, capabilities, and

experience. Therefore, it should be the contractor's responsibility to determine the most effective methods for excavation. The above comments are intended for informational purposes for the design team only and may be used to review the contractor's proposed excavation methods.

If voids or other significant solution features are encountered during site preparation/excavation operations, Terracon should be contacted to evaluate the feature from a geotechnical engineering standpoint. For most such features, filling or grouting the void with concrete would be appropriate to minimize the potential for water/material migration into the feature once construction has been completed. In some cases, preparation of a void mitigation plan could be required by the Texas Commission on Environmental Quality (TCEQ).

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards require the protection of workers adjacent to excavations. The OSHA guidelines and directives should be adhered to by the Contractor during excavation and construction operations to insure a safe working environment.

Earthwork

Construction areas should be stripped of all vegetation, loose topsoil, debris, organics, etc. Roots of trees to be removed within construction areas should be grubbed to full depths, including the dry soil around the roots. Prior to fill placement and/or construction, exposed soil subgrade areas should be carefully proofrolled with a 15-ton roller or equivalent equipment to detect weak zones. Weak areas detected during proofrolling, as well as zones containing debris or organics and voids resulting from removal of tree roots, boulders, etc., should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils. Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Fill Compaction Requirements

All fill material should be placed in uniform compacted lifts not exceeding 6 inches in thickness (maximum loose lift thickness of about 8 inches), unless noted otherwise in this report. Fill should be compacted to at least 95 percent of the Standard Proctor (ASTM D 698) maximum dry density at a moisture content ranging between -3 and +3 percent of optimum moisture content, unless stated otherwise.

Select Fill Requirements

Select fill to be utilized within the structure limits should consist of crushed limestone base material meeting the requirements of the Texas Department of Transportation (TxDOT) 2004 Standard Specifications Item 247, Type A, Grade 3.

Use of On-Site Material for Fill in Pavement, Landscape, or General Areas

Excavated on-site soils, if free of organics, debris, and rocks larger than 4 inches, may be considered for use as fill in pavement, landscape, or other general areas. The clayey soils should be compacted to the density indicated above and moisture conditioned between -3 and +3 percent of optimum moisture.

Excavated Stratum II limestone from the site may be considered for fill in pavement, landscape, or general areas provided the criteria stated below are satisfied. The use of rock fill in areas where underground utilities areas are planned will likely result in construction difficulties during trenching and excavation of the utility alignments. If utilities are to be placed in areas that are planned to receive rock fill, we recommend that the maximum rock size be limited to no greater than 3 inches for the full depth of the rock fill in these areas to reduce the potential for construction difficulties during utility trench excavation.

- The maximum lift height recommended is 1.5 feet, which will be controlled by the maximum boulder size. A maximum nominal rock size of 9 inches should be maintained.
- The largest nominal rock size of any given lift shall not exceed one-half of the lift height.
- The upper 12 inches of the fill placement shall be composed of lifts no more than 6 inches in compacted thickness (8-inch loose lift thickness) and contain no rocks larger than 3 inches in their largest dimensions.
- The rock fill shall be of sufficient size distribution such that no voids are present between larger rock sizes during placement.
- Such a rock fill placement operation should be continuously monitored by Terracon personnel to check that the fill operation is in accordance with the recommendations stated herein. (In-place density testing for such a fill operation is often not practical.)
- Please note that rock fills can create increased difficulty in terms of future excavation for utilities, etc. This should be considered prior to and during placement of the fill.

Surface Drainage

The performance of the foundation system for the proposed structures will not only be dependent upon the quality of construction, but also upon the stability of the moisture content of the near-surface soils. Therefore, we highly recommend that site drainage be developed so that ponding of surface runoff near the structures does not occur. Accumulation of water near the foundation may cause significant moisture variations in the soils adjacent to the foundation, thus increasing the potential for structural distress.

Positive drainage away from the structures must be provided during construction and maintained through the life of the proposed project. Infiltration of water into excavations should be prevented during construction. It is important that foundation soils are not allowed to become wetted. All grades must provide effective drainage away from the structures during and after construction. Exposed ground should be sloped at a minimum 5 percent away from the structures for at least 10 feet beyond the perimeter of the building.

GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide testing and

observation during excavation, grading, foundation installation, and other construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include, either specifically or by implication, any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

For any excavation construction activities at this site, all Occupational Safety and Health Administration (OSHA) guidelines and directives should be followed by the Contractor during construction to provide a safe working environment. In regards to worker safety, OSHA Safety and Health Standards require the protection of workers from excavation instability in trench situations.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

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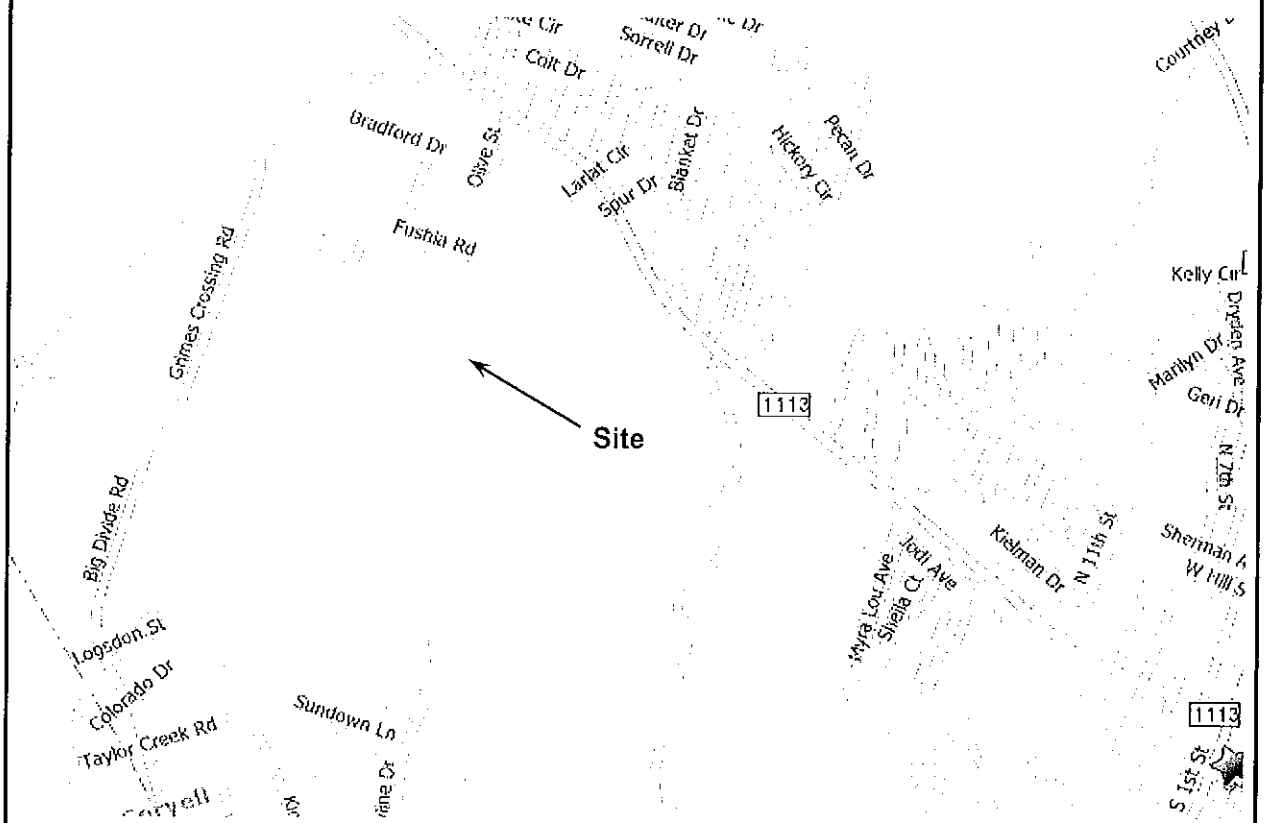
APPENDIX



VICINITY PLAN

Mesa Verde Elevated and Ground Storage Tanks

Copperas Cove, Texas

Terracon Project No. 96085172

Figure 1

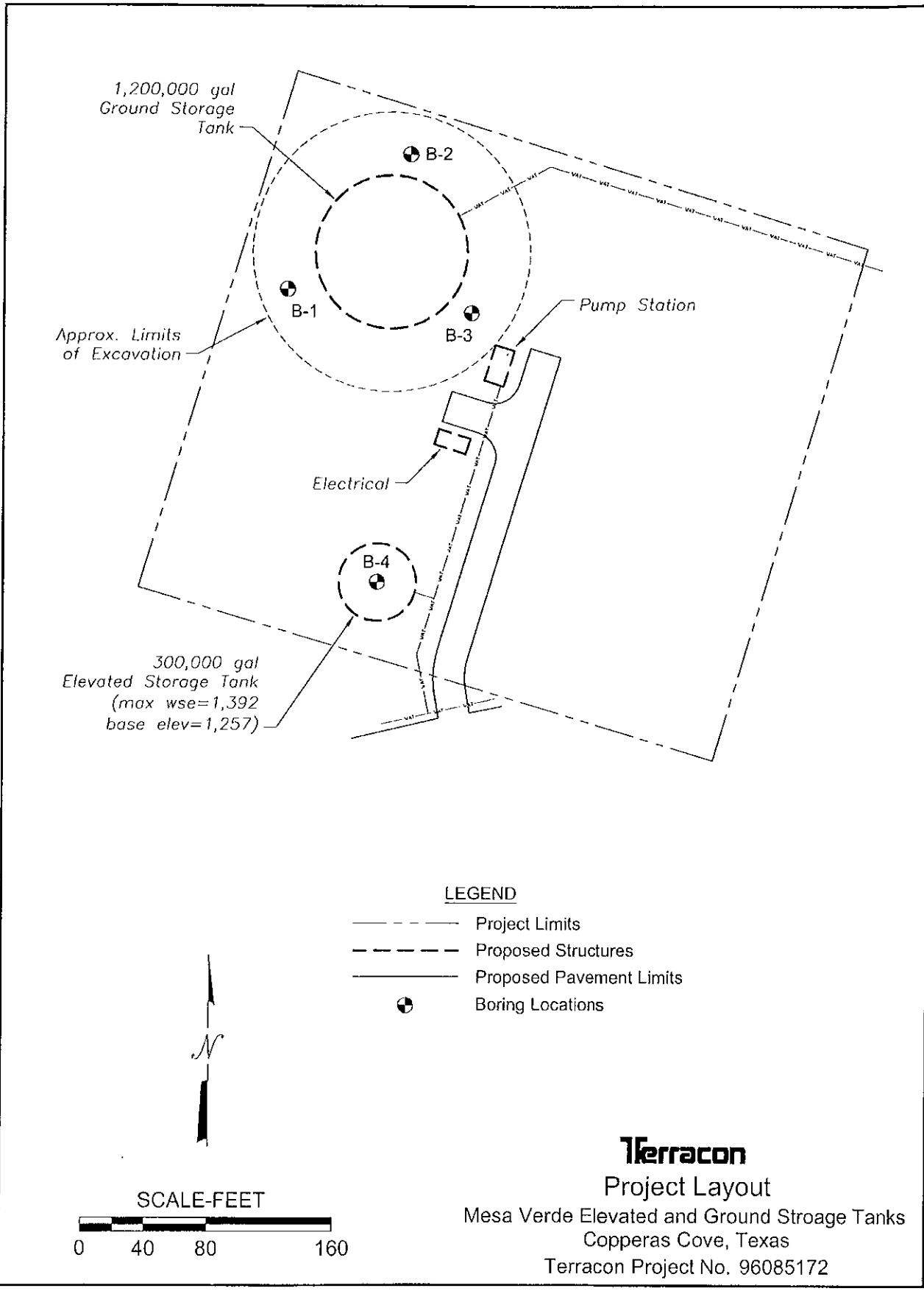

1,200,000 gal
Ground Storage
Tank
B-2
B-1
B-3
Approx. Limits
of Excavation
Pump Station
Electrical
B-4
300,000 gal
Elevated Storage Tank
(max wse=1,392
base elev=1,257)
LEGEND
Project Limits
Proposed Structures
Proposed Pavement Limits
Boring Locations
N
SCALE-FEET
0
40
80
160
Terracon
Project Layout
Mesa Verde Elevated and Ground Stroage Tanks
Copperas Cove, Texas
Terracon Project No. 96085172
Date Printed: Sep 18, 2008

Figure 2

LOG OF BORING NO. B-1

CLIENT: River City Engineering, Ltd.
Austin, Texas

PROJECT: Mesa Verde Elevated and Ground Storage Tanks

BORING LOCATION: See Figure 2
Copperas Cove

SITE: 304 Mesquite Circle
Copperas Cove, Texas

Approx. Surface Elevation: NA ft

Graphic Log	DESCRIPTION	DEPTH, FEET	SAMPLES: USCS SYMBOL	SAMPLES: TYPE	SAMPLES: SPT OR TXDOT CPT BLOWS/INCH	SAMPLES: CALIBRATED HAND PENETROM., TSF	SAMPLES: RECOVERY, % / RQD, %	TESTS: MOISTURE CONTENT, %	TESTS: DRY DENSITY, PCF	TESTS: LIQUID LIMIT, %	TESTS: PLASTICITY INDEX	TESTS: MINUS #200 SIEVE, %	TESTS: COMPRESSIVE STRENGTH, KSF	TESTS: FAILURE STRAIN, %
	1.5 **FAT CLAY** Very stiff, dark brown		CH	BS										
	LIMESTONE 4.0 Hard, highly weathered and fractured, tan			BS										
	LIMESTONE Hard, fractured, tan, with solution voids	5		RC			40/30							
		10		RC			80/52		130				373	
		15		RC			63/25							
		20		RC			100/37		145				281	
	▽	25		RC			92/92							
	-gray below 30 feet	30		RC			63/50		145				614	
		35		RC			48/30							
		40												

Continued Next Page

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL AND ROCK TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: Dry Augered 0 to 5 feet; Wet Rotary 5 to 45 feet

WATER LEVEL OBSERVATIONS, FEET			
WL	▽ 27.0	WD	▽
WL	▽		▽
WL			

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DATE DRILLED 9/2/2008

PROJECT NUMBER 96085172

FIGURE 3

LOG OF BORING NO. B-1

CLIENT: River City Engineering, Ltd. Austin, Texas	PROJECT: Mesa Verde Elevated and Ground Storage Tanks
BORING LOCATION: See Figure 2 Copperas Cove	SITE: 304 Mesquite Circle Copperas Cove, Texas

Graphic Log	DESCRIPTION	DEPTH, FEET	SAMPLES: USCS SYMBOL	SAMPLES: TYPE	SAMPLES: SPT OR TXDOT CPT BLOWS/INCH	SAMPLES: CALIBRATED HAND PENETROM., TSF	SAMPLES: RECOVERY, % / RQD, %	TESTS: MOISTURE CONTENT, %	TESTS: DRY DENSITY, PCF	TESTS: LIQUID LIMIT, %	TESTS: PLASTICITY INDEX	TESTS: MINUS #200 SIEVE, %	TESTS: COMPRESSIVE STRENGTH, KSF	TESTS: FAILURE STRAIN, %
	Approx. Surface Elevation: NA ft													
	LIMESTONE Hard, fractured, gray, with solution voids			RC			16/16							
	45.0 Boring Terminated at 45 feet	45												

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL AND ROCK TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: Dry Augered 0 to 5 feet; Wet Rotary 5 to 45 feet

WATER LEVEL OBSERVATIONS, FEET			
WL	▽ 27.0	WD	▽
WL	▽		▽
WL			

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DATE DRILLED 9/2/2008

PROJECT NUMBER 96085172

FIGURE 3

LOG OF BORING NO. B-2

CLIENT: River City Engineering, Ltd.
Austin, Texas

PROJECT: Mesa Verde Elevated and Ground Storage Tanks

BORING LOCATION: See Figure 2
Copperas Cove

SITE: 304 Mesquite Circle
Copperas Cove, Texas

Graphic Log	DESCRIPTION	DEPTH, FEET	SAMPLES: USCS SYMBOL	SAMPLES: TYPE	SAMPLES: SPT OR TXDOT CPT BLOWS/INCH	SAMPLES: CALIBRATED HAND PENETROM., TSF	SAMPLES: RECOVERY, % / RQD, %	TESTS: MOISTURE CONTENT, %	TESTS: DRY DENSITY, PCF	TESTS: LIQUID LIMIT, %	TESTS: PLASTICITY INDEX	TESTS: MINUS #200 SIEVE, %	TESTS: COMPRESSIVE STRENGTH, KSF	TESTS: FAILURE STRAIN, %
	Approx. Surface Elevation: NA ft													
	LEAN SANDY CLAY Hard, dark brown to tan		CL	SS	56/12									
			CL	SS	50/1			13		31	12			
	5.0 **LIMESTONE** Hard, fractured, tan	5		RC			47/20							
	-with solution voids to 20 feet	10		RC			95/8							
		15		RC			97/57		140				654	
		20		RC			37/20							
	▽	25		RC			47/0							
	-gray and brown below 30 feet	30		RC			*							
		35		RC			40/13							
		40												

Continued Next Page

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL AND ROCK TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: Dry Augered 0 to 5 feet; Wet Rotary 5 to 45 feet. * No sample recovered from 30 to 35 feet due to drilling equipment malfunctions.

WATER LEVEL OBSERVATIONS, FEET			
WL	▽ 27.0	WD	▽
WL	▽		▽
WL			

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DATE DRILLED 9/3/2008

PROJECT NUMBER 96085172

FIGURE 4

LOG OF BORING NO. B-2

CLIENT:	River City Engineering, Ltd. Austin, Texas	PROJECT:	Mesa Verde Elevated and Ground Storage Tanks
BORING LOCATION:	See Figure 2 Copperas Cove	SITE:	304 Mesquite Circle Copperas Cove, Texas

Graphic Log	DESCRIPTION	DEPTH, FEET	SAMPLES: USCS SYMBOL	SAMPLES: TYPE	SAMPLES: SPT OR TXDOT CPT BLOWS/INCH	SAMPLES: CALIBRATED HAND PENETROM., TSF	SAMPLES: RECOVERY, % / RQD, %	TESTS: MOISTURE CONTENT, %	TESTS: DRY DENSITY, PCF	TESTS: LIQUID LIMIT, %	TESTS: PLASTICITY INDEX	TESTS: MINUS #200 SIEVE, %	TESTS: COMPRESSIVE STRENGTH, KSF	TESTS: FAILURE STRAIN, %
	Approx. Surface Elevation: NA ft													
	LIMESTONE Hard, fractured, gray and brown			RC			53/7							
	45.0 Boring Terminated at 45 feet	45												

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL AND ROCK TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: Dry Augered 0 to 5 feet; Wet Rotary 5 to 45 feet. * No sample recovered from 30 to 35 feet due to drilling equipment malfunctions.

WATER LEVEL OBSERVATIONS, FEET			
WL	▽ 27.0	WD	▼
WL	▼		▼
WL			

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DATE DRILLED	9/3/2008
PROJECT NUMBER	96085172

FIGURE 4

LOG OF BORING NO. B-3

CLIENT:	River City Engineering, Ltd. Austin, Texas	PROJECT:	Mesa Verde Elevated and Ground Storage Tanks
BORING LOCATION:	See Figure 2 Copperas Cove	SITE:	304 Mesquite Circle Copperas Cove, Texas

Graphic Log	DESCRIPTION	DEPTH, FEET	SAMPLES: USCS SYMBOL	SAMPLES: TYPE	SAMPLES: SPT OR TXDOT CPT BLOWS/INCH	SAMPLES: CALIBRATED HAND PENETROM., TSF	SAMPLES: RECOVERY, % / RQD, %	TESTS: MOISTURE CONTENT, %	TESTS: DRY DENSITY, PCF	TESTS: LIQUID LIMIT, %	TESTS: PLASTICITY INDEX	TESTS: MINUS #200 SIEVE, %	TESTS: COMPRESSIVE STRENGTH, KSF	TESTS: FAILURE STRAIN, %
	Approx. Surface Elevation: NA ft													
	FAT CLAY 2.0 Hard, dark brown, with rock fragments		CH	SS	31/12									
	CLAYEY SAND Medium dense to very dense, reddish brown		SC	SS	20/12									
	5.5		SC	SS	50/1			9		29	13	45		
	LIMESTONE Hard, tan, with solution voids	5		RC			89/41							
		10		RC			100/78							
		15		RC			98/57		150				394	
		20		RC			100/72		147				538	
	▽	25		RC			92/87							
		30		RC			100/77							
		35		RC			70/70							
		40												

Continued Next Page

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL AND ROCK TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: Dry Augered 0 to 5 feet; Wet Rotary 5 to 45 feet

WATER LEVEL OBSERVATIONS, FEET			
WL	▽ 27.0	WD	▼
WL	▽		▼
WL			

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DATE DRILLED 8/29/2008

PROJECT NUMBER 96085172

FIGURE 5

LOG OF BORING NO. B-3

CLIENT:	River City Engineering, Ltd. Austin, Texas	PROJECT:	Mesa Verde Elevated and Ground Storage Tanks
BORING LOCATION:	See Figure 2 Copperas Cove	SITE:	304 Mesquite Circle Copperas Cove, Texas

Graphic Log	DESCRIPTION	DEPTH, FEET	SAMPLES: USCS SYMBOL	SAMPLES: TYPE	SAMPLES: SPT OR TXDOT CPT BLOWS/INCH	SAMPLES: CALIBRATED HAND PENETROM., TSF	SAMPLES: RECOVERY, % / RQD, %	TESTS: MOISTURE CONTENT, %	TESTS: DRY DENSITY, PCF	TESTS: LIQUID LIMIT, %	TESTS: PLASTICITY INDEX	TESTS: MINUS #200 SIEVE, %	TESTS: COMPRESSIVE STRENGTH, KSF	TESTS: FAILURE STRAIN, %
	Approx. Surface Elevation: NA ft													
	LIMESTONE Hard, tan, with solution voids			RC			100/60							
	45.0	45												
	Boring Terminated at 45 feet													

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL AND ROCK TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: Dry Augered 0 to 5 feet, Wet Rotary 5 to 45 feet

WATER LEVEL OBSERVATIONS, FEET			
WL	▽ 27.0	WD	▼
WL	▽		▼
WL			

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DATE DRILLED 8/29/2008

PROJECT NUMBER 96085172

FIGURE 5

LOG OF BORING NO. B-4

CLIENT: River City Engineering, Ltd. Austin, Texas	PROJECT: Mesa Verde Elevated and Ground Storage Tanks
BORING LOCATION: See Figure 2 Copperas Cove	SITE: 304 Mesquite Circle Copperas Cove, Texas

Graphic Log	DESCRIPTION	DEPTH, FEET	SAMPLES: USCS SYMBOL	SAMPLES: TYPE	SAMPLES: SPT OR TXDOT CPT BLOWS/INCH	SAMPLES: CALIBRATED HAND PENETROM., TSF	SAMPLES: RECOVERY, % / RQD, %	TESTS: MOISTURE CONTENT, %	TESTS: DRY DENSITY, PCF	TESTS: LIQUID LIMIT, %	TESTS: PLASTICITY INDEX	TESTS: MINUS #200 SIEVE, %	TESTS: COMPRESSIVE STRENGTH, KSF	TESTS: FAILURE STRAIN, %
	Approx. Surface Elevation: NA ft													
	LIMESTONE			BS										
	2.0 Auger only, no sample recovered													
	LIMESTONE Hard, tan, with solution voids			RC			50/11							
		5		RC			47/7							
		10		RC			90/75		112				197	
		15		RC			83/40							
	-gray and brown below 20 feet	20		RC			98/35							
	▽	25		RC			*							
	30.0 Boring Terminated at 30 feet	30												

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL AND ROCK TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: Dry Augered 0 to 2 feet; Wet Rotary 2 to 30 feet. * No sample recovered from 25 to 30 feet due to drilling equipment malfunctions..

WATER LEVEL OBSERVATIONS, FEET			
WL	▽ 27.0	WD	▽
WL	▽		▽
WL			

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DATE DRILLED 8/29/2008

PROJECT NUMBER 96085172

FIGURE 6

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on the No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI lots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains > 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

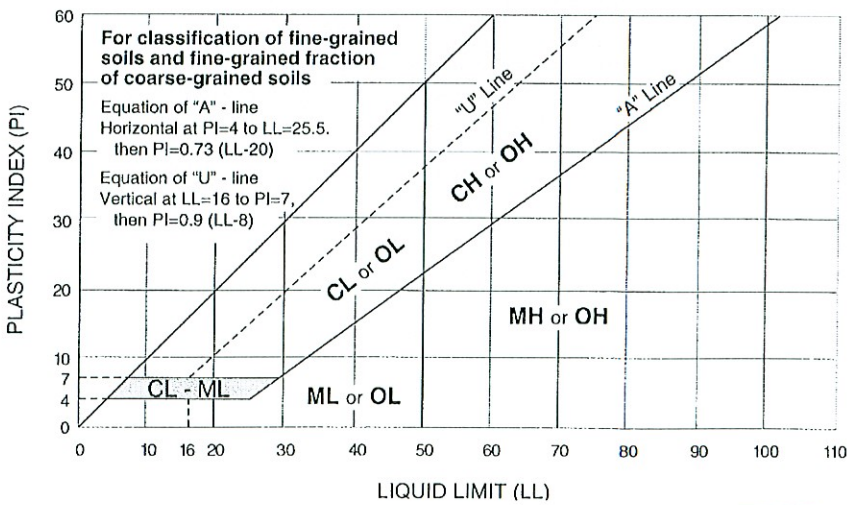
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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Form 111—6/98

FIGURE 7

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
TC:	TxDOT Cone Penetrometer Test	HA:	Hand Auger
CF:	Continuous Flight Auger	RC:	Rock Core
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For TxDOT cone penetrometer (TC) the penetration value is reported as the number of blows required to advance the sampler 12 inches or penetration in inches after 100 blows using a 170-pound hammer falling 24 inches, reported as "blows per foot" or inches per 100 blows, and is not considered equivalent to the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 -15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	TxDOT Cone Penetrometer (TC) Blows/Ft.	Relative Density
0 – 3	0-8	Very Loose
4 – 9	8-20	Loose
10 – 29	20-80	Medium Dense
30 – 49	80-5"/100	Dense
> 50	5"/100 to 0"/100	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

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FIGURE 8

GENERAL NOTES

Description of Rock Properties

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)

Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.

Very soft Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding and Foliation Spacing in Rock[a]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

Rock Quality Designator (RQD)[b]		Joint Openness Descriptors	
RQD, as a percentage	Diagnostic description	Openness	Descriptor
Exceeding 90	Excellent	No Visible Separation	Tight
90 – 75	Good	Less than 1/32 in.	Slightly Open
75 – 50	Fair	1/32 to 1/8 in.	Moderately Open
50 – 25	Poor	1/8 to 3/8 in.	Open
Less than 25	Very poor	3/8 in. to 0.1 ft.	Moderately Wide
		Greater than 0.1 ft.	Wide

a. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.
b. RQD (given as a percentage) = length of core in pieces 4 in. and longer/length of run.

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976.
U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.

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FIGURE 9