

Technical Construction Standard Specifications

1st Edition August 2017 - ORDINANCE NO. 2017-0-090



ORDINANCE NO. 2017-0-09D

AN ORDINANCE OF THE CITY OF MARBLE FALLS AMENDING CHAPTER 7, AND RENAMING SAME TO BUILDING, BUILDING REGULATIONS, AND TECHNICAL CONSTRUCTION STANDARD SPECIFICATIONS AND BY ADDING A NEW ARTICLE XIII, SECTION 7-331, TO ADOPT THE TECHNICAL CONSTRUCTION STANDARD SPECIFICATIONS MANUAL (“TCSS MANUAL”) OF THE CITY OF MARBLE FALLS, TEXAS, 1ST ED., DATED AUGUST 2017; AMENDING CHAPTER 11, “FLOOD DAMAGE PREVENTION,” SECTION 11-33 “STANDARDS FOR SUBDIVISION PROPOSALS,” BY REQUIRING SUBDIVISION PROPOSALS TO CONFORM TO THE TCSS MANUAL; AMENDING CHAPTER 28, “NONPOINT SOURCE POLLUTION CONTROL,” SECTION 28-53, “NONPOINT SOURCE POLLUTION CONTROL APPROVAL,” BY REQUIRING CERTAIN DEVELOPMENT TO COMPLY WITH THE TCSS MANUAL; AMENDING APPENDIX B, “LAND USE REGULATIONS,” REQUIRING COMPLIANCE WITH THE TCSS MANUAL AS IT RELATES TO LAND USE REGULATION AND DEFINING THE SAME; PROVIDING PENALTIES UP TO \$2000.00 PER VIOLATION; PROVIDING AN EFFECTIVE DATE, REPEALER, SEVERABILITY, AND PROPER NOTICE AND MEETING.

WHEREAS, The City Council of the City of Marble Falls, Texas (“City Council”), seeks to establish reasonable construction specifications to ensure that the installation of public infrastructure is of a quality acceptable to the City; and

WHEREAS, The City Council has caused to be prepared this ordinance calling for the implementation of certain construction specifications so as to implement and enforce certain necessary standards for the entire jurisdiction of the City of Marble Falls, Texas; and

WHEREAS, The City Council has set forth said construction specifications in the form of an ordinance, herein referred to as the Technical Construction Standard Specifications of the City of Marble Falls, 1st Ed., which Technical Construction Manual includes the Standard Specification and the Standard Details (collectively referred to as the “TCSS”); and

WHEREAS, The City Council seeks to update the City’s construction standards as needed in order to use the latest and most efficient methods of construction; and

WHEREAS, The City Council adopts this ordinance in order to promote the health, welfare, and safety of the City of Marble Falls and its citizens;

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF MARBLE FALLS, TEXAS:

SECTION I.

All of the above premises are hereby found to be true and correct legislative and factual findings of the City Council, and are hereby approved and incorporated into the body of this Ordinance as if copied in their entirety.

SECTION II.

A. The Code of Ordinances, Chapter 7, “Buildings and Building Regulations,” is hereby amended, by retitling the same as “Buildings, Building Regulations, and Technical Construction Standard Specification,” and by adding a new Article XIII, which shall be titled “Technical Construction Standard Specifications,” which shall read as follows:

ARTICLE XIII. - TECHNICAL CONSTRUCTION STANDARD SPECIFICATIONS

Sec. 7-331. – Adoption of Technical Construction Standard Specifications

- (a) The Technical Construction Standard Specifications of the City of Marble Falls, 1st Ed., consisting of the Standard Specifications and the Standard Details (collectively the “TCSS Manual”), dated August 2017, as may be amended from time-to-time, is hereby adopted.
- (b) One (1) copy of the TCSS Manual is incorporated herein by reference and shall be filed in the office of development services for permanent record and inspection and a copy shall be maintained on the City’s website.
- (c) All facilities constructed within the existing public right-of-way and utility easements, or newly dedicated right-of-way and utility easements which are intended to be dedicated to the City of Marble Falls, shall comply with the applicable provisions of the TCSS Manual as amended from time to time.
- (d) Unless deleted, amended, expanded, or otherwise changed herein, all provisions of the TCSS Manual shall be fully applicable and binding. In the event a conflict is determined to exist between the TCSS Manual and the laws of the State of Texas, or a federal requirement, the state or federal requirements shall be construed as controlling and taking precedence over this ordinance.
- (e) The TCSS Manual shall be comprised of the construction requirements and standard details for trenching and backfilling, concrete, water system, sewer system, streets, sidewalks, and driveways, storm drainage, and as otherwise set forth in the TCSS Manual. The TCSS may also include any additional provisions or requirements of the City of Marble Falls that pertain to the construction of site improvements such as streets, parking lots, driveways and sidewalk paving, storm

drainage structures, utility lines and facilities, screening walls/fences, retaining walls, landscaping and irrigation improvements, street lighting or signage, restricted access (gated) entrances to any type of development, and other similar improvements.

- (f) The City Manager or designee shall have the authority to determine whether or not the engineering plans for any type of site improvement are in conformance with the City's TCSS Manual.

B. The Code of Ordinances, Chapter 11, “Flood Damage Prevention,” section 11-33 “Standards for subdivision proposals,” is hereby amended by adding a new subsection (f), which shall read as follows:

- (f) All subdivision proposals shall comply with the TCSS Manual as adopted within section 7-331 of this code of ordinances, as may be amended from time to time.

C. The Code of Ordinances, Chapter 28, “Nonpoint Source Pollution Control,” section 28-53, “Nonpoint source pollution control approval,” is hereby amended by adding a new subsection (a)(3), which shall read as follows:

- (a)(3) All development, redevelopment, or other construction that occurs within the right of way, public easement, or construction that is, or is intended to be, dedicated to the City, shall comply with the TCSS Manual as adopted in section 7-331 of this code of ordinances, as may be amended from time to time.

D. The Code of Ordinances, Appendix B, “Land Use Regulations,” section 803, “Application of regulations,” is hereby amended by adding a new subsection b.8., which shall read as follows:

- b.8. The City of Marble Falls’ TCSS Manual, as adopted within section 7-331 of this code of ordinances, as may be amended from time to time.

E. The Code of Ordinances, Appendix B, “Land Use Regulations,” section 1007, “Access development (driveways and curb cuts)—title and purpose,” is hereby amended by adding a new subsection D.4., which shall read as follows:

- D.4. All construction within the right of way, and construction that is, or is intended to be, dedicated to the City, shall comply with the latest TCSS Manual, as adopted in section 7-331 of this code of ordinances, as may be amended from time to time.

F. The Code of Ordinances, Appendix B, “Land Use Regulations,” within the subchapter entitled “Definitions”, is hereby amended by adding a new subsection 394, which shall read as follows; all other definitions within said subchapter shall be re-numbered accordingly:

394. TCSS Manual. The City of Marble Falls Technical Construction Standard Specifications and the Standard Details (“TCSS” or “TCSS Manual”), as adopted within section 7-331 of this code of ordinances, as may be amended from time to time, for the construction standards and standard details associated with construction of improvements that shall be public infrastructure, or connecting to public infrastructure within the right-of-way, and/or connecting to public streets, alleys, or improved systems, or access points dedicated to the City.

III. SEVERABILITY

If any provision, section, sentence, clause or phrase of this Ordinance, or the application of same to any person or set of circumstances is for any reason held to be unconstitutional, void, invalid, or unenforceable, the validity of the remaining portions of this Ordinance or its application to other persons or sets of circumstances shall not be affected thereby, it being the intent of the City Council of the City of Marble Falls in adopting, and of the Mayor in approving this Ordinance, that no portion hereof or provision or regulation contained herein shall become inoperative or fail by reason of any unconstitutionality or invalidity of any portion, provision or regulation.

IV. REPEALER

All ordinances and parts of ordinances that are in conflict with this ordinance are hereby repealed.

V. PENALTY

A violation of any section of this ordinance shall be punishable as a misdemeanor under the provisions stated in Chapter 1, Section 1-9 of the Code of Ordinances of the City of Marble Falls.

VI. EFFECTIVE DATE

This Ordinance shall be and become effective immediately upon and after its passage and publication as may be required by governing law.

VII. PROPER NOTICE AND MEETING

It is hereby officially found and determined that the meeting at which this Ordinance was adopted was open to the public and that public notice of the time, place and purpose of said meeting was given as required by the Open Meetings Act, Chapter 551 of the Texas Government Code.

ADOPTED AND APPROVED on this 19th day of September, 2017 by a vote of the City Council of the City of Marble Falls, Texas.

CITY OF MARBLE FALLS, TEXAS



John Packer
John Packer, Mayor

ATTEST:

APPROVED AS TO FORM:

Christina McDonald
Christina McDonald, TRMC, City Secretary

Patty L. Akers
Patty L. Akers, City Attorney

STANDARD SPECIFICATIONS

CITY OF MARBLE FALLS, TX

ENGINEERING DEPARTMENT

FIRST EDITION - AUGUST, 2017

EFFECTIVE DATE - SEPTEMBER, 2017



800 Third Street
Marble Falls, Texas 78654

These Documents were prepared by
or under the supervision of:



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CITY OF MARBLE FALLS STANDARD SPECIFICATIONS (1ST EDITION)

NOTICE TO BIDDERS

The **CITY OF MARBLE FALLS STANDARD SPECIFICATIONS** are general in nature and may not include all requirements for any specific project.

Special Specifications, Special Provisions to Standard Specifications, and General Requirements may be included in the Project Manual for each specific project. Such Special Specifications, Special Provisions, and General Requirements that are included in the Project Manual for a specific project are hereby included as part of the construction specifications for that specific project.

It is the Bidder's sole responsibility to read, understand, and apply all other such Special Specifications, Special Provisions, and General Requirements included in the Project Manual.

PREPARED BY:

Eric Belaj
CITY ENGINEER



AUGUST 2017

FOREWORD

Outline of Specifications

Each specification is outlined by Articles and Sections. The basic Articles required for a specification are:

XXX.1. Description.

XXX.2. Materials.

XXX.3. Equipment.

XXX.4. Construction or Work Methods.

XXX.5. Measurement.

XXX.6. Payment.

Here “XXX” represents the Item number. Some Articles are not used in every Item. Measurement and Payment Articles are combined when the work described is subsidiary to bid items of the Contract.

Hierarchy of Organizational Elements

The hierarchy of organizational elements available below the Item level is as follows:

XXX.X. Article.

A. Section.

1. Section.

a. Section.

(1) Section.

(a) Section.

The term Section is used for all breaks below the Article.

SECTION 000
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103 DEFINITIONS AND ABBREVIATIONS

103.1 SUMMARY

This section includes definitions and resolves potential conflicts between associated documents and notes included in the Contract Documents. Conformance to the terms of this section is a requirement that is subsidiary to all other items in this Contract, and no direct payment shall be allowed for any item referenced under this section.

103.2 DEFINITIONS

The following words and expressions, or pronouns used in their place, shall whenever they appear in this Contract be construed as follows, unless a different meaning is clear from the context:

Abbreviations: Wherever the abbreviation defined herein occur on the plans, in the specifications, contract, bonds, advertisement, bid or in any other document or instrument herein contemplated or to which the specifications apply or may apply, the intent and meaning shall be as shown in Abbreviations and Acronyms sections.

Addendum, Bulletin, or Letter of Clarification: Written changes, revisions, or any additional contract provisions issued by the owner or its representative, to the prospective bidders, to be acknowledged by the bidders prior to bid opening.

Advertisement: Legal publications pertaining to the work contemplated or under contract.

Approved, Directed, Required, and Words of like Import: Whenever they apply to the work being performed as directed by the contract, specifications, drawings, or written direction given by the owner or representative, shall imply the direction, requirements, permission or designation of the owner.

Air Temperature: The temperature measured in degrees Fahrenheit (°F) in the shade, not in the direct rays of the sun, and away from artificial heat.

Apparent Low Bidder: The Bidder determined to have the numerically lowest total bid as a result of the tabulation of bids by the Department.

Architect or Engineer of Record: A person registered as an architect/engineer or licensed as a landscape architect, in accordance with State law, exercising overall responsibility for the design or a significant portion of the design and performs certain Contract administration responsibilities as described in the Contract; or a firm employed by the City to provide professional architectural/engineering services.

Award: The City's acceptance of a Contractor's bid for a proposed Contract that authorizes the Department to enter into a Contract.

Backfill: Embedment and final backfill as indicated in specifications of standard drawings.

Base: a layer of specified material of plan thickness placed immediately below the pavement course surfacing.

Bid: The written statement or statements duly filed with the City office specified in the advertisement for bids of these specifications by the person, persona, partnership, company, firm, association, or corporation proposing to do the work contemplated, including the approved form on which the formal bids for the work are to be prepared.

Bid Bond: The security designated in the advertisement and bid, to be furnished by each BIDDER on all bids in excess of \$50,000, as a guaranty of good faith to enter into a contract with the OWNER and execute the required bonds for the work contemplated after the work is awarded to the BIDDER and payment of damages upon the BIDDER'S failure to enter into the contract.

Bidder: Any person, persons, partnership, company, firm, association, or corporation acting directly or through a duly authorized representative submitting a bid for the work contemplated.

Bidders Questionnaire: A prequalification form completed by a prospective Bidder reflecting a Bidder's financial data and experience.

Blast Cleaning: Using one of the blasting methods including, but not limited to, water blasting, low-pressure water blasting, high-pressure water blasting, abrasive blasting, water-abrasive blasting, shot blasting, slurry blasting, water injected abrasive blasting, and brush blasting.

Brush Blasting: Sweeping lightly with an abrasive blast to remove loose material.

Business Day: A Business Day for non-construction activities is defined as the time period in which the Marble Falls City Hall is open for public business between the days of Monday through Friday (inclusive) from 8 A.M. to 5 P.M. In general discussions, a "Business Day" should differ from a "Calendar Day" and should be properly and intentionally written as such.

Calendar Day: Any successive day of the week, month, or year, without regard to holidays, or any other day in particular.

Central District, or Main Street District, or Downtown: For purposes of this division, the central business district is defined as that area bounded by Avenue J to the west, SH-281 to the east, Lakeside Park to the south, and RM 1431 to the north.

City: The City of Marble Falls, Texas. At times this definition may include a representative authorized to act on behalf of the City. Responsibility for final enforcement of contracts involving the City is by Charter vested in the City Manager.

City Attorney: The City Attorney of the City of Marble Falls, Texas, or the City Attorney's duly authorized assistants or agents.

City Engineer: The OWNER'S Project Manager overseeing the administration of the CONTRACT and the CONTRACTOR'S performance thereunder. Unless otherwise specifically provided in the CONTRACT Documents, the OWNER'S Project Manager is an employee of City, and is not the Consulting Engineer.

Certificate of Insurance: A form approved by the City covering insurance requirements stated in the Contract.

Change Order: A written order to the contractor from the City of Marble Falls authorizing and directing an addition, deletion, or revision to the work within the scope of the contract documents, or authorizing an adjustment to the contract price or time.

Contract (Documents): Contract documents are all of the written, printed, or typed and drawn language that comprise and govern the performance of the contract (or agreement) between the Owner and the contractor or consultant. The Contract Documents include but are not limited to Bid Advertisement, Instruction to Bidders, Proposal, Addendums, Specifications, General and Special Conditions, Drawings, Bid Bond, Performance Bond, Insurance, and any supplemental changes pertaining to the work or materials constructed.

Contract Intent: The intent of the Contract is to describe the complete work to be performed. The Contractor shall furnish materials, supplies, tools, equipment, labor, and other incidentals necessary for the proper prosecution and completion of the work in accordance with the Contract Documents.

Contract Price: The total amount payable to the contractor as directed under the terms and conditions of the contract documents. At times the term may be used in the context of describing the unit price of an item.

Contract Time: The number of working days specified for completion of the work including authorized additional working days.

Contract Work: Everything required furnishing and completing by the contractor, as directed by any, or all, parts of the contract documents.

Contractor: The person(s), partnership, firm, or any combination thereof, as an independent contractor entering into the contract for the execution of the work, acting directly or through a duly authorized representative.

Control of Access: The condition in which the right to access of owners or occupants of abutting land or other persons in connection with a highway, roadway, or construction site, is fully or partially controlled by public authority.

Control Point: An established point shown on the plans to provide vertical and horizontal references for geometric control for construction.

Commencement of Construction: The initial disturbance of soils associated with clearing and grubbing, grading, or excavation activities, as well as other construction-related activities (e.g., stockpiling of fill material, demolition).

Consulting Engineer: The person, firm, or entity hired as an independent consultant by the OWNER to design the Project and represent the OWNER in the administration of the CONTRACT in whatever capacity the OWNER designates; the OWNER may, at its sole option, designate the Consulting Engineer to be the Engineer for purposes of administration of the CONTRACT. The Consulting Engineer shall be understood to be the Consulting Engineer of the OWNER, and nothing contained in the CONTRACT Documents shall be construed to make the Consulting Engineer an employee of the OWNER, nor shall they be construed to create any contractual or agency

relationship between the Consulting Engineer and the CONTRACTOR. The term includes the officers, employees, associates, agents, and sub-consultants of Consulting Engineer, if any.

Date of Written Authorization: Date of the written work order authorizing the Contractor to begin work.

Drawing(s): Only those drawings specifically entitled as such and as specified in the contract, or in any bulletin, or any detailed drawing furnished by the OWNER, pertaining or supplemental thereto.

Easement: A real property right acquired by 1 party to use land belonging to another party for a specified purpose.

Embedment: Bedding and initial backfill.

Equal: Materials, articles or methods which are of equal or higher quality than those specified or shown on the drawings and as further defined in **Substitution of Materials** Section, as determined by the Engineer in his or her sole discretion.

Extra Work: Work other than that which is expressly or impliedly required by the Contract documents at the time of the execution of the Contract.

Final backfill: Material required filling the trench from the top of the initial backfill to ground elevation or subgrade of a street.

Hazardous Materials or Waste: Hazardous materials or waste include but are not limited to explosives, compressed gas, flammable liquids, flammable solids, combustible liquids, oxidizers, poisons, radioactive materials, corrosives, etiologic agents, and other material classified as hazardous by 40 CFR 261, or applicable City of Marble Falls, State of Texas, and federal regulations.

High-Pressure Water Blasting: Water blasting with pressures between 5,000 and 10,000 psi.

HS: Horseshoe shaped conduit, generally constructed of brick and mortar, usually older drainage systems. Newer systems are constructed of reinforced concrete.

Incentive/Disincentive Provisions: An adjustment to the Contract price of a predetermined amount for each day the work is completed ahead of or behind the specified milestone, phase, or Contract completion dates. The amount of the incentive/disincentive is determined based on estimated costs for engineering, traffic control, delays to the motorists, and other items involved in the Contract.

Initial backfill: Material that covers the utility line (usually 6-inches on all sides of the pipe or as directed by specs and drawings).

Inspector: Any representative of the OWNER or as specified in the contract documents designated to inspect the work.

Interpretation of Specifications: Throughout the Contract Documents, all declarative, imperative statements and phrases shall be interpreted as constituting specific instructions to the Contractor, unless specifically stated otherwise.

Joint venture: Any combination of individuals, partnerships, limited liability companies, or corporations submitting a single bid proposal.

Letter of Clarification: See Addendum.

Limits of Construction: An area with established boundaries, identified within the road right of way and easements, where the Contractor is permitted to perform the work.

Letting: The receipt, opening, tabulation, and determination of the apparent low Bidder.

Low-Pressure Water Blasting: Water blasting with pressures between 3,000 and 5,000 psi.

Maintenance Bond: A bond executed by a corporate surety in accordance with the contract documents and Article 7.19-1, Vernon's Texas Insurance Code, in the amount of the contract guaranteeing the prompt, full and faithful performance of the general guaranty and warranty contained in the Contract Documents.

Major Item: A major item is any line item of the work to be performed of the total contract amount, which amounts to 5 percent or more, or \$100,000, whichever is less.

Milestone Date: The date that a specific portion of the work is to be completed, before the completion date for all work under the Contract.

National Holiday: January 1, the last Monday in May, July 4, the first Monday in September, the fourth Thursday in November, December 24, or December 25.

Non-Site-Specific Contracts: Contracts in which a geographic region is specified for the work and for which work orders, with or without plans, further detail the limits and work to be performed.

Owner: The City of Marble Falls. The City may be represented by any of the Department Directors clearly identified in the contract documents as the principal contact person for each project.

Owner's Representative: The Engineer or other duly authorized assistant, agent, inspector or superintendent acting within the scope of the particular duties instructed to him or her by the City of Marble Falls.

Payment Bond: A bond executed by a corporate surety in accordance with Article 7.19-1, Texas Insurance Code and Chapter 2253, Texas Government Code, in the amount of the contract, solely for the protection and use of payment bond beneficiaries who have a direct contractual relationship with the general CONTRACTOR or a subcontractor to supply public work labor or material.

Performance Bond: The approved form of security furnished by the CONTRACTOR and the CONTRACTOR'S Surety as a guarantee of good faith on the part of the CONTRACTOR to execute the work in strict accordance with the plans, specifications and terms of the contract, and that the CONTRACTOR will maintain the work constructed by him/her in good condition for the period of time required; said security shall be in accordance with the City of Marble Falls Specifications and individual contract documents.

Plan or Plans: The plans are the drawings, or reproductions therefrom, made by or approved by the OWNER showing in detail the location, dimension and position of the various elements of the project, including such profiles, typical cross-sections, layout diagrams, working drawings, preliminary drawings and such supplemental drawings as the OWNER may issue to clarify other drawings or for the purpose of showing changes in the work hereinafter authorized by the OWNER. The plans are usually bound separately from the other parts of the Contract Documents, but they are part of the Contract Documents just as though they were bound therein.

Prequalification Statement: The forms on which required information is furnished concerning the Contractor's ability to perform and finance the work.

Project Midpoint: For the purposes of this addendum, the Mid-point of a project is that point at which one-half of the CONTRACT amount, less retainage and extra work, has been paid to the CONTRACTOR for services rendered.

Proposal: The written and signed offer of the bidder, when submitted on approved proposal forms, to perform the contemplated work and furnish the necessary material and labor in accordance with the provisions of the plans and specifications, special and general provisions, and all contract documents.

Proposal Guaranty: The security designated in the proposal and furnished by the Bidder as a guarantee that the Bidder will enter into a Contract if awarded the work.

Quality Assurance (QA): Sampling, testing, inspection, and other activities conducted by the Engineer to determine payment and make acceptance decisions.

Quality Control (QC): Sampling, testing, and other process control activities conducted by the Contractor to monitor production and placement operations.

Sandblasting, Dry: Spraying blasts of pressurized air combined with sand.

Sandblasting, Wet: Spraying blasts of pressurized water combined with sand.

Saturated Surface Dry (SSD): Saturated Surface Dry (SSD) describes the condition of the aggregate in which the pores in each particle of the aggregate particle are filled with water and no excess water is on the particle surface. This allows the absorption and the specific gravity of the aggregate to be measured.

Shot Blasting: Spraying blasts of pressurized air combined with metal shot.

Site: The area upon or in which the CONTRACTOR'S operations are carried on, and such other areas adjacent thereto as may be designated as such by the OWNER.

Special Provisions: The special clauses of the contract, setting forth conditions or requirements peculiar to the specific project involved, supplementing the standard or general specifications and taking precedence over any conditions or requirements of the standard or general specifications with which they are in conflict. The term includes any and all addendums that expressly supplement and take precedence over the general or standard specifications, regardless of whether they are peculiar to a specific project or apply to all projects.

Specifications (Specs): The directions, provisions, and requirements contained herein, together with the special provisions supplemental hereto pertaining to the method and manner of performing the work or to the qualities or quantities of the materials to be furnished under the contract Specifications include all of the general, special and technical conditions or provisions, and all addendum or supplements thereto.

Standard Drawings: Drawings and sketches approved by the City Engineer to be used in conjunction with project drawings, special provisions, and general specifications.

Standard Details: Standard Details are drawings set up for use in multiple projects, and are set as a minimum requirement. They may be included as a separate bound set of drawings, or may be included in whole or in part in the Construction Drawings, or both. Standard Details will be referenced in the construction drawings with a callout corresponding to the number of the Standard Detail as shown on the Standard Detail drawing itself.

Storm Water Pollution Prevention Plan (SWPPP or SW3P): A document consisting of the following: evaluation of how and where pollutants may be mobilized by stormwater onsite, site plan for managing stormwater run-off, identification of appropriate erosion and sediment controls, maintenance and inspection schedule, record keeping process, and identification of stormwater discharge points from site.

Subcontract: The agreement between the Contractor and subcontractor establishing the obligations of the parties for furnishing of materials and performance of the work prescribed in the Contract documents.

Sub-Contractor: The person(s), partnership, firm, or any combination thereof, as an independent contractor entering into the contract with the principal contractor for the execution of the work, acting directly or through a duly authorized representative, as directed by the contractor under contractual obligations with the owner.

Subbase: Layer of specified material of plan thickness between a base and a subgrade.

Subgrade: That portion of the roadbed upon which the subbase, base or the pavement is to be placed. It includes 12-inches beyond the back of the curb for concrete paved streets.

Subsidiary: Materials, labor, or other elements that because of their nature or quantity have not been identified as a separate item and are included within the items on which they necessarily depend.

Superintendent: The representative of the Contractor who is available at all times and able to receive instructions from the Engineer or authorized representatives and to act for the Contractor.

Supplier: Any subcontractor contracting with the CONTRACTOR, or any of its subcontractors, to fabricate or deliver or who actually fabricates or delivers materials, supplies or equipment to be consumed or incorporated into the work.

Sureties: The corporate bodies which are bound by such bonds as are required with and for the CONTRACTOR. The sureties engaged to be responsible for the entire and satisfactory fulfillment of the Contract and for any and all requirements as set out in the specifications, Contract or plans. In order for a surety to be acceptable, the surety shall conform to the requirements of Article 7.19-1, Texas Insurance Code.

Unit Price: Where in the bid form a "Unit Price" is set forth, the "Unit Price" shall include the furnishing by the CONTRACTOR of all labor, tools, materials, machinery, appliances, water, heat, utilities, transportation, plant and equipment appurtenant to and necessary for the construction in every detail and the completion in a workmanlike manner of all the work to be done under these specifications. The "Unit Price" shall also include all permanent protection of overhead, surface and underground structures, cleaning up, finish, overhead expense, bond, insurance, patent fees, royalties, risk due to the elements, delay, profit, injuries, damages, claims and all other items not specifically mentioned that may be required to construct fully each item of the work, complete in place.

Water-Abrasive Blasting: Spraying blasts of pressurized water combined with abrasive media.

Water Blasting: Spraying blasts of pressurized water of at least 3,000 psi.

Water-Injected Abrasive Blasting: Abrasive blasting with water injected into the abrasive/air stream at the nozzle.

Work: All work including the furnishing of all labor, materials, tools, equipment, required submittals and incidentals to be performed by the CONTRACTOR under the terms of the contract.

Work Order, or Notice to Proceed: Written notice to the Contractor to begin the work. The work order may include the date on which work or time charges are to begin, the number of working days for specified work (for multiple work order Contracts), and plan sheets providing additional details specific to a location or to an item of work for non-site-specific work.

Work Day: A work (or working) day is defined as a calendar day not including Saturdays, Sundays, or legal holidays authorized in the list prepared by the City for contract purposes, in which weather or other conditions not under the control of the CONTRACTOR shall permit the performance of the principal units of work underway for a continuous period of not less than 7 hours between 7 A.M. and 6 P.M. A principle unit of work shall be that unit which controls completion time of the contract. Nothing in this definition shall be construed as prohibiting the CONTRACTOR from working on Saturdays, if the CONTRACTOR so desires and permission of the OWNER has been granted. Work on Sundays shall not be permitted except in cases with the

written permission of the owner. If Saturday or Sunday work is permitted, working time shall be charged on the same basis as weekdays. Where the working time is expressed as calendar days or a specific date, the concept of working days shall no longer be relevant to the contract. Work at nighttime or outside the 7 A.M. and 6 P.M. shall not be permitted except in cases of extreme emergency and then only with the written permission of the owner.

Working Time, Completion Time or Contract Time: The time set forth in the contract for the performance and completion of the work contracted for. The time may be expressed as calendar days, working days or a specific date.

103.3 RESOLUTION OF CONFLICTS

Inclusion of specifications from multiple sources may lead to minor conflicts in terminology, dimensions, quantities, specifications, and requirements. Conflicts between any of the Contract Documents shall be resolved as follows:

1. Special Provisions in the Construction Contract shall take precedence over all other Contract Documents.
2. Requirements, quantities, and other information contained in the Specifications and Construction Drawings (including notes on the plans) shall take precedence over requirements contained in the Construction Contract. Conflicts between Specifications and Construction Drawings shall be resolved as detailed below.
3. Actual quantities measured in the field, installed and accepted, shall take precedence over quantities listed in any of the Contract Documents; however, payment for quantities may be by lump sum, unit price, plan quantity, or otherwise as described elsewhere in the Contract Documents.
4. In all cases where there are conflicts within the Contract Documents, the first Specification referenced on each line item on the Unit Price Schedule shall control for that line item, and shall determine the method of measurement for that line item.
5. Dimensions, quantities, specifications, and all other requirements that are included in a Project Manual (including requirements in the Unit Price Schedule) that has been prepared for a specific project, shall take precedence over dimensions, quantities, specifications, and all other requirements that are included in the Construction Drawings. Measurement units and item descriptions used in the Unit Price Schedule shall take precedence over measurement units and item descriptions included in the plans or specifications.
6. Dimensions, quantities, specifications (including notes) and all other requirements that are included in the Construction Drawings shall take precedence over conflicting data that is included in Standard Details, Standard Specifications, and Special Specifications.
7. Dimensions and quantities written in words or numbers shall take precedence over scaled measurements or quantities calculated from drawings, both in the Construction Drawings and Standard Details.
8. In all instances, written communications take precedence over any verbal understandings between any parties involved. Verbal instructions, submittals, and communications shall be for convenience only and shall not be binding on any party involved.
9. Any third-party reports, exhibits, documents, and / or recommendations that have been prepared by third parties, such as geotechnical reports and traffic studies that have been submitted to the design engineer for his use, may be made available or included in the Contract Documents for use as supporting data and for informational purposes only. The recommendations contained in such documents were made to the design engineer, and the design engineer may or may not have agreed

with and followed those recommendations during final design. Therefore, all other Contract Documents shall take precedence over recommendations and requirements contained in such third-party reports.

10. All other conflicts shall be resolved by the Owner, and shall be resolved in a manner that is consistent with the Owner's best interest.

103.4 ABBREVIATIONS

Wherever the abbreviations defined herein occur on the plans, in the specifications, contract, bonds, advertisement, proposal, or in any other document or instrument herein contemplated, or to which the specifications apply or may apply, the intent and meaning shall be as follows:

%	Percent
'	Foot or Feet
"	Inch or Inches
#	Pound or pounds
AASHTO	American Association of State Highway and Transportation Officials
ABA	American Bankers Association
ACI	American Concrete Institute
am, a.m.	Before noon
ANSI	American National Standards Institute
Asph.	Asphalt
Assn.	Association
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
APWA	American Public Works Association
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
Be	Outside diameter of Pipe
Bd	Trench width
Blvd	Boulevard
c	Centigrade
cc	Cubic Centimeter
CFR	Code of Federal Regulations
cfs	Cubic feet per second
C.I.	Cast Iron
CL, C.L.	Center Line
cm	Centimeter
co	Cleanout
c.o.c.	Cleveland Open Cup
Conc.	Concrete
Cond.	Conduit
Corr.	Corrugated
cSt	Centistokes (Viscosity)
Cu.	Cubic
Culv.	Culvert
CY,C.Y.	Cubic Yard
D	Inside Diameter
D.I.	Ductile Iron
Dia.	Diameter
Dr.	Drive, or Driveway
Elev.	Elevation
F	Fahrenheit
FM	Factory Mutual
fps	Feet per second
Ft.	Foot or Feet

Gal.	Gallon
g, gm	Gram
HDPE	High Density Polyethylene
HP	Horsepower
Hr.	Hour
ID	Inside Diameter
in.	Inch or Inches
ISSA	International Slurry Surfacing Association
Kg or kg	Kilogram
kPa	Kilopascals
L	Liter
Lb.	Pound or Pounds
LDPE	Low Density Polyethylene
L.F.	Linear foot or feet
Lin.	Linear
LL	Liquid Limit
LLDPE	Linear Low Density Polyethylene
LMDPE	Linear Medium Density Polyethylene
LOI	Loss on Ignition
M	Meter
Max.	Maximum
MH	Manhole
Min.	Minimum or Minute
M.J.	Mechanical Joint
mm	Millimeter
Mod.	Modified
Mono.	Monolithic
mph	Miles per hour
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
MPa	Megapascal
MUTCD	(Texas) Manual on Uniform Traffic Control Devices
NACE	National Association of Corrosion Engineers
Nat' I	National
NEMA	National Electrical Manufacturers Association
No.	Number
N.P.T.	National Pipe Thread
NRMCA	National Ready-mixed Concrete
NSF	National Sanitation Foundation
o.d.,OD	Outside Diameter
OSHA	Occupational Safety and Health Administration
oz.	Ounce
Pa	Pascal
PI, P.I.	Plasticity Index
pm,p.m.	After noon
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
PVCO	Molecularly Oriented PVC
R	Radius
RAP	Recycled/Reclaimed Asphalt Pavement
RCP	Reinforced Concrete Pipe
RCRA	Resource Conservation and Recovery Act
Reinf.	Reinforced or reinforcing
Rem.	Remove

Rep.	Replace
R/W, ROW, Sani., San.	Right-of-Way Sanitary
Sec.	Second
S.F.	Square Feet
Sq.	Square
SSPC	The Society for Protective Coatings [formerly Steel Structures Painting Council]
St.	Street
Strm	Storm
Std.	Standard
Str.	Strength
SWPPP	Storm Water Pollution Prevention Plan
SY, S.Y.	Square Yard
TAC	Texas Administrative Code
Tex-###-X	Refer to TxDOT Manual of Testing Procedures
TCEQ	Texas Commission on Environmental Quality
TMUTCD	Texas Manual on Uniform Traffic Control Devices
TxDOT	Texas Department of Transportation
TxDOT	Refer to TxDOT Standard Specifications for Construction of Highways, Streets and Bridges
Item#	Underwriter's Laboratory
UL	Micrometers
Um, nm	United States
US, U.S.	United States Code
U.S.C.	United States Environmental Protection Agency
USEPA	Vertical
Vert.	Volume
Vol.	Weight
Wt.	Water
WT	Wastewater
WW	Yard
Yd.	

104 INSTRUCTIONS TO BIDDERS

104.1 INTRODUCTION

Instructions to the Contractor in these specifications are generally written in active voice, imperative mood. The subject of imperative sentences is understood to be "the Contractor." The City's responsibilities are generally written in passive voice, indicative mood. Phrases such as "as approved," "unless approved," "upon approval," "as directed," "as verified," "as ordered," and "as determined" refer to actions of the Engineer unless otherwise stated, and it is understood that the directions, orders, or instructions to which they relate are within the limitations of and authorized by the Contract.

104.2 PROPOSAL PREPARATION

The bidder shall submit its proposal on the forms furnished or approved by the OWNER. All blank spaces in the form shall be correctly filled in, the bidder shall state the prices, in both words, and numerals, for which it proposes to do the work, contemplated or furnish the material required. Such prices shall be written in ink distinctly and legibly. If an individual submits the proposal, that individual or duly authorized agent must sign the proposal. If an association or partnership submits the proposal, the name and address must be given and the proposal signed by a duly authorized member of the association or partnership. If a corporation submits the proposal, the corporate name and business address must be given and the proposal signed by a duly authorized corporate officer or agent. Powers of attorney authorizing agents to sign the proposal must be properly certified and must be in writing and submitted with the proposal. The proposal shall be executed in ink. The CONTRACTOR accepts all risks associated with bidding in this manner. It is understood and agreed that the proposal may not be withdrawn once the bid-opening process has begun.

104.2.A. Plan, Specs, and Site Examination

Bidders are advised that the plans, specifications and other documents on file as stated in the advertisement shall constitute all the information, which the OWNER shall furnish. Bidders are required, prior to submitting any proposal, to review the plans and read the specifications, proposal, Contract and bond forms carefully; to obtain and read the most current versions of all referenced State, Federal, and National standards; to visit the site of the work; to examine carefully local conditions; to inform themselves by their independent research, tests and investigations of the difficulties to be encountered and judge for themselves the accessibility of the work and all attending circumstances affecting the cost of doing the work or time required for its completion; and to obtain all information required to make a proposal. No information given by the OWNER or any official thereof, other than that shown on the plans and contained in the specifications, proposals and other Contract documents, shall be binding upon the OWNER. Bidders shall rely exclusively upon their own estimates, investigations, tests and other data, which are necessary for full and complete information upon which the proposal may be based. Any bidder, by submitting a bid, represents and warrants: that it has prepared the bid in accordance with the specifications, with full knowledge and understanding of the terms and provisions thereof; that it has done any inspection or test it deems appropriate; that it has reviewed, studied and examined its bid prior to the signing and submission of same; and that it was cognizant of the terms of its proposal, verified its calculations and found them to be correct and agrees to be bound thereby.

- 1. Availability of Lands for Work:** The lands upon which the work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment or storage of materials and equipment to be incorporated in the work are to be obtained and paid for by Contractor. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Contract Documents.
- 2. Copies of Bidding Documents:** Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Engineer assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents. Owner and Engineer, in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bid for the Work and do not confer a license or grant for any other use.

3. **Bid Form:** The Bid Form is included with the Bidding Documents; additional copies may be obtained from Engineer (or the Issuing Officer). All blanks on the Bid Form must be completed by printing in black ink or by typewriter. Bids by corporations must be executed in the corporate name by the president or vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature. Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.

104.2.B. Quantities in Proposal

The quantities of the work and materials set forth in the proposal form or on the plans approximately represent the work to be performed and materials to be furnished, and are for the purpose of comparing the bids on a uniform basis. Payment shall be made to the CONTRACTOR only for the actual quantities of work performed or materials furnished as measured in the field or otherwise determined by the Engineer in accordance with the plans and specifications; and it is understood that the quantities may be increased or decreased as hereinafter provided, without in any way invalidating the bid prices. If greater or lesser quantities are required than those quantities indicated in the Unit Price Schedule, the Contractor shall provide the required quantities. The method and amount of payment adjustments for quantities and changes, if any, will depend on whether the contract is Lump Sum, Plans Quantity, or Unit Price, and will be calculated accordingly.

104.2.C. Addenda

Bidders desiring further information, or interpretation of the Specifications, must make request for such information in writing to the City or Engineer, a minimum of 48-hours before the bid opening. 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 or interpretation will be considered official or binding. Should a bidder find discrepancies in, or omissions from, the 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 twenty-four (24) hours before 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 City/Engineer twenty-four (24) hours before the opening of bids. The quantities of the work and materials set forth in the proposal form or on the plans approximately represent the work to be performed and materials to be furnished, and are for the purpose of comparing the bids on a uniform basis.

104.2.D. Statement of Qualification

No proposal shall be considered unless it has included a Bidders Statement of Qualifications (SOQ). A statement of Bidders Qualification form is to be filled and included in the proposal from all bidders. The City will award to contract to a qualified bidder; therefore an SOQ is required prior to award of contract. To demonstrate qualifications to perform the Work, each Bidder must be prepared to submit within five days after Bid opening detailed written evidence such as financial data, previous experience, present commitments and other such data as may be called for in the contract documents. Each bid must contain evidence of Bidder's qualification to do business in the state where the project is located or covenant to obtain such qualification prior to award of the contract.

104.2.E. Nonresponsive Proposal

No proposal shall be considered unless it is filed at the place and within the time limit for receiving proposals as stated in the advertisement and/or Notice to Bidders or any addendum. Each proposal shall be in a sealed envelope, plainly marked with the word "Proposal" and the name or description of the project as designated in the advertisement. A proposal that has one or more of the deficiencies listed below is nonresponsive and will not be considered.

1. Failure to sign the proposal.

2. The proposal is in a form other than the official proposal form issued to the Bidder or Bidders.
3. The proposal was not in the hands of the letting official at the time and location specified in the advertisement.
4. Proposal writing is illegible.
5. The Bidder fails to acknowledge or improperly acknowledges receipt of all addenda issued.
6. The Bidder modifies the proposal in a manner that alters the conditions or requirements for work as stated in the proposal form.
7. Any other items inconsistent with the requirements set for by the City.

104.2.F. Withdrawing the Proposal

Proposals filed with the OWNER can be withdrawn or modified and redeposit prior to the time set for opening proposals. Request for non-consideration of proposals must be made in writing addressed to the OWNER prior to the time set for opening proposals. After other proposals are opened and publicly read, the proposal for which non-consideration is properly requested will be returned unopened. The proposal may not be withdrawn after bid opening has commenced. The bidder, in submitting the same, warrants and represents that its bid has been carefully reviewed and checked and that it is in all things true and accurate and free of mistakes and that such bid shall not and cannot be withdrawn after opening because of any mistake committed by the bidder; provided, however, that any bidder may withdraw its bid 90 days after the actual date of opening thereof, should no award have been made to such bidder.

104.2.G. Bid Submission

Bids shall be submitted at the time and place indicated in the Advertisement of Invitation to Bid and shall be enclosed in an opaque sealed envelope, marked with the Project title and name and address of Bidder and accompanied by the Bid Security. If the Bid is sent through the mail or other delivery system the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it.

Each prospective Bidder is furnished one copy of the Bidding Documents with one separate unbound copy each of the Project Manual including the text "To be filled out and returned by bidder." The Bidding Documents may be retained by Bidder. The unbound copy of the Project Manual is to be completed and submitted in a sealed envelope labeled in the center of envelope with the project name. The bidder's full name and contact information shall be listed on the upper left hand corner of the envelope.

104.2.H. Opening and Consideration of Proposals

The proposals filed with the OWNER shall be opened at the time stated in the advertisement and/or in the Notice to Bidders, or any subsequently issued addendum, and publicly read aloud, and shall thereafter remain on file with the OWNER. No Contract shall be awarded based on such proposals until after at least two days have elapsed. Contract shall only be awarded after the City Council has made a decision to do so.

After proposals are opened, the proposals shall be tabulated for comparison on the basis of the bid prices and quantities shown in the proposal. Until final award of the Contract, the OWNER reserves the right to reject any or all proposals, to waive technicalities or irregularities at its option, to advertise for new proposals or proceed to do the work otherwise in the best interests of the OWNER. Each bidder shall be furnished a copy of the bid tabulation upon request.

104.2.I. Rejection of Proposals

Proposals shall be considered irregular if they show any omissions, alterations of form, additions, unbalanced values or conditions not called for, unauthorized alternate bids or other irregularities of any kind. The OWNER may reject any proposal containing any such irregularity. The OWNER, however, reserves the right to waive any irregularities and to make the award in the best interest of the OWNER.

The BIDDER or CONTRACTOR shall not take advantage of any error in the bidding or contract documents. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown in or mentioned in both. In the case of any apparent difference between the drawings and specifications, or any other apparent error which the BIDDER or

the CONTRACTOR may discover, the BIDDER or CONTRACTOR shall refer the matter to the OWNER, to which the decision of the OWNER shall govern and made known via the issuance of addenda. The OWNER shall have the right to correct any error discovered. Proposals may be rejected if they are found to be non-responsive or disqualified for other specific reasons.

104.2.J. Disqualification

Bidders may be disqualified and their proposals not considered for any, and not limited to, the following reasons:

1. Reasonable belief that collusion exists among the bidders.
2. Reasonable belief that any BIDDER is interested in more than one proposal for the work contemplated.
3. The BIDDER having a history of filing frequent, excessive and meritless claims, or fraudulent claims, against the OWNER, or against other contractors on a project of the OWNER.
4. The BIDDER or its Surety having defaulted on a previous Contract, or the BIDDER performing poorly on a previous Contract.
5. Lack of competency, skill, judgment, financial capability, integrity, reputation, reliability or responsibility to perform the work as revealed by the bid proposal, bid questionnaires, financial statement, performance history or other relevant information obtained by the OWNER.
6. Uncompleted work, which in the judgment of the OWNER shall prevent or hinder the prompt completion of additional work if awarded.
7. Failure of BIDDER to use OWNER'S form of bid bond in submitting its bid, or submission of a cashier's check drawn on a state or national bank not located in the OWNER'S jurisdictional area.
8. Unbalanced value of any bid items.
9. The BIDDER is currently a party to any litigation against the OWNER.

Other reasons not shown in these specifications shall be presented to City's Council. The last reserves the right to make final decision in disqualification situations not covered by these specifications.

104.2.K. Return of Proposal Guarantee

The OWNER shall normally return the proposal guaranties accompanying all proposals within 30 calendar days after bid opening except for the three apparent low proposals. The three apparent low proposal guaranties shall be retained by the OWNER until the required Contract and surety bonds have been executed, after which they shall be returned. The City may retain the remaining guaranties for up to 30 days after opening of bids if the one or more of the said are found to be within 3% of the lowest bid, or irregularities and other situations are found within the bids.

104.3 PROPOSAL GUARANTEE

No proposal shall be considered unless it is accompanied by a cashier's check on any state or national bank or acceptable bidder's surety bond, payable unconditionally to the OWNER. The cashier's check or bidder's surety bond shall be in the amount of not less than five (5) percent of the total amount of the bid. The type of check or money order must be indicated on the face of the instrument and the instrument must be no more than 90 days old. The proposal guaranty is required by the OWNER as evidence of good faith and as a guarantee that if awarded the Contract, the bidder shall execute the Contract and furnish the required bonds and evidence of insurance within 10 days after receipt of the awarded Contract or pay the damages as set forth below. The bidder's surety bond shall be conditioned that, if the proposal is withdrawn after the bids have been opened or the CONTRACTOR refuses to execute the Contract in accordance with its proposal and provide the required surety bonds, the CONTRACTOR and the surety shall become liable to the OWNER for the amount of the bidder's surety bond. In the event a cashier's check is submitted along with the proposal of the bidder, and the CONTRACTOR does not execute the Contract and provide the required surety bonds and evidence of insurance within 10 days after receipt of the awarded Contract, or withdraws its bid after bids have been opened, the OWNER shall be entitled to the proceeds of such check. Provided however, if the Contract price is less than \$100,000.00, the Bidder shall have the option of providing a Letter of Credit in lieu of a Performance Bond, said Letter of Credit to be in a form acceptable to City of Marble Falls.

104.4 CONFLICT OF INTEREST DISCLOSURE

The contractor shall fill out and submit a Conflict of Interest Disclosure form with bid documents. The questionnaires require disclosures describing certain business and gift giving relationships, if any, the filers may have with Local Government Officers or a member of a governing body of a local government entity.

This applies to:

- Businesses and individuals who contract with the City,
- Businesses and individuals who seek to contract with the City (regardless of whether a bidder is awarded the contract), and
- Agents who represent such businesses in their business dealing with the City

A copy of the required reporting form shall be included in the bid documents. Compliance is the individual responsibility of each individual, business and agent who is subject to the law's filing requirement.

If you are required to file a Conflict of Interest Questionnaire, you should file it with the Marble Falls City Secretary at 800 Third Street, Marble Falls, TX 78654.

105 CONTRACT AWARD AND EXECUTION

105.1 INTRODUCTION

The OWNER will attempt to award the Contract within 90 days after the opening of proposals. The award, if made, shall be to the lowest responsible bidder; but in no case shall the award be made until after investigations are made as to the responsibility of the bidder to whom it is proposed to award the Contract. The City will make decision based on physical location of the CONTRACTOR's business, whether bid amount falls within 3% of lowest bid, and including but not limited to contractors experience and financial accountability. If awarded the Contract, the bidder shall execute the Contract and furnish the required bonds and evidence of insurance within 10 calendar days after receipt of the awarded Contract.

105.2 CONTRACT AWARD

Owner reserves the right to reject any or all Bids, including without limitation the rights to reject any or all nonconforming, unresponsive, unbalanced or conditional Bids, and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive, or the Bidder is unqualified, or of doubtful financial ability, or fails to meet any other pertinent standard or criteria established by Owner. Owner also reserves the right to waive all informalities not involving price, time or changes in the Work and to negotiate contract terms other than price with the Successful Bidder.

In evaluating Bids, Owner will consider the qualifications of Bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

Owner also may consider the operating costs, maintenance requirements, performance date and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

By submitting a bid for the project described in these Instructions to Bidders, each bidder agrees to the determination of the low bidder and payment procedures described in the contract documents and each bidder further agrees that he is not, and will not be disadvantaged in any way by these bid evaluation procedures and/or subsequent bid award and/or payment procedures.

When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within fifteen days thereafter, Contractor will sign and deliver the required number of counterparts of the Agreement and attached documents to Owner with the required Bonds. If Owner does not request a specific number of counterparts, the Contractor will sign and deliver three (3) copies. Within ten days thereafter, Owner shall deliver one fully signed counterpart to Contractor. Each counterpart is to be accompanied by a complete set of the Drawings with appropriate identification.

105.3 CONTRACTOR'S WARRANTIES AND UNDERSTANDING

In consideration of, and to induce the award of this Contract to it, the CONTRACTOR represents and warrants:

1. That it is financially solvent, and sufficiently experienced and competent to perform the work.
2. That the facts stated in the proposal and the information given by it pursuant to the bidding documents is true and correct in all respects.
3. That has read, understood and complied with all the requirements set forth in the bidding documents.
4. That it is familiar with and understands all laws and regulations applicable to the work.
5. Unless otherwise specifically provided for in the Contract documents, the CONTRACTOR shall do all the work and shall furnish all the tools, equipment, machinery, materials, labor and appliances, except as herein otherwise specified, necessary or proper for performing and completing the work required by this Contract, in the manner and within the time herein prescribed.

105.3.A. Contractor Site Visit

By executing the Contract, the CONTRACTOR represents that it has visited the site of work, has fully familiarized itself with the local and on-site conditions under which the work is to be performed and has correlated its observation with the requirements of the Contract documents. In addition, the CONTRACTOR represents that it has satisfied itself as to subsurface conditions at the site of the work. Information, data and representations contained in the Contract documents pertaining to the conditions at the site, including subsurface conditions, are for information only and are not warranted or represented in any manner to accurately show the conditions at the site of the work. The CONTRACTOR agrees that it shall make no claims for damages; additional compensation or extension of time against the OWNER because of encountering actual conditions in the course of the work, which vary or differ from conditions or information, contained in the Contract documents. Except as provided in *Site Preparation* section, Existing Structures, Facilities and Appurtenances, all risks of differing subsurface conditions shall be borne solely by the CONTRACTOR.

105.3.B. Contractor Employee Wages

Contractor hereby acknowledges and agrees that Contractor and each subcontractor are responsible for complying with the applicable provisions of Chapter 2258 of the Texas Government Code regarding the payment of prevailing wage rates. Contractor and each subcontractor shall pay wages to persons performing labor in connection with this Contract in an amount that is not less than the applicable prevailing wage rates for such workers. The Contractor shall forfeit as a penalty to Owner sixty dollars (\$60.00) for each laborer, workman or mechanic employed for each calendar day, or portion thereof, such laborer, workman or mechanic is paid less than said stipulated rate for any work done under this Contract by the Contractor or by any subcontractor under Contractor. Owner may withhold additional funds as appropriate when confronted with wage rate violations.

105.4 BONDS

All Proposals shall be accompanied by a certified cashier's check (or BID BOND) upon a national or state bank in the amount of five percent (5%) of the Total Maximum Bid Price payable without recourse to City of Marble Falls, or a Bid Bond in the same amount from a reliable Surety company as a guarantee that Bidder will enter into a contract and execute Performance Bond within ten (10) days after Notice of Award of Contract to him.

If the Contract amount is greater than \$50,000 but less than or equal to \$100,000, only a Payment Bond in 100% of the Contract amount is mandatory; provided, however, that the bidder receiving the award may elect to furnish a Performance Bond in the same amount if the bidder so chooses. Provided however, if the Contract price is less than \$50,000.00, the Bidder shall have the option of providing a Letter of Credit in lieu of a Performance Bond, said Letter of Credit to be in a form acceptable to City of Marble Falls.

If the amount of the Contract, including OWNER-accepted alternates and allowances, if any, is greater than \$100,000, Performance and Payment Bonds in amount of 100% of the Contract amount are mandatory and shall be provided by the bidder receiving the award.

If the Contract amount is less than \$50,000, the bidder receiving the award may elect not to provide Performance and Payment Bonds, or a Letter of Credit; provided that in such event, no money will be paid to the CONTRACTOR until final completion and acceptance of all work by OWNER. If the bidder receiving the award elects to provide Performance and Payment Bonds in 100% of the Contract amount, progress payments will be disbursed in accordance with the applicable contract provisions. CONTRACTOR shall not begin any Work on this Project until all bonds and required insurance have been furnished by Contractor and approved by Owner. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents.

All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as

published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

105.4.A. Surety Bonds

With the execution and delivery of the Contract, the CONTRACTOR shall furnish and file with the OWNER in the amounts herein required, the surety bonds specified hereunder. Without exception, the OWNER'S bond forms must be used, and exclusive venue for any lawsuit in connection with such bonds shall be specified as the county in which the OWNER's principal office is located. Such surety bonds shall be in accordance with the provisions of Texas Government Code, Chapter 2253, as amended, and Article 7.19-1 of the Insurance Code, as amended. These bonds shall automatically be increased by the amount of any change order or supplemental agreement which increases the Contract price with or without notice to the surety, but in no event shall a change which reduces the Contract amount reduce the penal amount of such bonds. If performance and payment bond forms are included in the bid documents, these forms shall be used with this Contract.

All sureties must be listed as approved sureties by the U.S. Department of Treasury. In the event any surety on the bonds becomes insolvent or is otherwise unable to perform its obligations under the bonds, the CONTRACTOR shall provide substitute bonds or equivalent security satisfactory to the OWNER to protect the interests of OWNER and of persons furnishing labor and materials in the prosecution of the Work.

105.4.B. Performance Bond

A good and sufficient bond in an amount not less than 100-percent of the approximate total amount of the Contract, as evidenced by the proposal tabulation, or, conditioned on the faithful performance of the work in accordance with the plans, specifications and Contract documents, including performance of any guarantees or warranties required by OWNER, and including any extensions thereof, for the protection of the OWNER. This bond shall provide for the repair and/or replacement of all defects due to faulty materials and workmanship that appear within a period of one year from the date of completion and acceptance of the improvement by the OWNER or such lesser or greater period as may be designated in the Contract documents.

105.4.C. Payment Bond

Bond shall be in an amount not less than 100-percent of the approximate total amount of the Contract, as evidenced by the proposal tabulation, or otherwise solely for the protection and use of payment bond beneficiaries who have a direct contractual relationship with the prime CONTRACTOR, or a subcontractor to supply public work labor or material.

105.4.D. Maintenance Bonds

If required, Contractor shall provide a Maintenance Bond in the amount of 100 percent of the Contract Price. This Bond shall become effective on the date of Substantial Completion for all or any part of the project, and shall remain in effect for a period of two (2) years after the date of Substantial Completion for any roadway work, or any other work as indicated in the contractual documents, except as provided otherwise by Laws or Regulations. Surety for the Maintenance Bond shall meet the same requirements as for Performance and Payment Bonds set forth in this section. Specific requirements for this Maintenance Bond shall be as established in the Agreement.

105.4.E. Additional Bonds

If at any time the OWNER is, or becomes, dissatisfied with any surety on a performance, or payment bond, the CONTRACTOR shall, within five days after notice from the OWNER, substitute an acceptable bond (or bonds), or provide an additional bond, in such form and sum as requested, and signed by such other surety or sureties as may be satisfactory to the OWNER. The premiums on such bonds shall be paid by the CONTRACTOR without recourse to the OWNER. No further payments under the Contract shall be deemed due or payable until the substitute or additional bonds have been furnished to and accepted by the OWNER.

105.4.F. Developer Bonds

In order to insure that it might not incur liabilities, the City may require, before it gives approval of the plans for development, that the owner of said development shall provide sufficient surety bond(s) to guarantee that claims against such development, in the event of default, shall be satisfied. Such bonds shall be no less than 100-percent of the Developer-CONTRACTOR contract amount.

105.4.G. Sureties

No sureties shall be accepted by the OWNER who are now in default or delinquent on any bonds or who are interested in any litigation against the OWNER. All bonds shall meet the applicable requirements of Article 7.19-1, Texas Insurance Code and Chapter 2253, Texas Government Code, shall be made on forms furnished by the OWNER, and shall be executed by not less than one corporate surety authorized to do business in the State of Texas and acceptable to the OWNER. Each bond shall be executed by the CONTRACTOR and surety. Each surety shall designate on the bond the name, address and phone number of a representative for the surety located in a county of the State of Texas acceptable to the OWNER to whom any requisite notices may be delivered and on whom service of process may be had in matters arising out of such surety. The OWNER reserves the right to reject any and all sureties.

105.5 INSURANCE

Any insurance policies required under this Item may be written in combination with any of the others, where legally permitted, but none of the specified limits may be lowered or otherwise negatively impacted by doing so, nor may any of the requirements or special provisions of this Item be limited or circumvented by doing so.

105.5.A. Contractor's Insurance

Without limiting any of the other obligations or liabilities of the CONTRACTOR, during the term of the Contract the CONTRACTOR and each subcontractor at its own expense shall purchase and maintain the herein stipulated minimum insurance with companies duly approved to do business in the State of Texas and satisfactory to the OWNER. Certificates of each policy shall be delivered to the OWNER before any work is started, along with a written statement from the issuing company stating that said policy shall not be canceled, non-renewed or materially changed without 30 days advance written notice being given to the OWNER, except when the policy is being canceled for nonpayment of premium, in which case 10 days advance written notice is required. Prior to the effective date of cancellation, the CONTRACTOR must deliver to the OWNER a replacement certificate of insurance or proof of reinstatement. The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles the Owner to declare the Contract void if the Contractor does not remedy the breach within ten days after receipt of notice of breach from the Owner. Coverage shall be of the following types and not less than the specified amounts:

1. **Workers' Compensation** as required by Texas law, with the policy endorsed to provide a waiver of subrogation as to the OWNER; employer's liability insurance of not less than \$500,000 for each accident, \$100,000 disease - each employee, \$500,000 disease - policy limit.
Contractor hereby represents to the Owner that all employees of the Contractor who will provide services on the Project will be covered by worker's compensation coverage for the duration of the Project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the Texas Worker's Compensation Commission, Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

The policy shall contain the following endorsements in favor of Owner:

- a. Waiver of Subrogation, form WC 420304; and
- b. 30 day Notice of Cancellation, form WC 420601.

The following is the form of notice of worker's compensation coverage prescribed by the Texas Worker's Compensation Commission. Pursuant to Section 110.110(d)(7), this notice must be printed with a title in at least 30-point bold type, and text in at least 19-point normal type, and shall be in both English and Spanish and any other language common to the worker population.

The Contractor shall contractually require each person with whom it contracts to provide services on the Project to Provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of the Texas Labor Code, Section 401.011(44) for all of its employees providing services on the Project, for the duration of the Project. That person or entity shall provide prior to beginning work a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the Project, for the duration of the Project. This section's intent is to apply all requirements set forth for Contractor to all subcontractors, whether entities or persons with whom the CONTRACTOR has entered into a contract.

REQUIRED WORKER'S COMPENSATION COVERAGE

"The law requires that each person working on this site or providing services related to this construction project must be covered by worker's compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee." "Call the Texas Worker's Compensation Commission at (512) 440-3789 to receive further information on the legal requirement for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

2. **General liability insurance**, including independent CONTRACTOR'S liability, completed operations and contractual liability, covering, but not limited to, the liability assumed under the indemnification provisions of this Contract, fully insuring CONTRACTOR'S (or subcontractor's) liability for injury to or death of OWNER'S employees and third parties, extended to include personal injury liability coverage with damage to property of third parties, with minimum limits as set forth in the Contract Documents. Contractor's Liability Insurance shall also include completed operations and product liability coverage and eliminate the exclusion with respect to property under the care, custody and control of Contractor:
 - a. General Aggregate (Except Products -Completed Operations) of \$100,000;
 - b. Each Occurrence Bodily Injury of \$300,000;
 - c. Property Damage Each Occurrence of \$25,000. Property Damage liability insurance will provide Explosion, Collapse and Underground coverage where applicable.
 - d. OWNER listed as an additional insured, endorsement CG 2010.
 - e. 30 day notice of cancellation in favor of Owner, endorsement CG 0205.
 - f. Aggregate limits of insurance per project, endorsement CG 2503.
 - g. Waiver of Transfer of Recovery against Others in favor of Owner, endorsement CG 2404.
 - h. Independent Contractors coverage.
3. **Business Automobile Liability Insurance**, covering owned, hired, and non-owned vehicles, with a bodily injury (including death) minimum combined single limit of \$500,000 per occurrence for bodily injury and property damage. Alternate acceptable limits are \$250,000 bodily injury per person, \$500,000 bodily injury per occurrence and at least \$100,000 property damage liability each accident. Such insurance shall include coverage for loading and unloading hazards. The policy shall contain the following endorsements in favor of Owner:
 - a. Waiver of Subrogation endorsement TE 2046A;
 - b. 30 day Notice of Cancellation endorsement TE 0202A; and
 - c. Additional Insured endorsement TE 9901 B, naming City of Marble Falls, its Aldermen, officers, officials and employees as additional insured.
4. **Owner's Liability Insurance**: CONTRACTOR shall obtain, pay for and maintain at all times during the prosecution of the work under this Contract an OWNER's protective liability insurance policy naming the OWNER and the Design Engineer as insures for property damage and bodily injury, which may arise in the prosecution of the work or CONTRACTOR'S operations under this Contract. Coverage shall be on an "occurrence" basis, and the policy shall be issued by the same insurance company that carries the

CONTRACTOR's liability insurance with a combined bodily injury and property damage minimum limit of \$600,000 per occurrence and \$1,000,000 aggregate.

5. **"Umbrella" Liability Insurance:** If required by OWNER, CONTRACTOR shall obtain, pay for and maintain umbrella liability insurance during the Contract term, insuring CONTRACTOR for an amount of not less than \$1,000,000 per occurrence combined limit for bodily injury and property damage that follows form and applies in excess of the primary liability coverage required hereinabove. The policy shall provide "drop down" coverage where underlying primary insurance coverage limits are insufficient or exhausted. OWNER and Engineer shall be named as additional insurers.
6. **Railroad Protective Insurance:** When required in the Special Provisions, CONTRACTOR shall obtain, maintain and present evidence of railroad protective insurance (RPI). The policy shall be in the name of the railroad company having jurisdiction over the right-of-way involved. The minimum limit of coverage shall meet the specifications provided by the railroad company. The OWNER shall specify the amount of RPI necessary.

105.5.B. Insurance Requirements

Insurance to provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance and furnishing of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed or furnished by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable. Insurance furnished by the CONTRACTOR shall be in accordance with the following requirements:

1. Any policy submitted shall not be subject to limitations, conditions or restrictions deemed inconsistent with the intent of the insurance requirements to be fulfilled by the CONTRACTOR. The OWNER'S decision thereon shall be final.
2. Policies are to be written through companies duly licensed to transact that class of insurance in the State of Texas.
3. All liability policies required herein shall be written with an "occurrence" basis coverage trigger.
4. Companies issuing the insurance policies and CONTRACTOR shall have no recourse against the OWNER for payment of any premiums or assessments for any deductibles, as all such premiums and deductibles are the sole responsibility and risk of the CONTRACTOR.
5. Approval, disapproval or failure to act by the OWNER regarding any insurance supplied by the CONTRACTOR (or any subcontractors) shall not relieve the CONTRACTOR of full responsibility or liability for damages and accidents as set forth in the Contract documents. Neither shall the bankruptcy, insolvency or denial of liability by the insurance company exonerate the CONTRACTOR from liability.
6. No special payments shall be made for any insurance that the CONTRACTOR and subcontractors are required to carry; all are included in the Contract price and the Contract unit prices.
7. The CONTRACTOR shall retain all required certificates of insurance for the duration of the project and for one year thereafter and shall have the responsibility of enforcing insurance requirements among its SUBCONTRACTORS. The CITY shall be entitled, upon request and without expense, to receive copies of these certificates.

105.5.C. Owner's Property Insurance

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

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

105.6 CONTRACT EXECUTION

The CONTRACTOR shall within 10 business days after receipt of the Contract sign the necessary agreements entering into the required Contract with the OWNER. The failure of the CONTRACTOR to execute the Contract or provide the required statutory surety bonds within 10 business days after the Contract is received shall constitute a breach of its proposal and the OWNER may annul the award and retain the proceeds of the bid security. In the event the OWNER should re-advertise for bids, the defaulting CONTRACTOR may not be eligible to bid.

105.6.A. Intent of Contract Documents

The intent of the documents, unless otherwise specifically provided, is to produce complete and finished work, which the CONTRACTOR undertakes to do in full compliance with the Contract documents. It is not intended to mention every item of work in the specifications that can be adequately shown on the drawings, nor is it to show on the drawings all items of work described or required by the specifications. All materials or labor for work shown on the drawings or reasonably inferable therefrom as being necessary to produce a finished job shall be provided by the CONTRACTOR whether or not same is expressly covered in the specifications. No verbal conversation, understanding or agreement with any officer or employee or agent of the OWNER, either before or after the execution of the Contract, shall affect or modify any of the terms, conditions or obligations contained in the Contract documents.

105.6.B. Notice to Proceed

Upon OWNER receipt of the executed Contract and the required insurance and surety bonds, a notice to proceed shall be issued by the OWNER indicating the date upon which the Contract time shall start and the projected date of completion. The OWNER will attempt to provide the work order within the time specified in the plans. The CONTRACTOR shall commence work within 10 days from the date specified in the written work order. No work shall commence before the notice to proceed has been issued. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents, unless CONTRACTOR knew or reasonably should have known thereof.

105.6.C. Delay of Contract

The CONTRACTOR shall not be entitled to any claim for damages due to delay in the award or work order. If the CONTRACTOR encounters any delay occasioned by the OWNER's failure or inability to obtain right-of-way or is delayed by the relocation or removal of any of the utilities or other installations of similar kind, the CONTRACTOR shall not be entitled to any claim for damages by virtue of any delay. Should the OWNER unreasonably delay the issuance of the work order through no fault of the CONTRACTOR, the CONTRACTOR shall be entitled only to an equitable extension of Contract time, the Contract amount to remain unchanged.

- 1. Force Majeure:** A delay in the completion of the Work that arises from one or more of the following events shall be considered an excused delay provided notice is given as provided herein: unforeseeable causes beyond the control and without the fault or negligence of the Contractor or its subcontractors or suppliers, including but not restricted to, acts of God, acts of the public enemy, acts of terrorism, acts of federal, state or local government in its sovereign capacity, acts of Owner, fires, floods, epidemics, quarantines, freight embargoes, unusually severe weather (excluding delays caused by above-average but not excessive rainfall), or delays of Owner as described in subsections below, delays of subcontractors or suppliers at any time arising from unforeseeable causes beyond the control and without the fault or negligence of either the Contractor or subcontractors or suppliers performing Work under this Contract (provided, however, that failure to order supplies, materials or equipment when shortages are known or expected, in time to perform the Work in accordance with the Contract Documents, is not excused.)

The Contractor, within a reasonable period of time, but in no event more than 14 days from the beginning of any such delay (unless Contracting Officer grants a further period of time), notifies Contracting Officer or OWNER in writing of the causes of delay to enable Owner to investigate and document the cause and duration of the delay. The Contractor shall submit with each application for payment a "Time Extension Request" form (provided by the Project Manager) documenting any requests for Contract time extension. The form shall be submitted even if no time extension is requested.

2. **Delay for Weather Conditions:** The Contract Time set out in the Contract Documents, including Substantial Completion Date and Final Completion Date, are deemed to include normal weather conditions at the Project site. The Contractor may be entitled to an excused delay due to unusual and severe weather conditions if the weather conditions are (a) excessive and severe for the period of time, (b) could not have been reasonably anticipated, (c) had an adverse effect on the scheduled construction, and (d) Contractor reasonably performed other Work on the Project in place of the scheduled work and still incurred a delay in the construction schedule. In order to be entitled to a delay on this basis, Contractor must provide OWNER with notice of the delay (as provided herein) and data substantiating the claim, including weather information issued by the National Oceanic and Atmospheric Administration ("NOAA") for the City in which the Project is located (or if such information is not available for the Project location, then for the closest City) which shows that the weather conditions were in excess of those that are normal for the site, and job logs that indicate impacted work and estimated effect of the weather. Unless the parties agree to a different method of determining weather conditions, weather information produced by NOAA will be used to determine normal and abnormal weather conditions at the Project site.

In order to be entitled to a Time extension due to weather conditions, Contractor must provide OWNER with notice of the adverse condition and its impact on the construction schedule as soon as Contractor becomes aware that a delay will or is likely to occur, to enable Owner to investigate and document the conditions. Such notice will be provided in writing as soon as reasonably possible but in no event later than 14 days after the date of the commencement of the weather condition giving rise to the claim for the delay.

3. **Delay Caused by Owner:** If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or by Engineers (other than an excused delay), or of a separate contractor employed by the Owner, then the Contractor shall promptly notify the OWNER, in writing, of such delay, to enable Owner and/or the Engineers to take action to reduce or eliminate the delay. Contractor must notify Owner and Project Manager as soon as possible after it becomes aware of the condition that it believes has caused or will be likely to cause a delay, but in no event less than 7 days after it becomes aware of such condition. Contractor's failure to do so will constitute a failure to mitigate damages and a waiver of Contractor's claim as provided under the terms of the Contract Documents. Owner's proper exercise of any of its remedies under the Contract Documents, including, but not limited to, remedies of suspension of the Work or requirement for correction or re-execution of any defective Work, shall not under any circumstances be construed as constituting a delay to Contractor's performance of the Work.

In the event of an excused delay under this Section, the Contractor shall submit with each application for payment a "Time Extension Request" form (provided by the OWNER) documenting any requests for Contract Time extension. The form shall be submitted even if no time extension is requested. Project Manager will provide Contractor with a reasonable period of extension of the Contract Time as may be equitable, provided that all conditions for obtaining an extension are met. The time extension will be set out in a Change Order. Any such extension of the Contract Time shall be net of any unexcused delays caused by or due to the fault of Contractor or anyone performing Work under the Contract.

Any provision of the Contract Documents to the contrary notwithstanding, it is expressly agreed that the extension of the Contract Time shall be Contractor's sole remedy for any delay unless the same shall have been

caused by acts constituting interference by the Owner which interfered with Contractor's performance of the work, and then only to the extent that such acts continue after Contractor's written notice to Owner of such interference. Owner's exercise of any of its rights or remedies under the contract documents, including the right to suspend the Work or to require correction or re-execution of any defective Work shall not under any circumstances be construed as interference with Contractor's performance of the Work.

105.6.D. Modification of Contract

The OWNER reserves the right to make changes in the quantities of the work, as may be considered necessary or desirable and such changes shall not be considered as waiving or invalidating any conditions or provisions of the Contract or bonds. The CONTRACTOR shall perform the work as altered, whether increased or decreased, and no allowances shall be made for anticipated profits.

1. **Increased or Decreased Quantities of Work:** The OWNER reserves the right to decrease the work under this Contract. Payment to the CONTRACTOR for the Contract items shall be made for the actual quantities of work performed and material furnished at the unit prices set forth in the Contract, except as provided below:
 - a. When the quantity of work to be done or of materials to be furnished under any major item of the Contract is more than 125 percent or less than 75 percent of the quantity stated in the Contract, then either party to the Contract, upon demand, shall be entitled to negotiate for revised consideration on the portion of work above 125 percent of the quantity stated in the Contract.
 - b. Any revised consideration shall be paid for as is hereinafter provided under Payment for Extra Work Item. The foregoing notwithstanding, the total original Contract amount shall not be increased more than 25 percent; the CONTRACTOR, by submission of a bid and execution of the Contract, is deemed to consent to the OWNER's right to reduce the total original Contract amount by more than 25 percent. This would not be applicable to the Additional Bid Items which are used on a per need basis. The OWNER may increase or decrease these items without reserve.
2. **Alteration of Plans and Specifications:** The OWNER reserves the right to make such changes in the plans and specifications and in the character of the work as may be necessary or desirable to insure completion in the most satisfactory manner, provided such changes do not materially alter the original plans and specifications or change the general nature of the work as a whole. Such changes shall not be considered as waiving or invalidating any condition or provision of the Contract and bonds. Such changes shall be issued by the Engineer.
3. **Extra Work:** When any work is necessary to the proper completion of the project and for which no prices are provided for in the proposal and Contract, the CONTRACTOR shall do such work, but only when and as ordered in writing by the Engineer. Extra Work is further explained in Item for Payment of Extra Work and Item for Disputed Work and Claims for Additional Compensation.
4. **Differing Site Conditions:** During the progress of the work, differing subsurface or latent physical conditions may be encountered at the site. The two types of differing site conditions are defined as: differ materially from those indicated in the Contract and unknown physical conditions of an unusual nature differing materially from those ordinarily encountered or not anticipated and generally recognized as inherent in the work provided for in the Contract. Engineer shall be notified if differing site conditions are encountered. Unless directed otherwise, suspend work on the affected items and leave the site undisturbed. The Engineer shall make a determination whether differing site conditions exist. CONTRACTOR has the right to investigate site, perform any form of exploratory search at own expense prior to bids opening, provided that such investigation does not constitute a nuisance to OWNER or public, interrupt routine operations, or cause adverse impact of any form. The OWNER, or its representative, has the right to reject any differing site conditions claim if such conditions could have been determined with prior investigation by the CONTRACTOR.

The Project Manager/Engineer will observe the Work for general compliance with the Contract Documents. The Project Manager/Engineer will initiate Change Order Requests and evaluate the Contractor's proposed cost and related time, and develop Construction Change Directives. The Contractor shall provide proposed costs and time for Change Order Requests as soon as possible, but not more than 20 days, after receipt of the Change Order request from the OWNER. The OWNER will conduct inspections to determine the date or dates of Substantial Completion and the date of Final

Completion. The Project Manager in conjunction with the Design Engineer will review, upon receipt from the Contractor, the as-built drawings, written warranties, owner's manuals and related documents required by the Contract.

5. **Finality of Change Orders:** In addition to the OWNER, the CONTRACTOR shall sign the Change Order Documents to verify the terms and conditions established by the Change Order; however, failure or refusal of the CONTRACTOR to sign a Change Order shall not relieve the CONTRACTOR of its obligation to execute the proposed changes in accordance with this Item and the other terms and provisions of this Contract. Each Change Order shall be specific and final as to prices and the extension of time, if any, and no reservations or other provisions allowing for future additional money or time as a result of the particular changes identified and fully compensated in the Change Order.

105.6.E. Change Orders

Owner and Contractor may at any time, without notice to or approval of the Surety, by written Change Order hereto, make changes in the Work, the Contract Amount, the Contract Time, or otherwise modify the Contract. If applicable unit prices are contained in the Agreement, the Owner may require the Contractor to proceed with the desired unit prices specified in the Contract; provided that in case of a unit price contract the net value of all changes does not increase the original total amount of the agreement by more than twenty-five percent (25%) or decrease the original total amount by eighteen percent (18%).

Any provision in the Contract Documents to the contrary notwithstanding, in the event Contractor receives an order, directive, instructions, or other communication regarding the Work from Owner or Engineers that Contractor believes will result in a change in the scope of Work, the Contract Time and/or the Contract Amount, Contractor shall promptly notify the person making the request, and the OWNER that the requested change will result in an increase in the Contract Time and/or Contract Amount before undertaking the Work. Contractor may not perform the Work unless and until it receives a written Change Directive from OWNER. Failure of CONTRACTOR to follow this requirement will constitute a waiver by Contractor of the right to obtain additional time or additional payment for the work. This provision shall not apply to instructions given by Owner or Engineer in an emergency situation to prevent or address an imminent threat of injury to persons or damage to property, or action taken by Contractor in accordance with Section for Emergencies.

105.7 EXTRA WORK CLAIMS

Except where otherwise provided in the Contract Documents, claims by the CONTRACTOR, whether for damages, additional compensation, additional time or other reasons must be made by written notice to the OWNER within fourteen days after occurrence of the event or events giving rise to the particular claim. Every claim, whether for damages, additional compensation, additional time or other reasons shall be signed and sworn to by an authorized corporate officer (if not a corporation, then an official of the company authorized to bind the CONTRACTOR by his or her signature) of the CONTRACTOR, verifying the truth and accuracy of the claim. Such verification shall be a condition precedent to the acceptability of any claim asserted by the CONTRACTOR. The CONTRACTOR shall be deemed to have waived any claim not made strictly in accordance with the procedure and time limits set out in this paragraph.

105.7.A. Disputed Work Compensation Claims

If the CONTRACTOR is of the opinion that:

1. Certain work necessary or required to accomplish the result intended by this Contract or certain work ordered to be done as contract work by the OWNER is actually Extra Work and not CONTRACTOR work, or
2. any determination or order of the OWNER violates the terms and provisions of this Contract.

CONTRACTOR shall promptly, either before proceeding with such work or complying with such order or determination, notify the OWNER in writing of its contentions with respect thereto and request a final determination by the OWNER. Such determination of the OWNER shall be given in writing to the CONTRACTOR. If the OWNER determines that the work in question is Extra Work and not Contract work, or that the order complained of requires performance by the CONTRACTOR beyond that required by the Contract, or violates the

terms and provisions of the Contract, thereupon the OWNER shall cause either (a) the issuance of a written order covering the Extra Work as provided for Change or Modification of Contract hereof, or (b) the determination or order complained of to be rescinded or so modified so as to not require performance beyond that required by the terms and provisions of the Contract.

If written notice is not given, the Contractor waives the right to additional compensation unless the circumstances could have reasonably prevented the Contractor from knowing the cost impact before performing the work. Notice of the request and the documentation of the costs will not be construed as proof or substantiation of the validity of the request. Submittal of the request shall be in sufficient detail to enable the Engineer to determine the basis for entitlement, adjustment in the number of working days specified in the Contract, and compensation.

If the OWNER determines that the work in question is Contract work and not Extra Work, or that the determination or order complained of does not require performance by the CONTRACTOR beyond that required by the Contract or violate the terms and provisions of the Contract, the OWNER shall direct the CONTRACTOR to proceed, and the CONTRACTOR must promptly comply. In order to reserve its right to claim compensation for such work resulting from such compliance, however, the CONTRACTOR must, within fourteen (14) days after receiving the OWNER'S determination and direction, notify the OWNER in writing that the work is being performed, or that the determination and direction is being complied with. The CONTRACTOR must note on notice if the claimed Extra Work is still under protest or if the claim has been dropped by the CONTRACTOR. If the Extra Work claim has been dropped, the CONTRACTOR may not reinstate that same claim. Payment, if any is due, shall be made when the OWNER makes a final determination regarding the merit of the CONTRACTOR'S protest.

If the CONTRACTOR fails to so appeal to the OWNER for a determination or, having so appealed, should the CONTRACTOR thus fail to notify the OWNER in writing of its protest, the CONTRACTOR shall be deemed to have waived any claim for extra compensation of damages therefore. No oral appeals or oral protests, no matter to whom made, shall be deemed even substantial compliance with the provisions of this item.

A delay of the CONTRACTOR due to a court order against the OWNER, or due to the OWNER'S failure to secure right-of-way at the time required or because of a conflict of a utility with the work, shall not be cause for additional compensation for damages sustained by the CONTRACTOR, but may be a cause for extension of Contract working time only.

Unless the aforesaid requirements and conditions have been complied with by the CONTRACTOR, the OWNER shall be released from all claims arising under, relating to or by reason of this Contract, except for the sums to be due under the payment provisions of this Contract. It is further stipulated and agreed that no conduct on the part of the OWNER or any agent or employee of the OWNER shall ever be construed as a waiver of the requirements of this section, when such requirements constitute an absolute condition precedent to any approval of any claim for extra compensation, notwithstanding any other provisions of the Contract documents; and in any action against the OWNER to recover any sum in excess of the Contract amount, the CONTRACTOR must allege and prove strict compliance with the provisions of this section. The CONTRACTOR shall, upon notice from the OWNER, produce for examination and audit at the CONTRACTOR'S office, by the representatives of the OWNER, all its books and records showing all of its acts and transactions in connection with contractual performance as well as relating to or arising by reason of the matter in dispute.

The cost for extra work performed by Contractor or Subcontractor will be determined by either: 1) an agreed lump sum, 2) an agreed unit price, or 3) an actual field cost as agreed to by the Owner.

The Contractor and Subcontractor will be allowed mark-up percentages for overhead and profit for changes in the Work as described below, unless the Agreement sets forth different provisions for determining overhead and profit. In the event of a conflict, the provisions of the Agreement shall control. The maximum allowable mark-up percentage of the actual cost of the Work will be 15% on the first \$20,000 and 10% on the balance over \$20,000.

If subcontracted work is involved, the Contractor will include with Contractor's cost proposal a detailed breakdown for the Subcontractor in accordance with the above requirements for the Contractor. The Subcontractor will be allowed the same mark-up percentages as provided above for the Contractor. The Contractor will be allowed the following mark-up on subcontracted work: a maximum of 8% on the first

\$30,000, and 5% on the balance over \$30,000. Under no circumstances will the OWNER be obligated to accept any change orders requested by the contractor.

If the scope of Work is reduced by the Owner such that the Contractor will not incur costs for deleted Work, the Contractor will credit those costs to the Owner and retain only Contractor's overhead and profit incurred prior to notification of Owner's reduction of the scope of the Work. If extra Work is requested by the Owner, the Contractor will be allowed to add to Contractor's actual costs a percentage as noted above to cover Contractor's overhead and profit. When both additions and credits covering related Work or substitutions are involved in any one change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

105.7.B. Additional or Extra Work Compensation Claims

While the CONTRACTOR or any subcontractor is performing Extra Work or complying with a determination or order under protest in accordance with Disputed Work and Claims for Additional Compensation Item (the cost of which shall also be determined by the method set out as aforementioned), the CONTRACTOR shall daily furnish the Engineer or other representative of the OWNER at the project site with three copies of verified statements showing:

1. The name and number of each worker, foreman, timekeeper, mechanic, or laborer employed on Extra Work or engaged in complying with such determination or order, the character of Extra Work each is doing and the wages paid to him or her, including the rate and amount of payroll taxes, contribution for insurance and federal social security.
2. The nature, cost and quantity of any materials, supplies, tools, plant or construction equipment furnished or used in connection with the performance of the Extra Work or in complying with such determination or order, and from whom purchased or rented.

A copy of such statements shall be signed by the OWNER's representative, noting thereon any items in question, and shall be returned to the CONTRACTOR within two working days after submission. This signature shall not be construed as the OWNER's agreement and acceptance of items not questioned since all items are subject to subsequent review and audit by OWNER representatives. The CONTRACTOR and its subcontractors, when required by the OWNER, must also produce for inspection and audit by designated OWNER representatives, any and all of their books, vouchers, records, daily job diaries and reports, canceled checks, etc. showing the nature and quantity of labor, materials and equipment actually used in the performance of the Extra Work; the amounts expended therefore; and the costs incurred for insurance premiums and other items of expense directly chargeable to such Extra Work. The CONTRACTOR must permit the OWNER'S representatives to make extracts there from or copies thereof as may be desired. Failure of the CONTRACTOR to comply strictly with these requirements shall constitute a waiver of any claim for extra compensation on account of the performance of such Extra Work. OWNER (or representative) may require the CONTRACTOR at that time to sign document that they are not willing to provide all required information.

105.7.C. Cleanup

Upon completion of the work, CONTRACTOR shall remove litter, debris, objectionable material, temporary structures, excess materials, and equipment from the work locations. Clean and restore property damaged by the Contractor's operations during the prosecution of the work. Leave the work locations in a neat and presentable condition. This work will not be paid for directly but will be considered subsidiary to Items of the Contract. Remove from the right of way cofferdams, construction buildings, material and fabrication plants, temporary structures, excess materials, and debris resulting from construction.

Where work is in a stream, remove debris to the ground line of the bed of the stream. Leave stream channels and rights of way in a neat and presentable condition. Clean structures to the flow line or the elevation of the outfall channel, whichever is higher. Dispose of all excess material in accordance with federal, state, and local regulations.

The Contractor shall remove all spillage and tracking arising from the performance of the Work from such areas, and shall establish a regular maintenance program of sweeping and hosing to minimize accumulation of dirt and dust upon such areas. Contractor's construction of the Work shall include removal of spatters and spills from materials and landscaping shall be neat and plants and grass installed as part of the Project shall be healthy and in good condition, and exterior surfaces shall be clean, neat, and free of debris. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

The aforementioned site cleanup shall be done regardless whether there is a pending claim against the OWNER. The OWNER reserves the right to withhold a minimum payment of 10 (ten) percent of total contract price up to a maximum of 25 (twenty five) percent of total contract price from the contractor if OWNER has deemed the site improperly clean, safe, or fully finished per design drawings, general specifications, and special condition specifications.

106 CONTROL OF WORK

106.1 INTRODUCTION

This section shall be used in reference to coordination between different entities whether implicitly or explicitly involved or named in to contractual documents. With exception to litigations and claims, the following nomenclature shall be used as a guide in general coordination with entities and peoples such as but not limited to the OWNER, inspectors, and franchise utility companies.

106.2 CONTRACT DOCUMENTS

106.2.A. Authority of Engineer

The Engineer has the authority to observe, test, inspect, approve, and accept the work. The Engineer decides all questions about the quality and acceptability of materials, work performed, work progress, Contract interpretations, and acceptable Contract fulfillment. The Engineer has the authority to enforce and make effective these decisions. The Engineer acts as a referee in all questions arising under the terms of the Contract. The Engineer's decisions will be final and binding.

The Project Manager does not have the authority to execute Change Orders or agree to changes in the Work which affect the Contract Amount or the Contract Time. These changes must be approved by the City Engineer or City Manager and in some cases the City Council. The City may delegate any part of his respective functions hereunder, but the Contractor will be notified in writing of any such delegation and the extent thereof.

106.2.B. Priority of Contract Documents

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 Contract documents, priority of interpretation shall be in the following order: OWNERS written changes, signed agreement (or Contract), performance and payment bonds, proposal, special provisions (or conditions), advertisement for bids (or invitation to bidders, or request for proposals), project (or Contract) drawings, Technical Construction Standard Specifications, and Standard Details.

106.2.C. Contract Documents and Specifications

The OWNER shall furnish the CONTRACTOR, without charge, a minimum of one copy of the Contract and any supplemental drawings and specifications reasonably necessary for the proper execution of the work. At least one copy of all drawings and specifications shall be accessible at all times to the OWNER at the job site.

The plans, the specifications, the proposal, special provisions and all supplementary documents are intended to describe a complete work and are essential parts of the Contract. All requirements occurring in any of them are binding. In cases of discrepancies, figured dimensions shall govern over scaled dimensions; plans shall govern over Standard Specifications, special provisions shall govern over both plans and Standard Specifications. All other provisions of the Standard Specifications shall remain in force.

106.2.D. Supplemental Drawings and Specifications

In order to carry out the intent of the Contract documents and to assist the CONTRACTOR in performing its work, the OWNER, after the execution of the Contract, may, by supplemental drawings, specifications or otherwise, furnish additional information or instructions as may be necessary for construction purposes.

All such supplemental drawings, specifications or instructions are intended to be consistent with the Contract documents and reasonably inferable therefrom. The OWNER, or design Engineer, may charge the CONTRACTOR for submittal of additional copies deemed not necessary to complete the work per the contractual documents. no The OWNER shall not charge extra costs on a claim that particular supplemental drawings, specifications or instructions differ from the requirements of the Contract documents, incurring extra costs, unless the CONTRACTOR has first brought the matter, in writing, to the OWNER'S attention for adjustment before proceeding with the work covered by such.

If the OWNER shall decide that there is no departure from the requirements of the Contract documents, the CONTRACTOR shall then proceed with the work as shown, specified or directed. If the OWNER shall decide that extra work is involved, OWNER shall so modify the supplemental drawings, specifications or instructions to

eliminate the extra work, or cause a written change order to be issued in accordance with Item for Change or Modification of Contract herein.

106.2.E. Referenced Standards

All referenced State, Federal, and National standards, their most current version in effect, unless specifically noted otherwise shall be followed unless they fall in direct contradiction to the standards written herein. In case of conflict the CONTRACTOR shall notify the OWNER and obtain guidance prior to proceeding with work. Referenced standards may include, but are not limited to, publications such as TxDOT Standard Specifications for Construction of Highways, Streets and Bridges, TxDOT Manual of Testing Procedures, Federal Specifications, ASTM designations, AWWA standards, and standards of other professional societies and associations.

106.2.F. Contract Document Errors and Corrections

The Engineer shall be permitted to make such corrections or interpretations as may be necessary for the fulfillment of the intent of the Contract documents. The CONTRACTOR shall not take advantage of any apparent errors, omissions or discrepancies in the drawings or specifications. In case of any errors, omissions or discrepancies in the drawings or specifications, the CONTRACTOR shall promptly submit the matter to the OWNER who, in turn, shall promptly make a determination and issue the necessary instructions in writing. Any adjustment by the CONTRACTOR without this determination and instructions shall be at the CONTRACTOR's own risk and expense. The work is to be made complete as intended by the Contract Documents.

106.2.G. Plans and Shop Drawings

The Engineer may provide working drawings to supplement the plans with all necessary details not included on the Contract plans. The CONTRACTOR shall be permitted also to provide working drawings (sometimes referred to as shop drawings) as directed in the Contract Documents to supplement the plans with all necessary details not included on the Contract plans. Working drawings shall be prepared and furnished in a timely manner and obtain approval, if required, before the beginning of the associated work. For all working drawing submittal requirements, the Engineer may allow electronic and other alternative submission procedures.

“Shop Drawings” or “working drawings” means drawings, diagrams, schedules, and other data, which are prepared for the Work by the Contractor or any Subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work. “Samples” means physical examples furnished by the Contractor to illustrate materials, equipment or workmanship, and to assist in the establishment of standards by which the Work will be judged.

Working drawings shall be submitted using United States standard measures and in the English language. The routing of submittals for review and approval will be established at the preconstruction conference. The Contractor is responsible for the accuracy, coordination, and conformity of the various components and details of the working drawings. Department approval of the Contractor's working drawings will not relieve the Contractor of any responsibility under the Contract. The work performed under this Article will not be measured or paid for directly, but will be subsidiary to pertinent Items.

- 1. Purpose:** The purpose of submittals by the CONTRACTOR is to demonstrate that the CONTRACTOR understands the design concept, and that it demonstrates its understanding by indicating which equipment and materials it intends to furnish and install, and by detailing the fabrication and installation methods it intends to use. The CONTRACTOR shall be responsible for dimensions that are to be confirmed and correlated at the job site, fabrication processes and techniques of construction, coordination of its work with that of other trades and satisfactory performance its work. The CONTRACTOR shall check and verify all measurements and review submittals prior to being submitted, and sign or initial a statement included with the submittal, which signifies compliance with plans, specifications, and dimensions suitable for the application. No portion of the work requiring submission of a shop drawing, product data or sample shall be commenced until the submittal has been approved by the Engineer. All such portions of the work shall be in accordance with approved submittals.

2. **Procedure:** With reasonable promptness and in such sequence as to cause no delay in the work or in the work of the OWNER or any separate contractor, CONTRACTOR shall submit two (2) copies of shop drawings, layouts, manufacturer's data and material schedules as may be required by the Engineer for his/her review. Submittals may be checked by and stamped with the approval of the CONTRACTOR and identified as the Engineer may require. Such review by the Engineer shall include checking for general conformance with the design concept of the project and general compliance with information given in the General Contract Documents. Indicated actions by the Engineer, which may result from his/her review, shall not constitute concurrence with any deviation from the plans and specifications unless such deviations are specifically identified by the method described below, and further shall not relieve the CONTRACTOR of responsibility for errors or omissions in the submitted data. Processed shop drawing submittals are not change orders.
3. **Shop Drawing Conflicts:** If deviations, discrepancies or conflicts between submittals and the design drawings and/or specifications are discovered, either prior to or after submittals are processed, the design drawings and specifications shall govern. Any deviation from the specified criteria shall be expressly stated in writing in the submittal. The CONTRACTOR shall not be relieved of responsibility for any deviation from the requirements of the Contract documents by the Engineer's approval of shop drawings, product data or samples unless the CONTRACTOR has specifically informed the Engineer in writing of such deviation at the time of submission and the Engineer has given written approval to the specific deviation.
4. **Shop Drawing Approval:** ENGINEER will review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals accepted by ENGINEER. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER's review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where a particular means, method, technique, sequence or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.
5. **Shop Drawing Rejection and Delays:** The CONTRACTOR shall be responsible for delays caused by rejection of the submittal of inadequate or incorrect shop drawings, product data or samples. The CONTRACTOR shall be responsible for providing all copies of approved shop drawings necessary for the construction operations. One (1) copy of the approved submittals shall be retained by the CONTRACTOR at the job site until completion of the project and shall be available per the request of the OWNER or representative.
6. **Continuation of Work:** Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submissions accepted by ENGINEER, any related Work performed prior to ENGINEER's review and approval of the pertinent submittal will be at the sole expense and responsibility of CONTRACTOR. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by section under Claims, or as OWNER and CONTRACTOR may otherwise agree in writing.

106.3 WORKMANSHIP, WARRANTIES AND GUARANTEES

Unless otherwise expressly provided in the Contract drawings or specifications, the work shall be performed in accordance with the best modern practice with materials and workmanship of the highest quality and suitable for their purpose. The OWNER shall judge and determine the CONTRACTOR's compliance with these requirements.

106.3.A. Cooperation of Contractor

The CONTRACTOR shall cooperate with the Engineer, other Contractors, and utility and railroad companies. All work associated with fulfilling this requirement is subsidiary to the various Items of the Contract and no direct compensation will be made. Provide all information necessary to administer the Contract. Maintain at least one copy of the Contract at the work locations at all times.

Designate in writing a competent, English-speaking Superintendent employed by the Contractor. The Superintendent must be experienced with the work being performed and capable of reading and understanding the Contract. Ensure the Superintendent is available at all times and able to receive instructions from the Engineer or authorized representative and to act for the Contractor. The Engineer may suspend work if a Superintendent is not available or does not meet the above criteria.

1. **Cooperating with Utility Providers:** Use established safety practices when working near utilities. Consult with the appropriate utilities before beginning work. Notify the Engineer immediately of utility conflicts. The Engineer will decide whether to adjust utilities or adjust the work to eliminate or lessen the conflict. Unless otherwise shown on the plans, the Engineer will make necessary arrangements with the utility owner when utility adjustments are required. Use work procedures that protect utilities or appurtenances that remain in place during construction. Cooperate with utilities to remove and rearrange utilities to avoid service interruption or duplicate work by the utilities. Allow utilities access to the right of way. Immediately notify the appropriate utility of service interruptions resulting from damage due to construction activities. Cooperate with utilities until service is restored. Maintain access to fire hydrants when necessary.
2. **Cooperation between Contractors:** CONTRACTOR shall cooperate and coordinate with other Contractors working within the limits or adjacent to the limits. Cooperation shall be extended to sub-contractors, inspectors, or any other person(s) whether directly or indirectly related to the construction.
3. **Cooperating with Inspectors:** Inspectors are authorized representatives of the OWNER. Inspectors are authorized to examine all work performed and materials furnished, including preparation, fabrication, and material manufacture. Inspectors shall inform the Contractor of failures to meet Contract requirements. Inspectors may reject work or materials and may suspend work until any issues can be referred to and decided by the Engineer. Inspectors cannot alter, add, or waive Contract provisions, issue instructions contrary to the Contract, act as foremen for the Contractor, or interfere with the management of the work. Inspection or lack of inspection will not relieve the Contractor from obligation to provide materials or perform the work in accordance with the Contract. Contractor shall:
 - a. Provide safe access to all parts of the work and provide information and assistance to the Engineer to allow a complete and detailed inspection.
 - b. Give the Engineer sufficient notice to inspect the work. Work performed without suitable inspection, as determined by the Engineer, may be ordered removed and replaced at Contractor's expense.
 - c. Remove or uncover portions of finished but not inspected work as directed. Once inspected, restore work to Contract requirements. If the uncovered work is acceptable, the costs to uncover, remove, and replace or make good the parts removed will be paid for by the CONTRACTOR. If the work is unacceptable, assume all costs associated with repair or replacement, including the costs to uncover, remove, and replace or make good the parts removed. If the previously inspected and approved construction is modified or uncovered, the costs to uncover, remove, and replace or make good the parts removed will be paid for in accordance with Item for Changes in the Work.

106.3.B. Workmanship

If the OWNER notifies the CONTRACTOR in writing of defective work, the CONTRACTOR shall correct the deficiencies within fourteen (14) calendar days of the Notice at no additional cost to the OWNER. If the defective work is not corrected within fourteen (14) calendar days, or the CONTRACTOR is not making satisfactory progress (in the opinion of the OWNER) to correct the deficiencies, the OWNER may withhold future payments for All Work until the defective work has been corrected to the satisfaction of the OWNER.

106.3.C. General Warranty

CONTRACTOR warrants and guarantees to OWNER, ENGINEER and ENGINEER's Consultants that all Work will be in accordance with the Contract Documents and will not be defective. CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by abuse, modification or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors or Suppliers; or normal wear and tear under normal usage.

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

1. observations by ENGINEER;
2. recommendations of any progress or final payment by ENGINEER;
3. the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;
4. use or occupancy of the Work or any part thereof by OWNER;
5. any acceptance by OWNER or any failure to do so;
6. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by ENGINEER;
7. any inspection, test or approval by others; or
8. any correction of defective Work by OWNER.

Nothing written in these documents is intended to release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents. The warranty described herein binds the Contractor to repair or replace (at the option of Engineers or Owner) without cost to Owner, any Work discovered during the two year period to be out of compliance with the Contract Documents and any Work which during the two year period described herein exhibits defects in workmanship or materials or which malfunctions or fails to work correctly or in the manner intended.

The warranty provided herein will be extended by any work performed by the Contractor (or performed by the Owner or Surety in the event Contractor fails to perform its warranty obligations) in repairing or replacing non-complying or defective work or materials, so that all repaired or replaced work shall have a one year warranty from the date repairs or replacements are completed. In the event Contractor fails to comply with these provisions, Owner shall have, in addition to any other rights and remedies provided by law or the Contract Documents, the right to (1) perform the repair or replacement by its own employees or other contractor and demand reimbursement from Contractor for all amounts incurred by Owner, in which event Contractor shall pay said amounts to Owner within 30 days after demand, and/or (2) make demand on Surety to perform Contractor's obligations.

All warranties required by the Contract Documents shall include labor and materials and shall be signed by the manufacturer and/or Subcontractor as the case may be and countersigned by the Contractor. All warranties shall be delivered to the OWNER upon completion of the Work and before the submission of request for Final Payment. At the time of final completion of the Work, the Contractor agrees to assign to the Owner any and all manufacturers' warranties relating to materials and labor used in the Work and further agrees to perform the Work in such manner so as to preserve any and all such manufacturers' warranties.

106.3.D. Special Warranty

If within one year after final acceptance of the work by the OWNER, as evidenced by the final certificate of acceptance or within such longer or shorter period of time as may be prescribed by law or by the terms of any other applicable special warranty on designated equipment or portions of work as required by the Contract documents, any of the work is found to be defective or not in accordance with the Contract documents, the CONTRACTOR shall correct it promptly after receipt of a written notice from the OWNER to do so. This obligation shall survive termination of the Contract. The OWNER shall give such notice promptly after discovery of the condition.

The CONTRACTOR shall remove from the site all portions of the work which are defective or nonconforming and which have not been corrected unless removal is waived in writing by the OWNER.

All subcontractors', manufacturers' and suppliers' warranties and guarantees, express or implied, respecting any part of the work and any materials used therein, shall be obtained and enforced by the CONTRACTOR for the benefit of the OWNER without the necessity of separate transfer or assignment thereof, provided that if directed by the Engineer, the CONTRACTOR shall assign such warranties and guarantees in writing to the OWNER.

Any work repaired or replaced, pursuant to this section, shall be subject to the provisions of this section to the same extent as work originally performed.

106.3.E. Owner's Rights

The rights and remedies of the OWNER provided in this section are in addition to, and do not limit, any rights or remedies afforded to the OWNER by law or any other provision of the Contract documents, or in any way limit the OWNER's right to recovery of damage due to default under the Contract.

106.4 CONSTRUCTION STAKES

Unless otherwise expressly provided in the Contract drawings or specifications, the CONTRACTOR shall be responsible for all required Construction Staking associated with the project. When applicable, Costs for Construction Staking are paid under the appropriate bid item number included in the CONTRACT DOCUMENTS. In all other cases, Construction Staking is contingent to the rest of the project.

Copies of survey notes demonstrating third order level of accuracy shall be furnished to the OWNER within two weeks after the survey completion for final stakeout of the major project components. The furnished survey notes shall include the final vertical and horizontal stakeout notes for all drainage, street paving, structural, water, or sanitary sewer improvements. Alignments shall be tied to horizontal control with sufficient calls provided to delineate centerline or alignment. The location or monumentation of any real property boundaries or easements required for construction be performed by or under the direct supervision of a Registered Professional Land Surveyor in Texas as required by article 5282c of the Vernon's Texas Civil Statutes.

The CONTRACTOR is responsible for maintaining all survey control points and monuments in the construction area at all times and any costs for re-staking or re-establishing controls required shall be borne by the CONTRACTOR.

The OWNER will perform or confirm the initial and final measurement for payment and reserves the right to field verify any stakes placed, measurements for payment made and any work performed by the CONTRACTOR.

106.5 MEANS AND METHODS OF CONSTRUCTION

The OWNER'S approval of the CONTRACTOR'S means or methods of construction, or the OWNER's failure to exercise OWNER's right to prohibit such means or methods, shall not relieve the CONTRACTOR of its responsibility for the work or of its obligation to accomplish the result intended by the Contract documents; nor shall the exercise or non-exercise of such rights to prohibit create a cause of action for damages or provide a basis for any claim by the CONTRACTOR against the OWNER.

106.5.A. Drawings Conformity

All work shall conform to the lines, grades, cross-sections, and dimensions shown on the plans. Any deviation from the plans which may be required by the emergency needs of construction will be determined and authorized in writing by the OWNER.

106.5.B. Means and Methods

Unless otherwise expressly provided in the Contract drawings, specifications or bulletins, the means and methods of construction shall be such as the CONTRACTOR may choose; subject, however, to the OWNER's right to prohibit means and methods proposed by the CONTRACTOR which in the OWNER's judgment shall:

1. constitute a hazard to the work, or to persons or property, or shall violate express requirements of applicable laws or ordinances,

2. cause unnecessary or unreasonable inconvenience to the public,
3. not produce finished work in accordance with the requirements of the Contract documents,
4. not assure the work to be completed within the time allowed by the Contract.

Where the Contract drawings, specifications or bulletins do not require the use of specific means or methods of construction, sequencing of construction or a specific traffic control plan, the CONTRACTOR shall submit its proposed plan of procedure, sequencing or traffic control plan to the OWNER sufficiently in advance of the work affected to permit a reasonable time for review and comments. The sequence of construction and traffic control plan must be approved in advance by the OWNER before construction begins. Failure to submit the proposed plan within a reasonable time shall not create a claim for damages for resulting delay in the work or for damages, nor shall it be a cause for extension of working time to complete the work. CONTRACTOR further agrees to indemnify OWNER for any cause of action brought by any third party against the OWNER.

106.5.C. Construction Zone

CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants and anyone directly or indirectly employed by any of them from and against all claims, costs, losses and damages arising out of or resulting from any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER or any other party indemnified hereunder to the extent caused by or based upon CONTRACTOR's performance of the Work.

1. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as tools, appliances, construction equipment and machinery and surplus materials. CONTRACTOR shall leave the site clean and ready for occupancy by OWNER at Substantial Completion of the Work. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.
2. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

106.5.D. Construction Safety

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

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

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property.

All damage, injury or loss to any property, caused directly or indirectly, in whole or in part, by CONTRACT, Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant or anyone employed by any of them or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier or other person or organization directly or indirectly employed by any of them). CONTRACTOR's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with section of Acceptance of Work that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion). OWNER may issue a stop work order if it has been observed that unsafe working conditions, methods, materials, etc. are occurring at the construction site.

106.5.E. Construction Emergencies

CONTRACTOR shall designate a qualified and experienced safety representative at the site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in accordance with laws or Regulations.

In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from OWNER or ENGINEER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of such action.

106.5.F. Construction Safety Plan

CONTRACTOR shall provide a Safety Plan for the Project which complies with, but is not limited to, the following guidelines. The Contractor is responsible for reviewing the specific requirements of the Contract, analyzing the planned methods of operation, and incorporating any additional specific or unique safety requirements in the written plan. The Contractor is responsible for ensuring that all applicable safety regulations are addressed as part of the Safety Plan. No Work shall commence on the Project site until the Safety Plan has been reviewed by Owner.

1. General Provisions: The Safety Plan shall include:
 - a. An acknowledgement that the Contractor is totally responsible for compliance with OSHA requirements and relevant federal, state and local laws, rules and other regulations, which require a place of employment that is free of unsanitary or hazardous conditions that would harm an employee's health or safety or which establishes procedures or requirements for workplace safety.
 - b. An emergency evacuation plan, and site evacuation plan as may be appropriate for the Scope of Work.
 - c. The Contractor's proposal for compliance with the specific safety requirements, including the procedures for completing and forwarding to the Owner all on site accident and incident reports.
 - d. A layout drawing of the site indicating access roads, fire and ambulance lanes, location of first aid stations, location or required danger alarm systems, location of offices, parking for private vehicles and equipment, and storage of all flammable and/or combustible liquids, gases or other hazardous materials, and the evacuation assembly area, as may be appropriate for the Scope of Work.
 - e. Plans for providing medical service. A copy is to be posted at the work site first aid station and the following emergency numbers shall be included for the given work area: Marble Falls City Manager: 830-693-3615.

- f. The name of the Contractor's Safety Manager, Superintendent or (Contractor's Safety Supervisor), his/her qualifications and delineate his/her authority to direct work stoppage and expend funds to eliminate imminent hazardous conditions.
 - g. A description of the following issues :
 - (1) The frequency at which safety inspections will be conducted by the Contractor's Safety Engineer, Contractor's Safety Supervisor or other assigned inspector.
 - (2) Construction areas that will be designated « Hard Hat Areas» and where warning signs will be posted at all entry points.
 - (3) The greatest number of employees to be working at any one time during peak construction periods.
 - (4) Contractor's policies for initial safety indoctrination of all employees.
 - (5) Contractor's plans for continued safety education for all employees, including weekly safety meetings.
 - (6) Contractor's housekeeping rules or regulations.
 - (7) Plans for providing adequate lighting, ventilation, noise control, and personal protective equipment.
 - (8) Plans for controlling access to prevent unauthorized persons from entering the construction area.
 - (9) Site Safety equipment provided by Contractor, with locations.
 - (10) Persons who are trained to administer First Aid.
 - (11) Procedures to be followed in case of emergency.
2. Special Provisions: Depending on the type of construction, additional items must be incorporated into the Contractor's Safety Plan. When applicable, these include the following:
- a. Where the illustration of crane operation signals shall be posted on the Project site.
 - b. Traffic control and marking of hazards (i.e. haul roads, highways or other traffic intersections, utilities, prohibited areas).
 - c. Fire protection and security systems interruption which include automatic detection devices and alarms, automatic sprinkler systems, fire pumps, fire hydrants, applicable water supplies and reservoirs. Plans shall include measures and/or procedures to provide interim fire and security protection to facilities or areas affected by interruptions.
 - d. Excavations including slope protection, shoring, guarding, barricades, excavation access, and excavated material storage. Scaffolding, including planking size, cleats, guardrails, toe boards, anchor points, put-logs, section pins, and scaffold access.
 - e. Ladders, including types for specific uses and types of anchors to be utilized.
 - f. Use of cranes or derricks and the testing and inspection thereof, including hook latches, cables, boom stops, load tables, warning devices and fire extinguishers.
 - g. Testing and inspecting equipment, and the provision of backup alarms for tractors, backhoes, dozers, motor graders, etc.
 - h. Requirements for storage of flammable/combustible liquids for gases, including paints.
 - i. Submittal of false work (multi-story structures) and formwork drawings for review and approval. This item should also be indicated on the Contractor's progress schedule to prevent submittal delay which could hold up project.
 - j. Provision of toilets, including frequency at which toilets will be cleaned with soap and water, and sterilized.
 - k. Complete Blasting Plan, if applicable, which includes procedures for blasting, permits, explosives handling, explosive storage, explosive transportation, hole loading, blast signals, and blaster qualifications.
 - l. Checking and testing electrical tools and appliances for the required ground and installation of electrical circuits in accordance with the National Electric Code.
 - m. Use of safety nets in areas where the use of safety harnesses and life lines or scaffolds is not practical. Use of safety harnesses, lifelines and lanyards when necessary.
 - n. Providing welding protection, including shields, fire extinguishers, ventilation, hot work permits and fire watches.

106.5.G. Record Drawings

During the performance of Work under the Contract, the Contractor shall record and delineate accurately on one set of prints of the Drawings, which will be furnished to Contractor by the OWNER, all changes in such Work which constitute significant departures from the original Drawings. The set of Drawings thus corrected and changed shall show the Work as actually constructed ("As-Built Drawings" or "Record Drawings"). Such As-Built Drawings shall be delivered to the OWNER for review and approval at the earliest practicable date prior to completion of all Work under the Contract, in any event not later than the date of acceptance of the completed Work.

The Contractor shall review said As-Built Drawings on site with the Engineers at monthly intervals to verify proper recording of data and shall incorporate such revised Drawings as may be furnished by the Design Engineer as the job progresses. The As-Built Drawings shall show sufficient detail to convey, among other pertinent information, the following: 1. Physical dimensions, relation to existing conditions, and horizontal and vertical location of all underground or hidden installations; and 2. All modifications to the Work as recorded in Change Orders and Construction Change Directives.

106.6 COORDINATION

The OWNER and the CONTRACTOR shall designate an address and, if available, a facsimile number where all notices, directions or other communications may be delivered. If the OWNER and the CONTRACTOR agree, service of notice under this section may be accomplished by e-mail under the same provisions as notice by facsimile.

106.6.A. Local Access

The CONTRACTOR shall provide a telephone number, which will be answered by a representative during normal business hours and answered either live or electronically, outside normal business hours with said calls returned within one hour. The phone shall be accessible by direct dial without long distance charges for all citizens in the construction area and the City of Dallas personnel.

106.6.B. Service of Notices

Notices to the surety or sureties on Contract bonds shall be directed or delivered to the surety's home office or to the surety's designated agent for delivery of notices. Service by mail shall be presumed complete upon deposit of the paper, enclosed in a postpaid, properly addressed envelope, in a post office or official depository under the care and custody of the United States Postal Service. Service, by facsimile after 5:00 p.m. local time of the recipient, shall be deemed delivered on the following business day.

A party may change its designated address, facsimile number or e-mail address by delivering written notice of the new address, facsimile number or email address, properly signed, to all interested parties. Nothing herein contained shall be deemed to preclude hand delivery of any notice, direction or communication to a party mentioned above.

106.7 INSPECTION

It is the intent of the OWNER to inspect all work on this project. Some work may not require the presence of an inspector, and the CONTRACTOR should obtain written verification from the Engineer if an inspector is not needed before proceeding with that particular item of work. The CONTRACTOR must pay for all testing needed to determine acceptability for any work done without proper inspection, as directed by the Engineer.

The CONTRACTOR shall furnish the OWNER with every reasonable facility for ascertaining whether or not the work performed was in accordance with the requirements and intent of the plans and specifications. Any work done (except excavation) or materials used without suitable inspection by the OWNER may be ordered removed and replaced at the CONTRACTOR's expense.

106.7.A. Removal of Defective or Unauthorized Work

All work which has been rejected or condemned shall be repaired, or if it cannot be repaired satisfactorily, it shall be removed and replaced at the CONTRACTOR's expense. Defective materials shall be immediately removed from the site of the work. Work done without line and grade having been given, work done beyond the lines or not in conformity with the grades shown on the plans or as given, save as herein provided, work done without written authority and prior agreement in writing as to process, shall be done at the CONTRACTOR's risk and shall be considered unauthorized and at the option of the owner may not be measured and paid for and may be ordered removed at the CONTRACTOR's expense. Upon failure of the CONTRACTOR to repair satisfactorily or to remove and replace, if so directed, rejected, unauthorized or condemned work or materials immediately after receiving notice from the owner, the owner shall, after giving written notice to the CONTRACTOR, have the authority to cause defective work to be remedied or removed and replaced, or to cause unauthorized work to be removed and to deduct the cost thereof from any monies due or to become due the CONTRACTOR. Alternatively, the owner may, at its option, declare the CONTRACTOR in default, in which event the performance bond surety shall complete the Contract.

106.7.B. Final Inspection

Whenever the improvements provided for by the Contract shall have been completely performed on the part of the CONTRACTOR, the CONTRACTOR shall notify the OWNER that the improvement is ready for final inspection. If the work is not acceptable to the OWNER at the time of such inspection, OWNER shall inform CONTRACTOR as to the particular defects to be remedied before final acceptance shall be made. The OWNER shall make final inspection of all work included in the Contract as soon as practicable after remedies have been made and the work is ready for acceptance.

106.7.C. Notice for Inspection

The scheduled start of construction for each location shall be coordinated with the Department of Public Works a minimum of ten (10) days prior to the requested start date. Inspection of work associated with Department of Public Works projects will be done by the OWNER's appointed engineer, construction manager, or inspector. Inspections shall be requested through the appropriate appointed contract, a minimum of 24 hours prior to the need for inspection. The CONTRACTOR shall assure that the OWNER is aware of any work being performed on the project prior to the work taking place, and the CONTRACTOR should obtain written verification from the OWNER if an inspection is not needed before proceeding with any particular item of work.

106.7.D. Owner Site Visits

OWNER, ENGINEER, or its representative, will make visits to the site at intervals appropriate to the various stages of construction as OWNER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER will endeavor for the benefit of OWNER to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and on-site observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against defective Work. ENGINEER's visits and on-site observations are subject to all the limitations on ENGINEER's authority, responsibility, and particularly but without limitation, during or as a result of ENGINEER's on-site visits or observations of CONTRACTOR's Work ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work.

106.7.E. Overtime Inspection

Project inspectors must be paid at one and one-half their regular salary rates for all time spent on project inspection which exceeds 40 hours per week Monday through Friday and for time during legal Holidays declared by the OWNER. The OWNER will provide one inspector who will be available for this project during an eight-hour period on working days between the hours of 7:30 a.m. and 4:30 p.m., (Monday through Friday, except on legal Holidays,) for the duration of this project at no charge to the CONTRACTOR. All inspection performed on this project in excess of eight hours a day on working days, (Monday through Friday,) or before the hour of 7:30 a.m. or after the hour of 4:30 p.m., or performed on weekends or on legal Holidays may be considered overtime inspection.

The CONTRACTOR will be required to reimburse the OWNER for the cost of all inspection overtime, which may be necessary for the successful and expeditious prosecution of the work included in this CONTRACT. Inspection overtime will not be charged if the OWNER required the CONTRACTOR to work during overtime periods because of restrictions for water main tie-ins, traffic requirements, or other periods that inspection would normally be charged as determined by the OWNER. The OWNER's decision shall be final.

Except in an emergency situation, the CONTRACTOR shall be required to furnish in writing to the OWNER, not less than 36 hours in advance, a request to work overtime on Saturday, Sunday, Holiday, or any day on which the City Offices are closed for normal business. A written request is not required for overtime work on a weekday. Overtime will be scheduled at the discretion of the OWNER. The CONTRACTOR is not guaranteed that overtime will be accommodated.

Unless otherwise specified in the CONTRACT, inspection overtime will be charged to the CONTRACTOR, with the number of Inspectors to be determined by the OWNER under the following overtime conditions:

1. Weekdays between the hours of Midnight to 7:30 a.m. and between 4:30 p.m. to Midnight, at a rate of \$50.00 per hour per Inspector.
2. Saturdays, Sundays and Holidays between midnight to midnight with a minimum of four (4) hours, at rate of \$50.00 per hour per Inspector and a minimum of \$200 per day per Inspector.

Inspection fees will be accumulated during the monthly estimate period. A statement of charges for the estimate period will be provided to the CONTRACTOR. The statement of charges must be paid prior to the OWNER processing the next submitted estimate. PAYMENT IS DUE WITHIN TEN (10) DAYS AFTER THE DATE OF THE INVOICE. If payment is not made as due, the OWNER reserves the right to deduct or withhold amounts due from the monthly progress payment or final payment.

106.8 ACCEPTANCE

Once the work is satisfactory to the OWNER and in accordance with the specifications and CONTRACT documents, the CONTRACTOR shall be issued a certificate of acceptance. The Certificate of Acceptance will not be issued until all work required by contract, including all water and wastewater appurtenances have been adjusted to their final position.

106.8.A. Termination of Contract

The contract will be considered fulfilled, save as provided in any maintenance stipulations, bond, or by law, when all the work has been completed, the final inspection, and final acceptance made by the OWNER, and final payment made by the OWNER.

106.8.B. Guarantee after Completion

Unless otherwise specified in the technical section of these specifications, the CONTRACTOR shall, after test and acceptance, and for a period of one year from date of final written acceptance by the OWNER or within such longer or shorter period of time as may be prescribed by law or by the terms of any other applicable special warranty on designated equipment or portions of work as required by the contract documents, rebuild, repair, or replace any and all items which have proven defective due to unsatisfactory material and / or workmanship. Upon written notice from the OWNER, the CONTRACTOR shall immediately make any repairs that may be ordered, or such repairs will be made by the City of Marble Falls at the expense of the CONTRACTOR or the CONTRACTOR'S Surety. In case of an emergency where delay would cause serious loss or damage, the City of Marble Falls may undertake to have the defects repaired without previous notice. The expense of all repairs,

including all emergency repairs, shall be borne by the CONTRACTOR or the CONTRACTOR'S Surety, at no cost to the OWNER. This obligation shall survive termination of the contract.

106.8.C. Final Payment

Whenever the work provided for by the contract shall have been completely performed on the part of the CONTRACTOR, the CONTRACTOR shall notify the OWNER that the work is ready for final inspection. The OWNER will then make such final inspection and if the work is satisfactory and in accordance with the specifications and contract documents, the OWNER shall issue a certificate of acceptance to the CONTRACTOR and submit a request to accept the work performed by the CONTRACTOR and payment of a final estimate under the terms of which the OWNER will release 100% of the retainage, plus the unpaid portions of the final estimate as the OWNER deems advisable. All prior estimates upon which payments have been made are subject to necessary corrections or revisions in the final payment.

The amount of this final estimate, less any sums that have been previously paid, deducted or retained under the provisions of the contract, shall be paid the CONTRACTOR within 30 days after the final acceptance by the OWNER, provided the CONTRACTOR has furnished to the OWNER a consent of Surety and satisfactory evidence that all indebtedness connected with the work and all sums of money due for any labor, materials, apparatus, fixtures, or machinery furnished for and used in the performance of the work have been paid or otherwise satisfied, or that the person or persons to whom the same may respectively be due have consented to such final payment. The acceptance by the CONTRACTOR of the final payment as aforesaid shall operate as and shall be a release to the OWNER from all claims or liabilities under the contract, including all subcontractor claims, for anything done or furnished or relating to the work under the contract or for any act or neglect of said OWNER relating to or connected with the contract.

106.8.D. Audits

By execution of the Contract, CONTRACTOR grants the OWNER the right to audit, at City's election, all of CONTRACTOR'S records and billings relating to the performance of the Work under the Contract. CONTRACTOR agrees to retain such records for a minimum of three (3) years following completion of the Work under this Contract. OWNER agrees that it will exercise the right to audit only at reasonable hours.

107 CONTROL OF MATERIALS

107.1 INTRODUCTION

This section shall be used in reference to material quality, storage, sampling, and source. The specifications for materials set out the minimum standard of quality that the OWNER believes necessary to procure a satisfactory project. Use only materials that meet Contract requirements. Unless otherwise specified or approved, use new materials for the work. Contractor may suggest in writing to the OWNER of less expensive material. In such cases the payment to the contractor shall be reduced accordingly based on the agreed price between the OWNER and CONTRACTOR. Contractor may suggest in writing to the OWNER of higher quality material. In such cases these shall be no additional accrued cost to the OWNER unless the OWNER agrees in writing to the cost and installation of higher quality materials.

107.2 SUBSTITUTION OF MATERIALS

No substitutions will be permitted until the CONTRACTOR has received written permission of the Engineer to make a substitution for the material that has been specified. The Owner reserves the right to refuse to accept substitutions of materials or equipment. Requests for substitution shall be made prior to the date of the preconstruction conference. Where the term "or equal," or "or approved equal" is used, it is understood that if a material, product, or piece of equipment bearing the name so used is furnished it will be approvable, as the particular trade name was used for the purpose of establishing a standard of quality acceptable to the OWNER. If a product of any other name is proposed for use, the Engineer's approval thereof must be obtained before the CONTRACTOR procures the proposed substitute.

Where the term "or equal," or "or approved equal" is not used in the specifications, this does not necessarily exclude alternative items or material or equipment which may accomplish the intended purpose. However, the CONTRACTOR shall have the full responsibility of proving that the proposed substitution is, in fact, equal, and the Engineer, as the representative of the OWNER, shall be the sole judge of the acceptability of substitutions. The provisions of this sub-section as related to "Substitutions" shall be applicable to all sections of these specifications.

Should an authorized substitution require redesign of a portion of the work or alterations to the plans or specifications in order for the materials or articles which are to be substituted to properly fit or in other ways to be satisfactory, the Engineer shall accomplish such redesigns and alterations. The CONTRACTOR shall bear all reasonable costs associated with redesign and alteration efforts performed by the Engineer.

Owner may, in its discretion, agree to accept substitutions of materials or equipment after the Contract has been signed for good cause shown. The Contractor may make substitutions of materials or equipment only with the prior written consent of Owner after evaluation and approval by the applicable Engineer and in accordance with a Change Order. A request for substitution constitutes a representation by Contractor that Contractor:

- a) has investigated the proposed product and determined that it is equal or superior in all respects to the specified product;
- b) shall provide identical warranties as those required for the specified product or any extended warranties required by Owner as a condition for approval of the substitution;
- c) shall coordinate installation and make changes to other Work which may be required at no cost to Owner;
- d) waives claims for additional costs or time extension which may subsequently become apparent;
- e) certifies that the proposed product will not affect or delay the approved Construction Schedule; and

107.2.A. Salvageable Materials

All salvageable material shall be designated by and remain the property of the OWNER. Any designated salvageable material that is destroyed or damaged due to negligence of the CONTRACTOR shall be replaced with new material by the CONTRACTOR at no expense to the OWNER. Salvage material, unless designated for reuse, shall be returned to a location designated by the OWNER.

107.2.B. Source of Materials

The CONTRACTOR shall be free to obtain the approved materials, equipment and articles from sources of its own selection. However, if the OWNER finds that the work shall be delayed or adversely affected in any way because a selected source of supply cannot furnish a uniform product in sufficient quantity and at the time required and a suitable source does exist, or the product is not suitable for the work, the OWNER shall have the right to require the original source of supply changed by the CONTRACTOR. The CONTRACTOR shall have no claim for extra cost or damage because of this requirement.

107.2.C. Quality of Materials

The CONTRACTOR warrants to the OWNER that all materials and equipment furnished under this Contract shall be new unless otherwise specified in the Contract documents and that same shall be of good quality and workmanship, free from faults and defects and in conformance with the Contract documents. All materials and equipment not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective and shall be promptly repaired or replaced by the CONTRACTOR at the CONTRACTOR's sole cost upon demand of the OWNER. If required by the OWNER, the CONTRACTOR shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

The Contractor shall furnish to the OWNER for its approval the name of the manufacturer, the model number, and other identifying data and information respecting the performance, capacity, nature, and rating of the machinery and mechanical and other equipment that the Contractor contemplates incorporating into the Work. When required by the Contract or when called for by the OWNER, the Contractor shall furnish the OWNER for approval, full information concerning the material or articles the Contractor contemplates incorporating into the Work.

No lead based paint and no materials containing asbestos shall be incorporated into the Project. Coal tar sealants shall not be used on the Project. Contractor, subcontractors, and suppliers may be required to certify that these materials were not provided or installed as part of this Contract.

107.3 OFF-SITE STORAGE

Payment for costs incurred in storage of materials or equipment away from the project site will not be made by the OWNER unless:

1. The OWNER has approved off-site storage in writing; and
2. The materials or equipment are stored in a bonded warehouse located in the County approved by the OWNER and identified with the project for which they are stored as evidenced by warehouse receipts and appropriate documents of title.

Storage in facilities of the manufacturer or CONTRACTOR will not be permitted or paid for, unless such storage is expressly approved in writing by the OWNER.

107.3.A. Surplus Materials

Surplus materials shall be disposed of by the CONTRACTOR at his expense. Surplus excavation materials shall be removed from the site unless specified otherwise under the performance specifications.

107.4 MATERIAL SAMPLING AND TESTING

Unless otherwise stipulated in the Contract documents, initial testing of all materials, construction items or products incorporated in the work shall be performed at the direction and expense of the OWNER, including initial compaction and density tests deemed necessary. In the event materials, construction items or products incorporated in the work fail to satisfy the minimum requirements of the initial test, appropriate prove out test shall be made as directed by the OWNER to determine the extent of the failure and to verify that the corrective measures have brought the item up to specification requirements. The cost of all testing necessary to determine the extent of the failure and the adequacy of the corrective measures shall be the responsibility of the CONTRACTOR.

The failure of the OWNER to make any tests of materials shall in no way relieve the CONTRACTOR of its responsibility of furnishing materials conforming to the Contract documents.

Tests, unless otherwise specified, shall be made in accordance with the latest methods of the American Society for Testing and Materials (ASTM). The CONTRACTOR shall provide such facilities as the OWNER may require for collecting and forwarding samples and shall not use the materials represented by the samples until tests have been made. The CONTRACTOR shall furnish adequate samples without charge. Test materials and samples shall be stored so as to ensure the preservation of their quality and fitness for the Work. If directed by the Engineer, they shall be placed on wooden platforms or other hard, clean surfaces and shall be placed under cover if directed. Stored materials shall be placed and located so as to facilitate prompt inspection.

The CONTRACTOR shall furnish without additional cost to the OWNER such materials for testing as may be reasonably necessary. Retesting after failure to pass tests shall be at the expense of the CONTRACTOR. Should the percentage of rejected material or equipment be unreasonably large, the additional cost of such inspection and tests resulting therefrom shall be borne by the CONTRACTOR. The OWNER shall judge what is extra inspection and shall determine the additional cost incurred thereby and payable by the CONTRACTOR.

108 LEGAL AND CONTRACT RESPONSIBILITIES

108.1 INTRODUCTION

This section shall be used in reference to the legal relations and contract responsibilities between the OWNER and CONTRACTOR. This Contract is between the OWNER and the CONTRACTOR only. No person or entity may claim third-party beneficiary status under this Contract or any of its provisions, nor may any non-party sue for personal injuries or property damage under this Contract.

108.2 CONTRACTOR INDEPENDENCE

While engaged in carrying out and complying with the terms and conditions of this Contract the CONTRACTOR is, and shall be, an independent CONTRACTOR and shall not, with respect to its acts or omissions, be deemed an officer, employee or agent of the OWNER. The CONTRACTOR shall not at any time or in any manner represent that it or any of its agents or employees are in any manner agents or employees of the OWNER.

The fact that the OWNER or the Engineer shall have the right to inspect or observe CONTRACTOR's work during performance and to exercise the other rights and prerogatives expressly reserved to the OWNER or the Engineer under this Contract is not intended to, and shall not any time, change or affect the status of the CONTRACTOR as an independent CONTRACTOR with respect to the OWNER, the CONTRACTOR's own employees or any other person, firm or corporation. Nothing contained in the Contract documents shall create any contractual or agency relationship between the Engineer and the CONTRACTOR.

108.3 INDEMNIFICATION

CONTRACTOR COVENANTS AND AGREES TO AND DOES HEREBY INDEMNIFY, HOLD HARMLESS AND DEFEND, AT ITS OWN EXPENSE, THE OWNER, ITS OFFICERS, AND EMPLOYEES, FROM AND AGAINST ANY AND ALL CLAIMS OR SUITS FOR PROPERTY LOSS OR DAMAGE AND/OR PERSONAL INJURY, INCLUDING DEATH, TO ANY AND ALL PERSONS, OF WHATSOEVER KIND OR CHARACTER, WHETHER REAL OR ASSERTED, ARISING OUT OF THE WORK AND SERVICES TO BE PERFORMED HEREUNDER BY CONTRACTOR, ITS OFFICERS, AGENTS, EMPLOYEES, SUBCONTRACTORS, LICENSEES OR INVITEES, WHETHER OR NOT CAUSED, IN WHOLE OR IN PART, BY THE ALLEGED NEGLIGENCE OF THE OFFICERS, EMPLOYEES, OF THE OWNER. CONTRACTOR LIKewise COVENANTS AND AGREES TO, AND DOES HEREBY, INDEMNIFY AND HOLD HARMLESS OWNER FROM AND AGAINST ANY AND ALL INJURIES, DAMAGE, LOSS OR DESTRUCTION TO PROPERTY OF OWNER DURING THE PERFORMANCE OF ANY OF THE TERMS AND CONDITIONS OF THIS CONTRACT, WHETHER ARISING OUT OF IN WHOLE OR IN PART, ANY AND ALL ALLEGED ACTS OR OMISSIONS OF OFFICERS, SERVANTS, OR EMPLOYEES OF OWNER.

THE PROVISIONS OF THIS PARAGRAPH ARE SOLELY FOR THE BENEFIT OF THE PARTIES HERETO AND NOT INTENDED TO CREATE OR GRANT ANY RIGHTS, CONTRACTUAL OR OTHERWISE, TO ANY OTHER PERSON OR ENTITY.

The provisions of this indemnification and all other Indemnification obligations set out in the Contract Documents, shall survive the termination of this Contract, howsoever caused, as to events occurring prior to such termination, and no payment, partial payment, nor issuance of a certificate of Substantial Completion nor a certificate of final completion nor acceptance or occupancy in whole or in part of the Work shall waive or release any of the provisions of this section or of any other indemnification contained in the Contract Documents.

108.4 CLAIM AGAINST OWNER

No claim whatsoever shall be made by the CONTRACTOR or Sub-CONTRACTOR against any officer, servant, employee or agent of the OWNER for or on account of, anything done or omitted to be done in connection with this Contract.

108.4.A. Financial Interest

CONTRACTOR is hereby advised to comply with the OWNER's financial interest or comparable policy. If OWNER does not implement a financial interest or comparable policy of its own, provisions of this Item shall govern matters of financial interest.

No officer, servant, employee or agent of the OWNER shall have a financial interest, direct or indirect, in any contract with the OWNER or be financially interested, directly or indirectly, in the sale to the OWNER of any land, materials, supplies or services, except on behalf of the OWNER as an officer or employee. Any violation of this article with the knowledge, expressed or implied, of the persons, partnership, company, firm, association or corporation contracting with the OWNER shall render the Contract involved voidable by the OWNER.

108.4.B. Claim Venue

The parties herein agree that this Contract shall be performed in the county in which the OWNER'S principal office is located, and if legal action is necessary in connection therewith, exclusive venue shall lie in this county. The terms and provisions of the Contract documents shall be construed in accordance with the laws and court decisions of the State of Texas. The Contract shall be governed by and interpreted in accordance with the laws of the State of Texas. Venue for any action brought in connection with the Contract Documents shall lie in courts of competent jurisdiction in Burnet County, Texas. If any provision or part of the Contract Documents is held to be void or unenforceable under any Law or Regulation, all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

In the event of any suit or action arising out of or relating to the Contract, the prevailing party in such proceeding shall be entitled to recover reasonable attorney fees and court costs. Reference is made to Section 271.159 of the Texas Local Government Code in connection with the recovery of attorney's fees. The parties agree to mediate any dispute arising in connection with the Contract Documents in good faith prior to filing suit for damages. The parties agree to mediate any dispute in good faith prior to filing suit for relief other than injunctive relief.

108.5 NO WAIVER OF LEGAL RIGHTS

Inspection by the Engineer; any order, measurement, quantity or certificate by the Engineer; any order by the OWNER for payment of money; any payment for or acceptance of any work; or any extension of time or any possession taken by the OWNER shall not operate as a waiver of any provisions of the Contract or any power therein reserved to the OWNER of any rights or damages therein provided. Any waiver of any breach of Contract shall not be held to be a waiver of any other or subsequent breach. The OWNER reserves the right to correct any error that may be discovered in any estimate that may have been paid and to adjust the same to meet the requirements of the Contract documents. The OWNER reserves the right to recover by process of law sums as may be sufficient to correct any error or make good any deficiency in the work resulting from such error, dishonesty or collusion by the CONTRACTOR or its agents and the Engineer or assistants, discovered in the work before or after the final payment has been made.

108.5.A. Faulty or Uncompleted Work

Neither final acceptance of the work, nor final payment, shall relieve the CONTRACTOR of responsibility for faulty materials or workmanship. The CONTRACTOR shall promptly remedy any defects due thereto and pay for any damage to other work resulting therefrom. Likewise, neither final acceptance nor final payment, nor partial or entire use or occupancy of the work by the OWNER shall constitute acceptance of work not done in accordance with the Contract documents or relieve CONTRACTOR of liability with respect to any expressed or implied warranties or responsibility for faulty materials or workmanship, whether same be patently or latently defective.

The OWNER, or any officer or agent thereof, shall not be precluded at any time, either before or after final completion and acceptance of the work and final payment therefrom:

1. Showing the true and correct amount, classifications, quality and character of the work done and materials furnished by the CONTRACTOR or any other person under this Contract.
2. From showing at any time that any determination, return, decision, approval, order, letter, payment or certification is untrue and incorrect or improperly made in any particular, or
3. The work or the materials or any parts thereof do not in fact conform to the Contract requirements.

4. Demanding the recovery from the CONTRACTOR of any overpayments made to it, or such damages as the OWNER may sustain by reason of the CONTRACTOR's failure to perform each and every part of this Contract in strict accordance with its terms; or both.

108.5.B. Compensation of Acknowledged Work

The CONTRACTOR shall receive and accept compensation, as herein provided, as full payment for furnishing all labor, tools, material, equipment and incidentals; for performing all work contemplated and embraced under the contract; for all loss or damage arising out of the nature of the work, or from the action of the elements; for any unforeseen defects or obstruction which may arise or be encountered during the prosecution of the work and before its final acceptance by the OWNER; for all risks of whatever description connected with the prosecution of the work; for all expense incurred by or in consequence of suspension or discontinuance of such prosecution of the work as herein specified; for any infringement of patents, trademarks or copyrights; and for completing the work in an acceptable manner according to the plans and specifications.

Unless otherwise provided in the Contract documents, the CONTRACTOR shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation and other facilities and services necessary for the proper execution and completion of the work, whether temporary or permanent and whether or not incorporated or to be incorporated into the work.

108.5.C. Severability

In the event a term, condition, or provision in this Contract is determined to be void, unenforceable, or unlawful by a court of competent jurisdiction, then that term, condition or provision, shall be deleted and the remainder of the Contract shall remain in full force and effect.

108.5.D. Successors and Assigns

Subject to the limitations upon assignment and transfer herein contained, this Contract shall be binding upon and inure to the benefit of the parties hereto, their respective successors and assigns.

108.6 OBLIGATION AND WORK PERFORMANCE

Any failure or neglect on the part of OWNER, Engineer or inspectors to enforce provisions herein dealing with supervision, control, inspection, testing or acceptance and approval of the work shall never operate to relieve CONTRACTOR from full compliance with the Contract documents nor render owner liable to CONTRACTOR for money damages, extensions of time or increased compensation of any kind.

In addition to those matters elsewhere expressly made the responsibility of the CONTRACTOR, the CONTRACTOR shall have the full and direct responsibility for the performance and completion of the work under this Contract and for any act or neglect of the CONTRACTOR, its agents, employees or subcontractors. CONTRACTOR shall bear all losses, if any, resulting on account of the amount and character of the work, or because the conditions under which the work must be done are different from what CONTRACTOR estimated or anticipated, or because of weather, floods, elements or other causes.

108.7 EQUAL EMPLOYMENT OPPORTUNITY

During the performance of this Contract the CONTRACTOR agrees to nondiscrimination of employment practices.

108.7.A. Nondiscrimination Toward Employees

The CONTRACTOR shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, age or national origin. The CONTRACTOR shall take affirmative action to insure that applicants are employed and that employees are treated equally during employment without regard to their race, color, sex, religion, age or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination, rates of pay or other forms of compensation; and selection for training, including apprenticeship. The CONTRACTOR agrees to post in conspicuous places, available to employees or applicants for employment,

notices to be provided setting forth the provisions of this nondiscrimination clause. The CONTRACTOR shall, in all solicitations or advertisements for employees placed by or on behalf of the CONTRACTOR; state that all qualified applicants shall receive consideration for employment without regard to race, color, religion, sex, national origin or age. The CONTRACTOR shall include the provisions of this section in all subcontracts pertaining to the work.

108.7.B. Labor Unions

The CONTRACTOR shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a notice to be provided, advising the said labor union or workers' representatives of the CONTRACTOR'S commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

108.8 STATE AND LOCAL SALES TAXES

The OWNER qualifies for exemption from the state and local sales and use taxes, pursuant to the provisions of the Texas Limited Sales, Excise and Use Tax Act. Therefore, the CONTRACTOR shall not pay such taxes which would otherwise be payable in connection with the performance of this Contract.

The CONTRACTOR shall issue an exemption certificate in lieu of the tax on the purchase of all materials, supplies, equipment and other tangible personal property incorporated into the real property being improved; and all materials, supplies and other tangible personal property, other than machinery, or equipment and its accessories, and repair and replacement parts, necessary and essential for the performance of the Contract with the OWNER which is to be completely consumed at the job site.

Tangible personal property necessary and essential for the performance of the Contract includes only such materials, tools and supplies specifically needed and directly used to incorporate tangible personal property into the real estate being improved under the Contract. Overhead supplies and supplies used indirectly or only incidental to the performance of the Contract with the OWNER are not included in the exemption. Tangible personal property is "completely consumed" if after being used once for its intended purpose it is used up or destroyed. Any exemption certificate issued by the CONTRACTOR is subject to the existing rules and interpretation governing the exemption issued by the Comptroller of Public Accounts of the State of Texas. The OWNER will not make interpretations of the extent or applicability of the exemption in a particular case; if the CONTRACTOR, or any subcontractor or supplier of the CONTRACTOR, has any questions about the extent or applicability of the exemption in specific circumstances, guidance should be sought from the State Comptroller's Office. Under "reasons said purchaser is claiming this exemption" in the exemption certificate, the CONTRACTOR must name the OWNER and the project for which the equipment, material and supplies are being purchased, leased or rented.

The Contract Amount shall be final and be deemed to include all taxes payable (unless exempt as indicated above) in connection with the Work. CONTRACTOR may not issue a separate amount to OWNER indicating this to be the correct amount including all taxes and/or fees.

108.9 PATENTS

The CONTRACTOR shall pay all royalties and license fees and shall provide, by suitable legal agreement with the patentee or OWNER, for the use of any design, device, material or process covered by letters, patent or any copyright. The CONTRACTOR shall indemnify, defend, hold and save the OWNER and its officers, employees and agents harmless from all liability and claims for infringement of any patent or copyright. In the event that any claims, suit or action at law or in equity of any kind whatsoever is brought against the OWNER, or its officers, employees or agents involving any such patents, copyrights or license rights, then the OWNER shall have the right to and may retain from any money due or to become due to the CONTRACTOR such sum deemed necessary by the OWNER for its protection until such claim or suit shall have been settled and satisfactory evidence to that effect shall have been furnished the OWNER.

108.10 COMPLIANCE WITH LAWS

The CONTRACTOR shall fully comply with all local, state and federal laws, including all codes, ordinances and regulations applicable to this Contract and the work to be done thereunder, which exist or which may be enacted later by governmental bodies having jurisdiction or authority for such enactment.

108.10.A. Permits

The CONTRACTOR shall secure and pay for all permits and licenses necessary for the execution of the work and shall fully comply with all their terms and conditions. All work required under this Contract shall comply with all requirements of law, regulation, permit or license. If the CONTRACTOR finds that there is a variance, it shall immediately report this to the OWNER for resolution.

108.10.B. Pleas of Misunderstanding

No pleas of misunderstanding or ignorance thereof will be considered. The CONTRACTOR and the CONTRACTOR's Sureties shall indemnify and save harmless the OWNER against any claims or liability arising from or based on the violation of any such law, ordinance, regulation or order whether by the CONTRACTOR, employees, or Subcontractors. The OWNER shall not be liable for interest on any progress or final payment to be made under this Contract, except as may be provided by the applicable provisions of the Prompt Payment Act, Chapter 2251, Texas Government Code.

108.10.C. Jobsite Notice

Contractor shall post at the Project site, in a conspicuous place, any notices required by law to be posted there, and any notices required by the Owner in writing to be posted there, including the following notices required to be posted by Owner:

1. Workers' Compensation Notice:

NOTICE OF REQUIRED WORKERS' COMPENSATION COVERAGE
(Contractor Must Post at Project Site)

REQUIRED WORKERS' COMPENSATION COVERAGE

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

"Call the Texas Workers' Compensation Commission at 512-440-3789 to receive information on the legal requirement for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

REQUISITOS SOBRE COBERTURA DE COMPENSACIÓN

"La ley requiere que todas las personas que trabajan en esta localidad o proporcionan servicios relacionados con este proyecto de construcción estén cubiertos por seguro de compensación. Esto incluye personas que proporcionan, transportan, o entregan equipo o materiales, o proporcionan trabajo o transportación y otros servicios relacionados a el proyecto, cualquiera que sea la identidad de su patrón o su situación como empleado."

"Llame a la Comisión Tejana de Compensación a Trabajadores (Texas Workers' Compensation Commission), marcando el 512-440-3789 para recibir información de los requisitos legales sobre cobertura de seguros, para verificar si su patrón ha proporcionado la cobertura requerida, o para reportarlo, sin no lo ha hecho."

2. Notice of City of Marble Falls Safety Rules:

CITY OF MARBLE FALLS SAFETY RULES

The following City of Marble Falls safety rules must be followed at all times:

- 1. The possession or use of tobacco products, alcoholic beverages, illegal drugs, and firearms or weapons on Owner's property is prohibited at all times, twenty-four hours a day. There shall be zero tolerance for violations of this provision.**
- 2. Contractor, subcontractors and all other persons performing Work at the Project site shall use only such access to the site and facilities as are designated by Owner, and shall comply with all other rules and requirements established by Owner for use or occupancy of the Project site. In addition, Contractor, and subcontractors shall be aware that there are construction and access easements existing on the Owner's property and upon the adjacent properties that govern coordination of construction activities. Contractor and subcontractors shall perform the Work in compliance with these easements at all times.**
- 3. Owner shall have the right to require the immediate removal from the Project site of any person performing Work who violates the provisions of these Safety Rules or who fails to comply with all other rules or requirements established by the City of Marble Falls for use or occupancy of the Project site. Owner may prohibit such person from being allowed to perform Work at the Project site in the future.**

108.11 PROTECTION OF WORK AND OF PERSONS AND PROPERTY

The CONTRACTOR shall have the responsibility to provide and maintain all safety measures and take all precautionary measures required by law or otherwise to protect persons and property while said persons or property are approaching, leaving or within the work site or any area adjacent to said work site.

It shall be the duty and responsibility of the Contractor and all of its subcontractors to be familiar with and comply with all requirements of Public Law 91-596, 29 U.S.C. §§ 651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto, and to enforce and comply with all applicable provisions of OSHA.

108.11.A. Sanitary Provisions

The CONTRACTOR shall establish and enforce among its employees such regulations in regard to cleanliness and disposal of garbage and waste as shall tend to prevent the inception and spread of infectious or contagious diseases and to prevent effectively the creation of a nuisance about the work on any property either public or private, and such regulations as are required by the OWNER shall be put into immediate force and effect by the CONTRACTOR. The necessary sanitary conveniences for the use of laborers on the work, properly secluded from public observation, shall be constructed and maintained by the CONTRACTOR in such a manner and at such points as shall be approved by the OWNER, and their use shall be strictly enforced by the CONTRACTOR. All sanitary laws and regulations of the State of Texas and the OWNER's jurisdiction shall be strictly complied with.

108.11.B. Public Convenience

Materials stored about the work site shall be so placed, and the work shall at all times be so conducted, as to cause no greater obstruction to the traveling public than is considered necessary by the OWNER. The CONTRACTOR shall make provisions by bridges or otherwise at all cross streets, highways, sidewalks and private driveways for the free passage of pedestrians and vehicles, provided that where bridging is impracticable or unnecessary, in the opinion of the OWNER, the CONTRACTOR may make arrangements satisfactory to the OWNER for the diversion of traffic and shall, at its own expense, provide all material and perform all work necessary for the construction and maintenance of roadways and bridges for the diversion of traffic. Sidewalks must not be obstructed except by special permission of the OWNER. The materials excavated, and the construction materials or plant used in the construction of the work, shall be placed so as not to

endanger the work or prevent free access to all fire hydrants, water valves, gas valves, manholes for the telephone, telegraph signal or electric conduits, sanitary sewers and fire alarm or police call boxes in the vicinity.

1. **Notice:** The OWNER reserves the right to remedy any neglect on the part of the CONTRACTOR as regards to the public convenience and safety which may come to its attention, after 24 hours' notice in writing to the CONTRACTOR, save in cases of emergency, when it shall have the right to remedy any neglect without notice; and in either case, the cost of such work done by the OWNER shall be deducted from the monies due or to become due the CONTRACTOR. The CONTRACTOR shall notify the OWNER when any street is to be closed or obstructed; such notice shall in the case of major thoroughfares or streets upon which transit lines operate be made 48 hours in advance. The CONTRACTOR shall, when directed by the OWNER, keep any street or streets in condition for unobstructed use by emergency services. Where the CONTRACTOR is required to construct temporary bridges or to make other arrangements for crossing over ditches or streams, its responsibility for accidents shall include the roadway approaches as well as the structures of such crossings.
2. **Right of Way:** Where the work passes over or through private property, the OWNER shall provide such right-of-way. The CONTRACTOR shall notify the proper representatives of any public utility, corporation, any company or individual, not less than 48 hours in advance of any work which might damage or interfere with the operation of property along or adjacent to the work. The CONTRACTOR shall be responsible for all damage or injury to property of any character (except such as may be required by the provisions of the Contract documents or caused by agents or employees of the OWNER) by reason of any negligent act or omission on the part of the CONTRACTOR, its employees, agents or subcontractors, or at any time due to defective work or materials, or due to its failure to reasonably or properly prosecute the work, and said responsibility shall not be released by the fact that the work shall have been completed and accepted.

108.11.C. Protection of Work

During performance and up to date of final acceptance, the CONTRACTOR shall be under the absolute obligation to protect the finished work against any damage, loss or injury. In the event of such damage, loss or injury, the CONTRACTOR shall promptly replace or repair such work, whichever the OWNER shall determine to be preferable. The obligation to deliver finished work in strict accordance with the Contract prior to final acceptance shall be absolute and shall not be affected by the OWNER's approval of or failure to prohibit means and methods of construction used by the CONTRACTOR. All risk of loss or damage to the work shall be borne solely by the CONTRACTOR until final completion and acceptance of all work by the OWNER, as evidenced by the OWNER's issuance of a certificate of acceptance.

108.11.D. Protection of Persons

The CONTRACTOR shall have the responsibility to provide and maintain all warning devices and take all precautionary measures required by law or otherwise to protect persons and property while said persons or property are approaching, leaving or within the work site or any area adjacent to said work site. Compensation shall be paid to the CONTRACTOR for the installation or maintenance of any warning devices, barricades, lights, signs or any other precautionary measures required by law or otherwise for the protection of persons or property according to item for Barriers and Warning and or Detour Signs.

The CONTRACTOR shall assume all duties owed by the OWNER to the general public in connection with the general public's immediate approach to and travel through the work site and the area adjacent to said work site. Where the work is carried on, in or adjacent to any street, alley, sidewalk, public right-of-way or public place, the CONTRACTOR shall at its own cost and expense provide such flagmen and watchmen in addition to its responsibility to furnish, erect and maintain such warning devices, barricades, lights, signs, and other precautionary measures for the protection of persons or property as are required by law.

During periods when schools are in session, the CONTRACTOR will be required during the construction of the Work to maintain a suitable all-weather footpath across the Work at all designated school crosswalks and to move and reinstall pedestrian crossing warning signs as construction and routing of traffic lanes require.

The CONTRACTOR's responsibility for providing and maintaining flagmen, watchmen, warning devices, barricades, signs, and lights, and other precautionary measures shall not cease until directed in

writing by the OWNER or until final payment, whichever occurs first. If the OWNER discovers that the CONTRACTOR has failed to comply with the applicable federal and state law by failing to furnish the necessary flagmen, warning devices, barricades, lights, signs or other precautionary measures for the protection of persons or property, the OWNER may order such additional precautionary measures as required by law to be taken to protect persons and property. The CONTRACTOR shall reimburse the OWNER for any expense incurred by the OWNER in taking any additional precautionary measures as a result of the CONTRACTOR's failure to do so.

108.11.E. Protection of Property

The CONTRACTOR will be held responsible for all damage to the work and other public or private property due to the failure of warning devices, barricades, signs, lights, or other precautionary measures in protecting said property, and whenever evidence is found of such damage, the Engineer may order the damaged portion immediately removed and replaced by and at the cost and expense of the CONTRACTOR. Minimum standards for safeguarding pedestrian and vehicular traffic are contained in the current Texas Manual of Uniform Traffic Control Devices, as amended, Texas Department of Transportation. Signage, barricades and other traffic control devices for detouring and maintenance of traffic on this Contract shall be as provided in above said manual and as directed by the Engineer. Costs associated with the acquisition and removal of required traffic control devices shall be considered incidental to the Work.

108.11.F. Trench Safety Regulations

The CONTRACTOR shall be responsible for complying with state laws and federal regulations relating to trench safety, including those which may be enacted during the performance under this Contract. The CONTRACTOR is advised that Federal Regulations 29 C.F.R. 1926.650-1926.652 have been, in their most recent version as amended, in effect since January 2, 1990. THE CONTRACTOR SHALL FULLY COMPLY WITH THE U. S. DEPARTMENT OF LABOR OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) REGULATIONS PERTAINING TO EXCAVATIONS, TRENCHING, AND SHORING AND SHALL PROVIDE AND FAMILIARIZE ITS EMPLOYEES INVOLVED IN EXCAVATION AND TRENCHING WITH THE PROVISIONS IN OSHA PAMPHLET NUMBER 2226, EXCAVATING AND TRENCHING OPERATIONS.

1. **Indemnification:** CONTRACTOR AGREES TO DEFEND, INDEMNIFY AND HOLD OWNER, ITS OFFICERS, SERVANTS, AGENTS AND EMPLOYEES, COMPLETELY HARMLESS FROM ANY CLAIMS, LAWSUITS, JUDGMENTS, COSTS AND EXPENSES (INCLUDING ATTORNEY'S FEES, IF ANY) FOR ANY PERSONAL INJURY (INCLUDING DEATH), PROPERTY DAMAGE OR OTHER HARM FOR WHICH RECOVERY OF DAMAGES IS SOUGHT (INCLUDING ANY INJURY, DEATH OR DAMAGE SUFFERED BY THE CONTRACTOR'S OWN EMPLOYEES) ARISING OUT OF OR OCCASIONED BY THE USE OF ANY TRENCH EXCAVATION PLANS, REGARDLESS OF THEIR ORIGIN, OR BY ANY NEGLIGENT, GROSSLY NEGLIGENT, STRICTLY LIABLE OR INTENTIONAL ACT OF THE CONTRACTOR, A SUBCONTRACTOR OR ANY INDIVIDUAL EMPLOYEE OR LABORER (WHETHER OR NOT AN EMPLOYEE OF THE CONTRACTOR OR A SUBCONTRACTOR) IN THE PERFORMANCE OR SUPERVISION OF ACTUAL TRENCH EXCAVATION UNDER THE CONTRACT. THIS INDEMNITY APPLIES REGARDLESS OF WHETHER OWNER'S OR CONSULTING ENGINEER'S NEGLIGENCE OR FAULT IN THE ADMINISTRATION OF THIS CONTRACT OR IN THE PREPARATION, REVIEW OR APPROVAL OF THE OWNER'S OR CONTRACTOR'S TRENCH EXCAVATION PLAN CONTRIBUTED TO THE INJURY, DEATH OR DAMAGE. OWNER ACCEPTS NO LIABILITY WHATSOEVER AS A RESULT OF ITS PREPARATION, REVIEW OR APPROVAL OF ANY TRENCH EXCAVATION PLAN UNDER THIS CONTRACT. OWNER MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE ADEQUACY OR CORRECTNESS OF ANY TRENCH EXCAVATION PLAN. (THE PROVISIONS OF THIS PARAGRAPH ARE SOLELY FOR THE BENEFIT OF THE PARTIES TO THE CONTRACT AND ARE NOT INTENDED TO CREATE OR GRANT ANY RIGHTS, CONTRACTUAL OR OTHERWISE, TO ANY OTHER PERSON OR ENTITY. THIS PARAGRAPH SHALL NOT BE CONSTRUED TO WAIVE ANY GOVERNMENTAL IMMUNITY OF THE OWNER. THIS PARAGRAPH CONTROLS IN THE EVENT OF A CONFLICT WITH ANY OTHER INDEMNITY OR OWNER-WARRANTY PROVISION IN THE SPECIFICATIONS).
2. **Trench Safety Plan:** CONTRACTOR shall be responsible for providing to the OWNER an acceptable trench safety plan signed and sealed by a Professional Engineer qualified to do such work and

licensed/registered in the State of Texas. The CONTRACTOR shall be responsible for selecting an appropriate method of providing trench safety after due consideration of the job conditions, location of utilities, pavement conditions and other relevant factors. Slope-back methods which may result in unnecessary displacement of utilities and/or destruction of pavement shall not be used without permission from the OWNER. Plans for devices used to provide trench safety such as trench shields and shoring systems will be likewise certified by professional engineers licensed/registered in the State of Texas or by a professional engineer licensed/registered in the state of manufacture of the shield or shoring system.

3. **Explosives:** When required by the plans, or as requested, CONTRACTOR shall provide a written blasting plan. The OWNER retains the right to reject the blasting plan. CONTRACTOR shall store all explosives securely and clearly mark all storage places with "DANGER – EXPLOSIVES." Store, handle, and use explosives and highly flammable material in compliance with federal, state, and local laws, ordinances, and regulations. Assume liability for property damage, injury, or death resulting from the use of explosives. Contractor shall give at least a 48-hr. advance notice to the appropriate Roadmaster before doing any blasting work involving the use of electric blasting caps within 200 ft. of any railroad track.

108.11.G. Shoring and Sheeting

The sides of all excavation shall be supported in accordance with the trench safety plan. Where bracing or sheeting and shoring are used, the trench width shall be increased accordingly, shall be considered as incidental work, and shall not be paid for as a separate item. All sheeting, shoring, and bracing shall have sufficient strength and rigidity to withstand the pressure exerted, to maintain the sides of the excavation properly in place, and to protect all persons or property from injury or damage. When excavations are made adjacent to existing buildings or other structures or in paved streets, particular care shall be taken to adequately sheet, shore, and brace the sides of the excavation to prevent undermining of or settlement beneath the structures or pavement. Underpinning of adjacent structures or pavement shall be done at the CONTRACTOR'S own cost and expense and in a manner satisfactory to the OWNER, or, when required by the OWNER, the pavement shall be removed, the void(s) satisfactorily filled, compacted, and the pavement replaced by the CONTRACTOR. The entire expense of such removal and subsequent replacement thereof shall be borne by the CONTRACTOR. Wooden sheeting, shoring, and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill, if directed by the OWNER.

The removal of all sheeting, shoring, and bracing shall be done in such manner as not to endanger or damage either new or existing structure, or private or public properties, and so as to avoid cave-ins or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring, or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the CONTRACTOR, with the approval of the OWNER, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place.

108.11.H. Trenching Inspection

The CONTRACTOR shall cause all shoring or bracing to be inspected by an OSHA competent person. According to OSHA regulations, a competent person is defined as one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

108.11.I. Payment of Special Trenching

Payment for trench safety shall be by the lineal feet (L.F.) of trench exceeding a depth of 5-ft. unless otherwise specified in the Contract. Excavation for slope-back methods shall be subsidiary to the trench safety pay item including replacement and re-compaction. Excess excavation for other trench safety methods is also subsidiary to the trench safety pay item. Costs relating to the preparation of the trench safety plan including geotechnical investigation, testing and report preparation fees are all subsidiary to the pay item for trench safety. Should trench safety measures be required during Contract performance where no pay item has been provided, then the CONTRACTOR shall immediately notify the OWNER and, if directed to do so, provide trench safety under the

provisions of Item for Extra Work and/or Item for Payment of Extra Work. Should the OWNER fail to authorize the work as provided for in aforementioned items, then the CONTRACTOR shall proceed under the provisions of item for Claims for Additional Compensation, and item for Performance of Extra or Disputed Work. Trench safety requirements are mandatory and shall not be waived. Payment for special shoring, if any, shall be based on the square feet (S.F.) of shoring used.

108.11.J. Soil Borings

Soil Borings are to be used for information only and are not warranted accurate in any way. The OWNER accepts no responsibility for any deviation from or variance in soil types and/or depths shown on the borings.

108.12 WORKING AREA

The CONTRACTOR shall confine its equipment, storage of materials and construction operations to the area shown on the Contract drawings or stated in the specifications, prescribed by ordinance, laws, or permits or as may be directed by the OWNER, and shall not unreasonably encumber the site or public right-of-way with its construction equipment, plant or materials. Such area shall not be deemed for the exclusive use of the CONTRACTOR. Other contractors of the OWNER may enter upon and use such portions of the area and for such items as determined by the OWNER are necessary for all purposes required by its contracts. The CONTRACTOR shall give to such other contractors all reasonable facilities and assistance to the end that the work on this and other contracts shall not be unduly or unreasonably delayed. Any additional areas desired by the CONTRACTOR for its use shall be provided at its own effort, cost and expense.

108.12.A. Project Signs

Project signs shall be furnished, constructed, and erected by the CONTRACTOR as directed by the OWNER. Signs shall be placed in a location selected by the OWNER and maintained in good condition until the completion of the project. Project signs shall be removed by the CONTRACTOR upon the completion and acceptance of the project by the OWNER.

108.12.B. Railway Crossings

Where the work encroaches upon any right-of-way of any railway, the OWNER shall secure the necessary easement for the work. Where railway tracks are to be crossed, the CONTRACTOR shall observe all the regulations and instructions of the railway company as to methods of doing the work or precautions for safety of property and the public. All negotiations with the railway company, except for right-of-way, shall be made by the CONTRACTOR. The railway company shall be notified by the CONTRACTOR not less than five days prior to commencing the work. The CONTRACTOR shall not be paid separate compensation for such railway crossing but shall receive only the compensation as set out in the proposal. Prior to crossing or working on Railroad Right-of-Way, the CONTRACTOR will be required to contact the railroad company, or companies, and to execute CONTRACTOR's Agreements as may be required by each railroad company involved. No work shall be permitted where railroads are involved until the Engineer is furnished sufficient correspondence from the railroad company involved to ascertain that either the agreement has been executed and a certified copy of the insurance policy furnished, or that no such action is required.

108.13 EXISTING STRUCTURES AND APPURTENANCES

This item addresses only matters arising from certain existing, man-made surface and subsurface structures, facilities and appurtenances, not naturally occurring conditions. AS PROVIDED IN ITEM FOR CONTRACTOR'S WARRANTIES AND UNDERSTANDING, THE OWNER SHALL HAVE NO LIABILITY WHATSOEVER FOR ANY CLAIM ARISING FROM A DIFFERING, NATURALLY OCCURRING SURFACE OR SUBSURFACE CONDITION, OR FROM ANY MAN-MADE CONDITION THAT IS NOT A SURFACE OR SUBSURFACE STRUCTURE, FACILITY OR APPURTENANCE. The OWNER'S responsibility for any claim arising from existing, man-made surface and subsurface structures, facilities and appurtenances is governed solely by this item., and any situation involving a differing subsurface condition not included herein shall be governed solely by Item for Contractor's Warranties and Understanding.

108.13.A. Locations

The plans show the general locations of all known, existing man-made surface and subsurface structures, facilities and appurtenances. The locations of many gas mains, water and wastewater mains, storm sewers, drains, culverts, conduits and other man-made utility structures, facilities and appurtenances, however, are unknown. Notwithstanding any other provisions of the Contract, the Contractor shall be solely responsible for location and protection of any and all public lines and utility customer service lines in the Work area. Failure of a utility to be indicated does not relieve the Contractor of responsibility to protect utility lines encountered. The Contractor shall notify "One Call" (1-800-344-8377, or 811), and exercise due care to locate and to mark, uncover or otherwise protect all such lines within the limits of construction and any of the Contractor's work or storage areas.

THE OWNER DOES NOT WARRANT THE PLANS TO SHOW THE EXACT LOCATIONS OF ANY AND ALL KNOWN, EXISTING MAN-MADE SURFACE AND SUBSURFACE STRUCTURES, FACILITIES AND APPURTENANCES, AND DOES NOT WARRANT THAT IT KNOWS OF THE EXISTENCE OF ALL POSSIBLE EXISTING MAN-MADE SURFACE AND SUBSURFACE STRUCTURES, FACILITIES AND APPURTENANCES. The OWNER assumes no responsibility, except as provided below, for any failure to show any or all of these structures on the plans or to show them in their exact locations.

The OWNER may conduct certain test borings to be made on the site and indicated on the plans such information, or any information pertaining to the character or depth of materials is found from observations, records or otherwise. The action of the OWNER in revealing such information shall not in any manner be construed as a warranty on the part of the OWNER of the exact nature of the subsurface conditions that shall be encountered during construction of the work. Although the information is shown as accurately as possible, the OWNER does not guarantee that any materials to be encountered at any point or points are even approximately the same, either in character or elevations, as those shown on the plans. The information thus furnished by the OWNER is intended only as a guide to the CONTRACTOR's own investigations preliminary to submitting a bid for the work.

108.13.B. Conditions for to Work or Payment Increases

The CONTRACTOR and OWNER mutually, expressly agree that the failure of the OWNER to show any existing, man-made surface or subsurface structure, facility or appurtenance on the plans, or the failure to show them on the plans in their exact locations, shall not be considered as a basis of a claim for Extra Work, damages or other compensation of any kind, nor shall it be considered as a basis for increasing the quantities of work or unit prices on any bid item, unless:

1. The CONTRACTOR could not have discovered the existing, man-made surface or subsurface structure, facility or appurtenance by a reasonable review of the plans and specifications and a reasonable, careful inspection of the work site prior to bid opening or award of the Contract.
2. The existing, man-made surface or subsurface structure, facility or appurtenance is in a location that necessitates a substantial change in the alignment, depth or hydraulic gradient of the work to be constructed under the Contract because the CONTRACTOR cannot, by the use of reasonable skill or care, place the work in accordance with the original alignment, depth or hydraulic gradient.
3. The existing surface or subsurface structure, facility or appurtenance requires the construction of a special structure, facility, appurtenance or other special work, provisions for which are not already made in the plans and specifications, to protect the existing man-made surface or subsurface structure, facility or appurtenance, or the work to be constructed under the Contract from damage.

If either of the above elements occurs, the provisions of the specifications regarding claims for Extra Work apply. Otherwise, the condition is considered part of the Contract work and OWNER shall not be liable for extra compensation. Provided, however, that the OWNER will not be liable for payment of Extra Work claims under this subsection that are not timely filed in accordance with other provisions of the specifications, nor shall the OWNER be liable to pay for any additional work or additional costs arising solely from a decision of the CONTRACTOR to change the original means or methods of construction chosen because an existing, man-made surface or subsurface structure, facility or appurtenance is encountered.

108.13.C. Utility Coordination and Protection

It is the intention of the OWNER that all known conflicts between utility-owned facilities and the proposed construction will be cleared prior to the issuance of the work order. Utility information shown on the plans must be confirmed by actual field check in advance of construction. It will be the CONTRACTOR'S responsibility to locate and report all utility conflicts to the Engineer promptly in order to avoid unnecessary delays, and the CONTRACTOR will cooperate with utility owners in making the adjustment(s). Conflicts that are found during construction will be resolved as expeditiously as possible. The CONTRACTOR will be required to protect adequately all utility-owned facilities from damage or displacement by its operations.

The adjustment or location of any utility-owned facility which the CONTRACTOR may desire for its own convenience or ease of construction will be its responsibility to coordinate and will be at its own expense.

108.13.D. Hazardous Materials

OWNER shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. OWNER shall not be responsible for any such materials brought to the site by CONTRACTOR, Subcontractor, Suppliers or anyone else for whom CONTRACTOR is responsible. Contractor agrees that it shall not transport to, use, generate, dispose of or install at the Project site any hazardous substance (as defined herein), except in accordance with applicable Environmental Laws. Further, in performing the Work, the Contractor shall not cause any release of hazardous substances into, or contamination of, the environment, including the soil, the atmosphere, any water course or ground water, except in accordance with applicable Environmental Laws.

Upon uncovering any such materials the CONTRACTOR shall immediately:

1. Stop all Work in connection with such hazardous condition and in any area affected thereby (except in an emergency as required by paragraph 6.23),
2. Notify OWNER and ENGINEER (and thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such hazardous condition or take corrective action, if any. CONTRACTOR shall not be required to resume Work in connection with such hazardous condition or in any such affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR special written notice specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or specifying any special conditions under which such Work may be resumed safely.

If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of such Work stoppage or such special conditions under which Work is agreed by CONTRACTOR to be resumed, either party may make a claim therefore as provided in the Contract Documents. If after receipt of such special written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order such portion of the Work that is in connection with such hazardous condition or in such affected area to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a claim therefor as provided in the Claims Section of these provisions. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others.

108.14 PROJECT CLEAN-UP

The CONTRACTOR shall be aware that keeping the project site in a neat and orderly condition is considered an integral part of the contracted work and as such shall be considered subsidiary to the appropriate bid items.

Clean up work shall be done as directed by the Engineer as the work progresses or as needed. If, in the opinion of the Engineer it is necessary, clean-up shall be done on a daily basis. Clean up work shall include, but not be limited to removing the trash, paper, rubbish and debris resulting from operations, sweeping streets clean of

dirt or debris, alleviating any dust nuisance in the work area, storing excess material in appropriate and organized manner and keeping trash of any kind off of residents' property.

If the Engineer does not feel that the jobsite has been kept in an orderly condition, on the next estimate payment (and all subsequent payments until completed) of the appropriate bid item(s) will be reduced by 25%. Upon completion of the work and before final acceptance and final payment shall be made, the CONTRACTOR shall completely clean and remove from the site of the work all equipment, construction materials, surplus and discarded materials, temporary structures and debris of every kind. CONTRACTOR shall leave the site of the work in a neat and orderly condition equal to that which originally existed, or as called for in the Contract documents. Surplus and waste materials removed from the site of the work shall be disposed of at locations satisfactory to the Engineer, and at the CONTRACTOR's sole cost.

108.14.A. Disposal of Materials

Surplus excavation and other materials removed as a part of the construction may be deposited at a legal disposal site in accordance with all applicable federal, state and local laws and regulations. In addition, if the materials are disposed of within private property, a release from the property owner must be obtained before final acceptance of the Work. Surplus excavation and other materials must not be deposited in areas designated as flood plain or along natural drainage ways. Material so deposited will be required to be removed at the CONTRACTOR'S expense and the area restored to its natural condition. Failure to comply promptly with the requirements of this special provision will result in withholding of payments due.

108.14.B. Restoration of Property

When and where any damage or injury is done to public or private property on the part of the CONTRACTOR, it shall restore or have restored at its own cost and expense such property to a condition equal (or improved) to that existing before such damage was done by repairing, rebuilding or otherwise restoring as may be directed, or it shall make good such damage or injury in a manner acceptable to the property owner or the Engineer. Replacement of previously constructed items, such as curb, gutter, sidewalks, driveways, paving, etc., shall conform to the specifications for new construction, unless directed otherwise by the OWNER. In case of failure on the part of the CONTRACTOR to restore such property or make good such damage or injury, the OWNER may, upon 48 hours' written notice, under ordinary circumstances, and without notice when a nuisance or hazardous condition results, proceed to repair, rebuild or otherwise restore such property as may be determined necessary, and the cost thereof shall be deducted from any monies due or to become due the CONTRACTOR under its Contract; or where sufficient Contract funds are unavailable for this purpose the CONTRACTOR or its surety shall reimburse the OWNER for all such costs.

109 PROSECUTION AND PROGRESS

109.1 INTRODUCTION

Before starting work, CONTRACTOR shall schedule and attend a preconstruction conference with the Engineer. Failure to schedule and attend a preconstruction conference is not grounds for delaying the beginning of working.

Unless otherwise shown in the Contract, begin work within 30 calendar days (7 calendar days for routine maintenance Contracts) after the authorization date to begin work as shown on the work order. It is the intent of this specification to provide a continuous construction operation without delay except as occasioned by unforeseeable causes beyond the control and without the fault or negligence of the CONTRACTOR, and it shall be the CONTRACTOR'S responsibility to execute the work in the most expeditious manner.

109.2 CONSTRUCTION SCHEDULE

The CONTRACTOR must submit to the OWNER, within ten days after the Effective Date of the Agreement, a detailed Construction Schedule outlining the major items of work on the project. This schedule must be approved as to form by the OWNER prior to CONTRACTOR starting work on the project. The schedule must be updated on a monthly basis. CONTRACTOR shall submit a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

If the schedule submitted is not to the OWNER's satisfaction, the CONTRACTOR shall have an additional five days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to CONTRACTOR until the schedules are submitted to and acceptable to ENGINEER as provided below. The progress schedule will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within any specified Milestones and the Contract Times, but such acceptance will neither impose on ENGINEER responsibility for the sequencing, scheduling or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefor. CONTRACTOR's schedule of Shop Drawing and Sample submissions will be made acceptable to ENGINEER as providing a workable arrangement for reviewing and processing the required submittals. CONTRACTOR's schedule of values will be acceptable to ENGINEER as to form and substance.

109.2.A. Stop Work

The OWNER has the authority to stop work on the project if the CONTRACTOR fails to provide an updated schedule as requested. The OWNER shall not be responsible for any delay as a result of the CONTRACTOR'S failure to submit the schedule in a timely manner.

109.2.B. Preconstruction Conference

Within twenty days after the Contract Times start to run, but before any Work at the site is started, OWNER shall schedule a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules, procedures for handling Shop Drawings and other submittals, processing Applications for Payment and maintaining required records.

109.3 PROSECUTION OF THE WORK

The CONTRACTOR shall begin the work to be performed under this Contract not later than 10 days from the date specified in the work order and shall conduct the work in such a manner and with sufficient equipment, material, and labor as is necessary to insure its completion within the working time.

Should the prosecution of the work be discontinued by the CONTRACTOR, the CONTRACTOR shall notify the OWNER at least twenty-four hours in advance of resuming operations. Work shall be done only during the hours between 7:00 am and 6:00 pm unless the OWNER approves other hours. Nighttime work is allowed only when shown on the plans or directed or allowed by the Engineer. Nighttime work is defined as work

performed from 30 min. after sunset to 30 min. before sunrise. CONTRACTOR may work on Saturdays if so desires and permission of the OWNER has been granted. Work on Sundays shall be permitted only with the written permission of the OWNER. If Saturday or Sunday work is permitted, working time shall be charged on the same basis as weekdays. Where the working time is expressed as calendar days or a specific date, the concept of working days shall no longer be relevant to the Contract. Work requiring inspection will not be permitted on a legal City holiday except by special written permission of the OWNER. Any work done without proper inspection is subject to removal and replacement at the direction of the OWNER.

109.4 OBLIGATION TO COOPERATE WITH OTHER CONTRACTORS

The OWNER may award other contracts for additional work on this project, and the CONTRACTOR shall fully cooperate with such other contractors and shall coordinate and fit its work to be done hereunder to such additional work as may be contracted by the OWNER. At the time of bidding, prospective bidders shall be advised of other planned contract work, which is expected to affect the work area. The CONTRACTOR shall not commit or permit any act, which shall interfere with the performance of work by any other contractor.

Upon receiving written notice from the CONTRACTOR that another contractor is failing to coordinate its work with the work under this Contract as directed by the OWNER, the OWNER shall promptly investigate the charge and take such necessary action as the situation may require.

However, the OWNER shall not be liable to the CONTRACTOR for damages suffered by the CONTRACTOR due to the fault or negligence of another contractor or through failure of another contractor to carry out the directions of the OWNER. Should any interference occur between contractors, the Engineer may furnish the CONTRACTOR with written instructions designating priority of effort or change in methods, whereupon the CONTRACTOR shall immediately comply with such direction. In such event, the CONTRACTOR shall be entitled to an extension of working time only for unavoidable delays verified by the Engineer; however, no increase in the Contract price shall be due the CONTRACTOR.

109.5 EMPLOYEES

The CONTRACTOR shall employ only competent, efficient workpeople and shall not use on the work any unfit person or one not skilled in the work assigned to him or her and shall at all times maintain good order among its employees. Whenever the OWNER shall inform the CONTRACTOR in writing that, in its opinion, any employee is unfit, unskilled, disobedient, or is disrupting the orderly progress of the work, such employee shall be removed from the work and shall not again be employed on it.

Under urgent circumstances, the OWNER may orally require immediate removal of an employee for cause, to be followed by written confirmation.

109.6 SUBCONTRACTS

The CONTRACTOR shall not make any subcontract for performing any portion of the work included in the CONTRACT without written notice to the OWNER. This CONTRACT having been made pursuant to the bid submitted by the CONTRACTOR and in reliance with the CONTRACTOR'S personal qualifications and responsibility, the OWNER reserves the right to withhold approval of any SUBCONTRACTOR, which the OWNER may deem would not be in the OWNER'S best interest.

The CONTRACTOR shall, as soon as practicable after signing the CONTRACT, submit a separate written notice to the OWNER identifying each proposed SUBCONTRACTOR. Upon request of the OWNER, the CONTRACTOR shall promptly furnish additional information tending to establish that any proposed SUBCONTRACTOR has the necessary facilities, skill, integrity, past experience and financial resources to perform the work in accordance with the terms and conditions of this CONTRACT.

Nothing contained in the Contract Documents shall create any contractual relation between Owner and any Subcontractor or supplier or any party with whom Owner or any of its Subcontractors or suppliers contracts.

Each subcontract agreement for a portion of the Work is hereby assigned by the Contractor to the Owner and the Surety; provided, however, that such assignment shall be effective as to Owner only after Owner's written

termination of the Contract or Contractor's right to proceed under terms of the Contract, and acceptance in writing by Owner of the particular subcontract.

109.5.A. Approval of Subcontractor

The CONTRACTOR must submit, with the request for approval of a SUBCONTRACTOR, the location, within the Highland Lakes area, of at least three contracts where the SUBCONTRACTOR has performed construction similar to the construction outlined in the CONTRACT. If required by the OWNER, the SUBCONTRACTOR'S representative will accompany the OWNER'S representative on examination of the referenced work. The CONTRACTOR must also submit to the OWNER a revised Schedule of Work and SUBCONTRACTOR/SUPPLIER Payment form anytime there is a change in the SUBCONTRACTOR/SUPPLIER participation on the CONTRACT.

109.5.B. Subcontractor Replacement

If the OWNER determines that any proposed SUBCONTRACTOR is unacceptable, it shall so notify the CONTRACTOR, who may thereupon submit another proposed SUBCONTRACTOR unless the CONTRACTOR decides to do the work itself. Disapproval by the OWNER of any proposed SUBCONTRACTOR shall not provide a basis for any time extension claim or additional compensation of any nature, including but not limited to anticipated profit, overhead, or delay, by the CONTRACTOR. If an approved SUBCONTRACTOR fails to perform properly the work undertaken, it shall be removed from the job upon request of the OWNER, following notification to the CONTRACTOR in writing of the request for removal and the reasons therefore. Each subcontract entered into shall provide that the provisions of this CONTRACT shall apply to all SUBCONTRACTORS and their officers and employees in all respects as if they were employees of the CONTRACTOR. The OWNER'S decision not to disapprove of any subcontract shall not relieve the CONTRACTOR of any of its responsibilities, duties, and liabilities hereunder. The CONTRACTOR shall be solely responsible for the acts, omissions, negligence, or defaults of its SUBCONTRACTORS and of such SUBCONTRACTOR'S officers, agents and employees, each of whom shall, for this purpose, be deemed to be the agent or employee of the CONTRACTOR to the extent of its subcontract.

The CONTRACTOR agrees to bind each SUBCONTRACTOR and each SUBCONTRACTOR agrees to be bound by the terms of the CONTRACT documents insofar as applicable to its respective work. The CONTRACTOR and each SUBCONTRACTOR jointly and severally agree that nothing in the CONTRACT documents or otherwise shall create or be deemed to create any rights in favor of a SUBCONTRACTOR against the OWNER; nor shall be deemed or construed to impose upon the OWNER any obligation, liability or duty to a SUBCONTRACTOR; or to create any contractual relation whatsoever between a SUBCONTRACTOR and the OWNER.

The provisions contained herein shall likewise apply to any sub-subcontracts.

109.5.C. Sub-Contractual Relations

The CONTRACTOR is solely responsible for making payments properly to his SUBCONTRACTORS and SUPPLIERS on the Project. During construction of the Project, the CONTRACTOR shall submit each month a CONTRACTOR'S Report of SUBCONTRACTOR/SUPPLIER Payment (the "Report"). The Report shall show all payments made to date by the CONTRACTOR (plus existing retainage) to each SUBCONTRACTOR and SUPPLIER involved in the Project. The Report shall be made on a form approved and supplied by the OWNER. As an alternative to the Report, the CONTRACTOR may furnish Affidavits of Payment Received, which affidavits shall be executed by each SUBCONTRACTOR and SUPPLIER owed money and paid during the previous progress payment period for work or materials furnished on the Project. If, for any reason, the CONTRACTOR is withholding payment to a SUBCONTRACTOR or SUPPLIER due to a dispute or other problem with performance, the CONTRACTOR shall note on the Report form the amount withheld and that payment is in dispute. The OWNER may require the CONTRACTOR to document and verify the dispute or other problem in question. Receipt by the OWNER of the Report or Affidavits of Payment Received shall be a condition precedent to payment on any invoice or estimate.

The OWNER reserves the right in its sole discretion to withhold payment to the CONTRACTOR should it appear from the Report or other information furnished to the OWNER that the Report has not been properly completed.

109.5.D. Sub-Contractual Claims

When submitting a bid proposal, the CONTRACTOR thereby assigns to the City any and all claims for overcharges associated with this contract or any subcontracts directly or indirectly related to the work, which overcharges may arise under the Anti-Trust Laws of the United States, 15 U.S.C.A., Section 1, et seq (1973). The CONTRACTOR shall include in all his subcontracts a clause that requires his SUBCONTRACTORS to assign to the City all claims for overcharges on purchases and supplies, which may arise under the Anti-Trust Laws of the United States, 15 U.S.C.A., Section 1 et seq (1973). The CONTRACTOR shall require his SUBCONTRACTORS to execute a notarized assignment on or before the date of the City's approval of the respective SUBCONTRACTORS for the work, which assignment shall become a part of the prime contract and made a part hereof for all purposes.

The CONTRACTOR agrees to thoroughly review and analyze any claim for additional time, additional compensation, or other damages filed by a SUBCONTRACTOR, in good faith, as to its merits and amount. CONTRACTOR also agrees that it will not present or pass the claim through to the OWNER as if it were the CONTRACTOR'S claim, if the claim is subject to any valid legal or equitable defenses available to either OWNER or CONTRACTOR under the CONTRACT documents, the terms of the Subcontract, or applicable statutory or case law, which defenses include, but are not limited to, any and all notice and claim defenses arising under the Subcontract or the CONTRACT documents. If the SUBCONTRACTOR'S claim is subject to any valid legal or equitable defense under the CONTRACT documents, the Subcontract, or applicable statutory or case law, CONTRACTOR shall, as a condition precedent to the filing of any claim against the OWNER by virtue of any derivative liability of the OWNER under the CONTRACT documents or applicable law, defend against the invalid SUBCONTRACTOR claim in a court of competent jurisdiction, at CONTRACTOR'S sole cost and expense. Failure of CONTRACTOR to defend against invalid SUBCONTRACTOR claims as required in this paragraph shall constitute a complete and unequivocal waiver of any right of CONTRACTOR to seek reimbursement from OWNER. Further, if the CONTRACTOR fails to provide the defense required above, CONTRACTOR shall be obligated to indemnify and reimburse OWNER for all expenses and costs, including but not limited to attorney's fees and expert witness costs, incurred by OWNER in defending any lawsuit based upon a SUBCONTRACTOR claim, in which lawsuit a valid legal or equitable defense was available under the CONTRACT documents, the Subcontract or applicable statutory or case law.

109.6 ASSIGNMENTS

The CONTRACTOR shall not assign, transfer, convey, or otherwise dispose of this Contract, or its right to execute it, or its right, title or interest in it or any part thereof without the previous written consent of the Surety Company and the written approval of the OWNER. The CONTRACTOR shall not assign, either legally or equitably, by power of attorney or otherwise, any of the monies due or to become due under this Contract or its claim thereto without the prior written consent of the Surety company and the written approval of the OWNER. Nothing in this paragraph is intended to conflict with Texas Business and Commerce Code.

The approval of the OWNER of a particular assignment, transfer or conveyance shall not dispense with such approval to any further or other assignments. The approval by the OWNER of any assignment, transfer or conveyance shall not operate to release the CONTRACTOR or Surety hereunder from any of the Contract and bond obligations, and the CONTRACTOR shall be and remain fully responsible and liable for the defaults, negligent acts and omissions of its assignees, its agents and employees, as if they were its own. Should the prosecution of the work be discontinued by the CONTRACTOR, the CONTRACTOR shall notify the OWNER at least twenty-four hours in advance of resuming operations.

If the CONTRACTOR does, without the consent of the OWNER, assign, transfer, convey, or otherwise dispose of the contract or of the CONTRACTOR'S right, title or interest therein, or any part thereof to any person or persons, partnership, company, firm or corporation, or by bankruptcy, voluntary or involuntary, or by assignment under the insolvency laws of any state, attempt to dispose of the contract or make default in or abandon said contract, then the contract may, at the option of the OWNER, be revoked and annulled, unless the sureties shall successfully complete said contract, and any monies due or to become due under this contract shall be retained by the OWNER as liquidated damages for the reason that it would be Impracticable and difficult to fix the actual damage.

109.7 TEMPORARY WORK SUSPENSION

The OWNER shall have the right by written order to suspend the work temporarily, in whole or in part, whenever, in the judgment of the OWNER, such temporary suspension is required.

109.7.A. Reasons for Suspension

1. Because it is in the interest of the OWNER generally;
2. Due to government or judicial controls or orders which make performance of this CONTRACT temporarily impossible or illegal;
3. To coordinate the work of separate contractors at the job site;
4. To expedite the completion of a separate contract even though the completion of this particular CONTRACT may be thereby delayed;
5. Because of weather conditions unsuitable for performance of the work, including of designated ozone alerts as determined by the National Weather Bureau or other authorized agency; or
6. Because the CONTRACTOR is proceeding contrary to CONTRACT provisions or has failed to correct conditions considered unsafe for workers.
7. Because of certain events and activities occurring in proximity to the construction where it would be in the best interest of the public and the CONTRACTOR for such work to be suspended.

The written order of the OWNER to the CONTRACTOR shall state the reasons for suspending the work and the anticipated periods for such suspension. Upon receipt of the OWNER'S written order, the CONTRACTOR shall suspend the work covered by the order and shall take such means and precautions as may be necessary to properly protect the finished and partially finished work, the unused materials and uninstalled equipment, including the provision of suitable drainage about the work and the erection of temporary structures where necessary. The CONTRACTOR shall not suspend the work without written order from the OWNER and shall proceed with the work promptly when notified by the OWNER to resume operations.

109.7.B. No Additional Compensation

No additional compensation shall be paid to the CONTRACTOR for any suspension under Item for Reasons for Suspension, above or otherwise where same is caused by the fault of the CONTRACTOR. Where such temporary suspension is not due to the fault of the CONTRACTOR, or as a result of a designated Ozone Alert Period, it shall be entitled to:

1. an equitable extension of working time for the completion of the work, not to exceed the delay caused by such temporary suspension, as determined by the OWNER; and
2. the actual and necessary costs of properly protecting the finished and partially finished work, unused materials and uninstalled equipment during the period of the ordered suspension as determined by the OWNER as being beyond the CONTRACT requirements, such costs, if any, to be determined on the basis set forth in Item for Payment for Extra Work, herein; and
3. where the CONTRACTOR elects to move equipment from the job site and then return it to the site when the work is ordered resumed, the actual and necessary costs of these moves, in an amount determined by the OWNER under the provisions of Item of Payment for Extra Work; provided, however, no compensation shall be allowed if the equipment is moved to another construction project for the OWNER.
4. Where such temporary suspension is not due to the fault of the CONTRACTOR and is the result of a designated Ozone Alert Period, the CONTRACTOR shall be entitled to additional time as provided above, but is not entitled to additional compensation.

Other than the additional time and compensation stated above, CONTRACTOR shall not be entitled to any other time extension related to the suspension, nor any additional compensation in any way related to such suspension.

109.7.C. Emergency Contract Termination Clause

Whenever, because of a national emergency, so declared by the President of the United States, or other lawful authority, it shall be impossible for the CONTRACTOR to obtain all labor, materials, and equipment necessary for the prosecution of the work with reasonable continuity, the CONTRACTOR shall notify the OWNER. If the

OWNER cannot, after a reasonable time, help obtain priorities for the materials and equipment within a reasonable effort, then the Contract shall be considered as terminated, and the CONTRACTOR shall be entitled to payment for work performed that is acceptable to OWNER based upon unit prices contained in the bid or, if the Contract is lump sum, then based upon the schedule of values submitted by the CONTRACTOR. CONTRACTOR shall not be entitled to any compensation for anticipated profit, overhead, delay damages or any other compensation for work that has not been performed.

109.8 DELAYS AND LIQUIDATED DAMAGES

The CONTRACTOR may be entitled to an extension of working time under this CONTRACT only when all details supporting the claims for such extension are submitted to the OWNER in writing by the CONTRACTOR within fourteen (14) days from and after the time when any alleged cause of delay shall occur, and then only when such time is approved by the OWNER. The CONTRACTOR shall notify the OWNER immediately upon encountering any condition that the CONTRACTOR believes may cause a claim for a time extension. In adjusting the CONTRACT time for the completion of the project, unforeseeable causes beyond the control and without the fault or negligence of the CONTRACTOR, including but not restricted to inability to obtain supplies and materials when orders for such supplies and materials were timely made and materials are not available from other sources, acts of God or the public enemy, acts of the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather conditions, ozone alerts as determined by the National Weather Bureau or other authorized agency, or delays of SUBCONTRACTORS due to such causes beyond their control shall be taken into consideration.

If the satisfactory execution and completion of the CONTRACT should require work and materials in greater amounts or quantities than those set forth in the CONTRACT, requiring more time for completion than the anticipated time, then the CONTRACT time may be equitably increased, but not more than in the same proportion as the cost of the additional work bears to the cost of the original work contracted for. No allowances shall be made for delays or suspension of the performance of the work due to the fault of the CONTRACTOR.

109.8.A. Delays

No adjustment of the CONTRACT time shall be made if, concurrently with the equitable cause for delay, hindrance, disruption, force majeure, impact, or interference, there existed a cause for delay due to the fault or negligence of the CONTRACTOR or CONTRACTOR'S agents, employees or SUBCONTRACTORS. Notwithstanding any other provisions of the CONTRACT Documents, including the General and Special Provisions, no adjustment shall be made to the CONTRACT price and the CONTRACTOR may not be entitled to claim or receive any additional compensation as a result of or arising out of any delay, hindrance, disruption, force majeure, impact or interference, foreseen or unforeseen, resulting in adjustment of the CONTRACT time, including but not limited to those caused in whole or in part by the acts, omissions, failures, negligence or fault of the OWNER, its officers, servants or employees. Delays; Extension of Time; Liquidated Damages, and no act of the OWNER shall be deemed a waiver or entitlement of such extension.

109.8.B. Liquidated Damages

For each day that any work shall remain uncompleted after the time specified in the proposal and the Contract, or the increased time granted by the OWNER, or as equitably increased by additional work or materials ordered after the Contract is signed, the sum per day given in the Schedule 009.8.B.1 **Liquidated Damages**, unless otherwise specified in the special provisions, shall be deducted from the monies due the CONTRACTOR.

Schedule 109.8.B.1 Liquidated Damages

Amount of Contract (\$)	Amount of Liquidated Damages (\$)
Less than 25,000	100 Per Day
25,000 to 99,999.99	160 Per Day
100,000 to 999,999.99	240 Per Day
1,000,000 or More	500 Per Day

The sum of money thus deducted for such delay, failure or non-completion is not to be considered as a penalty, but shall be deemed, taken and treated as reasonable liquidated damages, per day that the CONTRACTOR shall be in default after the time stipulated in the Contract for completing the work. The said amounts are fixed and agreed upon by and between OWNER and CONTRACTOR because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER in such event would sustain; and said amounts are agreed to be the amount of damages which the OWNER would sustain and which shall be retained from the monies due, or that may become due, the CONTRACTOR under this Contract; and if said monies be insufficient to cover the amount owing, then the CONTRACTOR or its surety shall pay any additional amounts due. In the event that the actual damages incurred by the OWNER exceed the amount of liquidated damages, OWNER shall be entitled to recover its actual damages.

109.9 CONTRACTOR DEFAULT

The work or any portion of the work under this Contract shall be suspended immediately on written order of the OWNER declaring the CONTRACTOR to be in default. A copy of such notice shall be served on the CONTRACTOR's surety. The Contract may be terminated by the OWNER for any good cause or causes, among others of which special reference is made to either the following:

1. Failure of the CONTRACTOR to start the work within 10 days from date specified in the written work order issued by the OWNER to begin the work.
2. Substantial evidence that the progress of the work being made by the CONTRACTOR is insufficient to complete the work within the specified working time.
3. Failure of the CONTRACTOR to provide sufficient and proper equipment, materials or construction forces for properly executing the work.
4. Substantial evidence that the CONTRACTOR has abandoned the work or discontinued the performance of the work or any part thereof and failure to resume performance within a reasonable time after notice to do so.
5. Substantial evidence that the CONTRACTOR has become insolvent or bankrupt, or otherwise financially unable to carry on the work.
6. Deliberate failure on the part of the CONTRACTOR to observe any requirements of the Contract Documents or to comply with any orders given by the Engineer as provided for in the Contract Documents.
7. Failure of the CONTRACTOR to promptly make good any defects in materials or workmanship, or any defects of any nature, the correction of which has been directed in writing by the OWNER.
8. Substantial evidence of collusion for the purpose of illegally procuring a contract or perpetrating fraud on the OWNER in the construction of work under Contract.
9. Repeated and flagrant violations of safe working procedures.
10. The filing by the CONTRACTOR of litigation against the OWNER prior to final completion of the work.

When the work is suspended for any of the causes itemized above, or for any other cause or causes, the CONTRACTOR shall discontinue the work or such part thereof as the OWNER shall designate, whereupon the surety may either at its option assume the Contract or that portion thereof which the OWNER has ordered the CONTRACTOR to discontinue and perform the same or, with the written consent of the OWNER, sublet the same, provided, however, that the surety shall exercise its option within two weeks after the written notice to discontinue the work has been served upon the CONTRACTOR and upon the surety or its authorized agents. The surety in such event shall assume the CONTRACTOR's place in all respects and shall be paid by the OWNER for all work performed by it in accordance with the terms of the Contract, but in no event shall such payments exceed the Contract amount, regardless of the cost to the surety to complete the work.

109.9.A. Surety Compensation

All monies remaining due the CONTRACTOR at the time of its default shall thereupon become due and payable to the surety as the work progresses, subject to all terms of the Contract. In case the surety does not, within the hereinabove specified time, exercise its obligation to assume the Contract or that portion thereof which the OWNER has ordered the CONTRACTOR to discontinue, then the OWNER shall have the power to complete by contract or otherwise, as it may determine, the work herein described or such part thereof as it may deem necessary; and the CONTRACTOR hereto agrees that the OWNER shall have the right to take possession of or use

any or all of the materials, plant, tools, equipment, supplies and property of every kind provided by the CONTRACTOR for the purpose of its work and to procure other tools, equipment and materials for the completion of the same and to charge to the account of the CONTRACTOR the expense of said contract for labor, materials, tools, equipment and expenses incident thereto. The expense so charged shall be deducted by the OWNER out of such monies as may be due or may at any time thereafter become due the CONTRACTOR under and by virtue of the Contract or any part thereof.

109.9.B. New Contractor Selection

The OWNER shall not be required to obtain the lowest bid for the work of completing the contract, but the expenses to be deducted shall be the actual cost of such work. In case such expense is less than the sum which would have been payable under the Contract if the same had been completed by the CONTRACTOR, then in such case the OWNER may pay the CONTRACTOR the difference in the cost, provided that the CONTRACTOR shall not be entitled to any claim for damages or for loss of anticipated profits.

In case such expense shall exceed the amount which would have been payable under the Contract if the same had been completed by the CONTRACTOR, the CONTRACTOR and its surety shall pay the amount of the excess to the OWNER on notice from the OWNER for excess due including any costs incurred by the OWNER, such as inspection, legal fees and liquidated damages. When any particular part of the work is being carried on by the OWNER by contract or otherwise under the provisions of this section, the CONTRACTOR shall continue the remainder of the work in conformity with the terms of the Contract and in such manner as not to hinder or interfere with the performance of workmen employed as above provided by the OWNER or surety.

109.10 TERMINATION AND SUSPENSION

The performance of the work under this Contract may be terminated by the OWNER in whole or from time to time in part, in accordance with this section, whenever the OWNER shall determine that such termination is in the best interest of the OWNER.

109.10.A. Court Ordered Suspension

The CONTRACTOR shall suspend such part or parts of the work pursuant to a court order issued against the OWNER and shall not be entitled to additional compensation for anticipated profits, overhead, delay damage or any other form of compensation by virtue of such court order; neither shall the CONTRACTOR be liable to the OWNER in the event the work is suspended by such court order, unless such suspension is due to the fault or negligence of the CONTRACTOR.

109.10.B. Notice of Termination for Convenience

Any such termination shall be effected by serving a notice of termination to the CONTRACTOR specifying the extent to which performance of work under the Contract is terminated, and the date upon which such termination becomes effective. Further, it shall be deemed conclusively presumed and established that such termination is made with just cause as therein stated; and no proof in any claim, demand or suit shall be required of the OWNER regarding such discretionary action.

After receipt of a Notice of Termination, the Contractor shall cooperate fully with Owner in minimizing the cost to Owner of such termination and shall, as directed by the Contracting Officer, protect the Work accomplished and properties acquired for performance of the Work, terminate or cancel incomplete subcontracts and purchase orders, and dispose of surplus materials and other properties.

In the event of such a termination, the Contract Amount shall be equitably adjusted to a sum which shall fairly compensate the Contractor for all Work completed and for all costs incurred (net of salvage) in part performance of the incomplete portions of the Work and for all costs incurred in connection with the termination, but exclusive of profit on the incomplete portions of the Work. In no event shall such sum be less than the portion of the Contract Amount allotted to the completed portion of the Work.

109.10.C. Contractor Action

After receipt of a notice of termination, and except as otherwise directed by the OWNER, the CONTRACTOR shall:

1. **Stop Work:** Stop work under the CONTRACT on the date and to the extent specified in the notice of termination.
2. **No Further Orders:** Place no further orders or subcontracts for materials, services, or facilities except as may be necessary for completion of such portion the work under the CONTRACT as is not terminated.
3. **Deliver and Assign to OWNER:** At the OWNER'S written request, deliver and assign to OWNER, or any person or entity acting on the OWNER'S behalf, any or all subcontracts, purchase orders and options made by CONTRACTOR in the performance of the work, and deliver to the OWNER true and correct originals and copies of such CONTRACT Documents.
4. **Transfer Title to OWNER:** Transfer title to the OWNER and deliver in the manner, at the times, and to the extent, if any, directed by the OWNER:
 - a. **Deliver Fabricated or Un-fabricated Parts:** The fabricated or un-fabricated parts, work in process, completed work, supplies and other material produced as a part of, or acquired in connection with the performance of, the work terminated by the notice of termination; and
 - b. **Deliver Completed or Partially Completed Plans:** The completed or partially completed plans, drawings, information, and other property which, if the CONTRACT had been completed, would have been required to be furnished to the OWNER.
5. **Complete Performance:** Complete performance of such part of the work as shall not have been terminated by the notice of termination.
6. **Protect and Preserve Property:** Take such action as may be necessary, or as the OWNER may direct, for the protection and preservation of the property related to its CONTRACT which is in the possession of the CONTRACTOR and in which the OWNER has or may acquire an interest.

At a time not later than thirty (30) Calendar Days after the termination date specified in the notice of termination, the CONTRACTOR may submit to the OWNER a list, certified as to the quantity and quality, of any or all items of termination inventory not previously disposed of, exclusive of items the disposition of which has been directed or authorized by the OWNER. Not later than fifteen (15) Calendar Days thereafter, the OWNER shall accept title to such items and remove them or enter into a storage agreement covering the same, provided that the list submitted shall be subject to verification by the OWNER upon removal of the items, or, if the items are stored, within forty-five (45) Calendar Days from the date of submission of the list, and provided that any necessary adjustments to correct the list as submitted shall be made prior to final settlement.

109.10.D. Termination Claim

Within 60 days after notice of termination, the CONTRACTOR shall submit its termination claim to the Engineer in the form and with the certification prescribed by the Engineer. Unless one or more extensions in writing are granted by the Engineer upon request of the CONTRACTOR, made in writing within such 60-day period or authorized extension thereof, any and all such claims shall be conclusively deemed waived.

109.10.E. Claim and Action Against Owner

No claim against the OWNER under the Contract or for breach of the Contract or additional compensation for extra or disputed work shall be made or asserted against the OWNER under the Contract or in any court action except pursuant to the provisions of Item for Payment of Extra Work, Item for Disputed Work and Claims for Additional Compensation, and Item for Performance of Extra or Disputed Work, and unless the CONTRACTOR shall have strictly complied with all requirements relating to the giving of notice and information with respect to such claim as required under said sections.

109.10.F. Termination Compensation

Subject to the provisions of Item for Termination Claim, the CONTRACTOR and OWNER may agree upon the whole or any part of the amount or amounts to be paid to the CONTRACTOR by reason of the total or partial termination of work pursuant hereto, provided that such agreed amount or amounts shall never exceed the total

Contract price as reduced by the amount of payments otherwise made and as further reduced by the Contract price of work not terminated. The Contract shall be amended accordingly, and the CONTRACTOR shall be paid the agreed amount. No amount shall be due for lost or anticipated profits. Nothing in Item for Failure to Agree hereunder, prescribing the amount to be paid to the CONTRACTOR in the event of failure of the CONTRACTOR and the OWNER to agree upon the whole amount to be paid to the CONTRACTOR by reason of the termination of work pursuant to this section, shall be deemed to limit, restrict or otherwise determine or affect the amount or amounts which may be agreed upon to be paid to the CONTRACTOR pursuant to this paragraph.

109.10.G. Failure to Agree

In the event of the failure of the CONTRACTOR and the OWNER to agree, as provided in Item for Termination Compensation, upon the whole amount to be paid to the CONTRACTOR by reason of the termination of work pursuant to this section, the OWNER shall determine, on the basis of information available to it, the amount, if any, due to the CONTRACTOR by reason of the termination and shall pay to the CONTRACTOR the amounts determined. No amount shall be due for lost or anticipated profits.

109.10.H. Deductions

In arriving at the amount due the CONTRACTOR under this section, there shall be deducted:

1. All unliquidated advance or other payments on account theretofore made to the CONTRACTOR, applicable to the terminated portion of this Contract.
2. Any claim which the OWNER may have against the CONTRACTOR in connection with this Contract
3. The agreed price for or the proceeds of sale of any materials, supplies or other things kept by the CONTRACTOR or sold, pursuant to the provisions of this clause, and not otherwise recovered by or credited to the OWNER.

109.10.I. Adjustment

If the termination hereunder be partial prior to the settlement of the terminated portion of this Contract, the CONTRACTOR may file with the Engineer a request in writing for an equitable adjustment of the price or prices specified in the Contract relating to the continued portion of the Contract (the portion not terminated by the notice of termination), and such equitable adjustment as may be agreed upon shall be made in such price or prices; nothing contained herein, however, shall limit the right of the OWNER and the CONTRACTOR to agree upon the amount or amounts to be paid to the CONTRACTOR for the completion of the continued portion of the Contract when said Contract does not contain an established Contract price for such continued portion.

109.10.J. No Limitation of Rights

Nothing contained in this section shall limit or alter the rights, which the OWNER may have for termination of this Contract or any other right which OWNER may have for default or breach of Contract by CONTRACTOR.

109.11 USE OF COMPLETED PORTIONS OF WORK

The OWNER may, after written notice to the CONTRACTOR, and without incurring any liability for increased compensation to the CONTRACTOR, take over and use any completed portion of the work prior to the final completion and acceptance of the entire work included in the Contract, and notwithstanding that the time allowed for final completion has not expired. The CONTRACTOR shall not object to, nor interfere in any way with, such occupancy or use after receipt of the OWNER'S written notice. Immediately prior to such occupancy and use, the OWNER shall inspect such portion of the work to be taken over and shall furnish the CONTRACTOR a written statement of the work, if any, still to be done on such part. The CONTRACTOR shall promptly thereafter complete such unfinished work to permit occupancy and use on the date specified in the OWNER'S written order, unless the OWNER shall permit specific items of work to be finished after the occupancy and use by the OWNER.

The provisions in the paragraph above shall not apply to portions of roads, streets, bridges or detours upon which traffic is diverted to enable the continuation of the Contract work. Neither such usage, as performed under this section, nor the written statement of work still to be done shall be held in any way an acceptance of

said work or structure or any part thereof, nor as a waiver of any of the provisions of these specifications or other Contract Documents pending final completion and acceptance of the work; all necessary repairs and removals of any section of the work so put into use, due to the defective materials or workmanship or to operations of the CONTRACTOR, shall be performed by the CONTRACTOR at its own expense. In the event the CONTRACTOR is unreasonably delayed by the OWNER exercising its rights under this section, the CONTRACTOR may submit a request for an extension of time under Item for Delays; Extension of Time; Liquidated Damages; no additional compensation or delay damages will be paid.

110 MEASUREMENT AND PAYMENT

110.1 INTRODUCTION

The Engineer will measure all completed work using United States standard measures, unless otherwise specified.

110.2 PAYMENT FOR LABOR AND MATERIAL

The CONTRACTOR shall furnish payrolls and personnel records, which pertain to current construction contracts with the OWNER for the purpose of ascertaining compliance with minimum wage rates published by the OWNER. Monthly and final estimates for payment will not be processed unless the CONTRACTOR complies with this requirement in a timely manner.

The CONTRACTOR for itself or any of its SUBCONTRACTORS shall pay all indebtedness, which may become due to any person, firm, or corporation having furnished labor, material or both in the performance of this CONTRACT. It shall be the responsibility of each person, firm or corporation claiming to have furnished labor, materials or both, in connection with this CONTRACT, to protect its interest in the manner prescribed by applicable laws of the State of Texas, provided, however, that as this Contract provides for a public works project, no lien of any kind shall ever exist or be placed against the work or any portion thereof, or any public funds or retainage held by the OWNER; and any SUBCONTRACTOR shall look solely to the CONTRACTOR and the payment bond surety, and not the OWNER, for payment of any outstanding amounts due for labor, materials or any other indebtedness in connection with the work. However, the OWNER may, at any time prior to making final payment, require the CONTRACTOR to furnish a Consent of Surety to any payment due the CONTRACTOR for completed work and may, at the discretion of the OWNER or the request of the Surety, make the check jointly payable to the CONTRACTOR and the Surety.

110.2.A. Payment for Materials

1. **Materials On-Hand:** Materials purchased and stored more than 30 days before use shall be considered materials on-hand. Payment for such materials shall be made as materials are consumed.
2. **Materials Stored Off-Site:** Off-site storage of such materials and payment for off-site storage shall be accomplished according to Item for Off-Site Storage.

110.2.B. Payment for Extra Work

Extra Work done by the CONTRACTOR, as authorized and approved by the OWNER, shall be compensated for in the manner described in this Item. The compensation provided for Extra Work done constitutes full and final payment for the cost of the Extra Work, which cost is limited to: all reasonable costs of labor, materials, supplies, tools, equipment or machinery rental, power, fuel, lubricants, water and other similar operation expenses (but only for the time that such of the above things are employed or used on such Extra Work) incurred in the performance of the Extra Work, and a ratable proportion of premium expenses for all bonds and insurance required under the Contract, to the extent that the Extra Work would cause an increase in such bond or insurance premiums; and a markup amount of not-to-exceed 15-percent of the above mentioned costs to cover and compensate the CONTRACTOR for profit, overhead, profit-and-overhead markups charged to CONTRACTOR by other subcontractors and suppliers, general supervision, field office expense and all other elements of cost and expense not embraced within the cost of the Extra Work. No cost of off-site storage shall be included in the above description of cost unless off-site storage has been approved and directed by the OWNER in writing. No other claims or reservations of right as to additional costs, prices, markups, costs not permitted to be included under this paragraph, disallowed costs or other future additional money or time shall be accepted; each change order shall be specific and final.

1. **Distinguishing Extra Work:** For purposes of this Item or any other provision of the Contract documents that allows a claim for Extra Work, the term "Extra Work" means work that is not reasonably within the scope of the Contract Documents and not otherwise incidental or necessary to performance of the Contract. The term does not include any change by the CONTRACTOR in the means and methods of performing the Work from that anticipated or bid (even if such change in means or methods is requested or directed by the OWNER), whether or not the change is due to foreseeable or

unforeseeable events or conditions, if the intended result or scope of the Work is not expanded or increased. The OWNER shall not be liable for any claim due to a change in the means or methods of construction by the CONTRACTOR, resulting in additional costs, if the OWNER has not changed the plans or specifications and if the intended result and scope of the work required by and reasonably inferred from the Contract Documents remains the same. The OWNER shall also not be liable for any claim for work required in performance of the Contract, without which the Contract could not be completed, notwithstanding that the CONTRACTOR did not contemplate or foresee the degree or amount of work that would be necessary or required to complete the Contract and notwithstanding that it cost the CONTRACTOR more to complete the Contract work than the original Contract price.

2. **Method of Determination:** The method of determination and payment of cost, or credit to the OWNER, for any Extra Work shall be one of the following:
 - a. Unit prices agreed on in writing by the Engineer and approved by the OWNER and executed by the OWNER and CONTRACTOR before the Extra Work is commenced or unit prices already included in the Contract documents, subject to all other conditions of the Contract. Mutual acceptance of a not-to-exceed lump sum properly itemized and supported by sufficient substantiating data to permit evaluation before the Extra Work is commenced, subject to all other conditions of the Contract.
 - b. A not-to-exceed cost to be determined in a manner agreed upon by the parties plus a mutually acceptable fixed or percentage fee, agreed upon before the Extra Work is commenced and subject to all other conditions of the Contract.
 - c. The force account method provided in Item for Force Account Work.
3. **Force Account Work:** If the CONTRACTOR and the OWNER cannot agree to one of the methods of calculating cost provided in Item for Method of Determination above, or if the parties agree to a method but cannot agree to a final dollar figure, or if the CONTRACTOR for whatever reason fails or refuses to sign the Change Order in question, the CONTRACTOR, provided it receives a written order signed by the OWNER, shall promptly proceed with the work involved. Nothing in this paragraph shall be construed to relieve the CONTRACTOR of any obligations it has under the disputed work provisions of Item for Disputed Work and Claims for Additional Compensation, and Item for Performance of Extra or Disputed Work, and where applicable the CONTRACTOR is still obligated to abide with those Items as well as this Item for Force Account Work. The cost of the work involved shall then be calculated on a force account basis, on the basis of the actual, reasonable field cost of the work attributable to the changes, plus a reasonable allowance for overhead, profit, markups of other subcontractors and suppliers, general supervision, field office expense and other elements of cost not embraced within the actual field cost as specified herein, such allowance in any case never to exceed 15%. In such case, the CONTRACTOR shall keep a detailed itemized account of the work involved and the actual field cost incurred, in a format acceptable to the Engineer and with such appropriate supporting data as the Engineer or the OWNER may prescribe. Sworn copies of the itemized accounting shall be directed to the Engineer each day during the performance of the force account work. Failure of the CONTRACTOR to submit the sworn-to itemized accounting daily as required herein shall constitute a waiver by the CONTRACTOR of any right to dispute the OWNER'S determination of the amount due the CONTRACTOR for force account work. Actual, reasonable field cost of the work to be charged under this Item of Force Account Work for force account work is limited to the following:
 - a. The reasonable wages of all workmen, foremen, timekeepers, mechanics and laborers, plus costs of social security, old age and unemployment insurance, fringe benefits required by agreement or custom (excluding employee or executive bonuses), and worker's compensation insurance, for the time such labor is actually employed or used on force account work.
 - b. Reasonable costs of materials, tools, supplies and equipment (but not to include off-site storage unless so approved and directed in writing by the OWNER), whether incorporated or consumed into the force account work.
 - c. Reasonable rental costs of machinery and equipment, exclusive of hand tools, only for the time actually employed or used on force account work, whether rented from the CONTRACTOR or others.

- d. A pro rata portion of premium expenses for all bonds and insurance to the extent force account work would cause an increase in such bond or insurance premiums.

Pending final determination of the cost to the OWNER, payment of undisputed amounts on force account shall be included on the monthly estimate as work is completed unless otherwise expressly provided in the written order signed by the OWNER to perform the work. Nothing in this Item for Force Account Work shall be construed as directing the CONTRACTOR's means and methods of performing the work in question.

110.3 PAYMENT WITHHELD

In addition to express provisions elsewhere contained in the Contract, the OWNER may withhold or nullify from any payment otherwise due the CONTRACTOR such amount as determined necessary to protect the OWNER'S interest, or, if it so elects, may withhold or retain all or a portion of any payment or refund payment on account of either of the following:

1. Unsatisfactory progress of the work not caused by conditions beyond the CONTRACTOR'S control.
2. Defective work or not corrected defective work.
3. CONTRACTOR'S failure to carry out instructions or orders of the OWNER or its representative.
4. Reasonable doubt that the Contract can be completed for the balance then unpaid.
5. Work or execution thereof not in accordance with the Contract documents.
6. Claim filed by or against the CONTRACTOR or reasonable evidence indicating probable filing of claims.
7. Failure of the CONTRACTOR to make payments to any subcontractor or suppliers for material or labor used in the performance of the Work.
8. Damage to another CONTRACTOR.
9. Unsafe working conditions allowed persisting by the CONTRACTOR.
10. Failure of the CONTRACTOR to provide work schedules as required by the OWNER.
11. Use of subcontractors without the Engineer's approval.
12. Failure of the CONTRACTOR to keep current as-built record drawings at the job site or to turn same over in completed form to the OWNER.

When the grounds for withholding payment are removed, payment shall be made for amounts withheld because of them, and OWNER shall never be liable for interest on any delayed or late payment. To the greatest extent permitted by applicable law, Owner shall not be deemed to be in breach of the Contract Documents by reason of the withholding of any payment which Owner is entitled to withhold pursuant to, or which it withholds in good faith in reliance on, any provision of the Contract Documents, and no interest shall accrue in connection with the withheld payment(s) determined to have been properly withheld. In determining whether amounts claimed for payment by Contractor, or any subcontractor, are in dispute, Owner shall have the right to consider amounts withheld under this provision, due to Contractor fault or in an attempt to protect the public from loss or overpayment of public funds, to be amounts in dispute. Nothing in this Section or in the Contract Documents shall limit or reduce any right of the Owner to offset amounts owed to Contractor by amounts owed to Owner by Contractor, or to exercise any other rights or remedies provided by law or equity.

110.4 MONTHLY ESTIMATES AND PAYMENTS

This Item is not intended to contradict previous sections pertaining to MONTHLY ESTIMATE, PARTIAL PAYMENTS, RETAINAGE, FINAL INSPECTION, ACCEPTANCE AND FINAL PAYMENTS.

110.4.A. Monthly Estimates

Between the 25th day and the last day of each month, the OWNER shall make an approximate estimate of the value of the work done during the month under the specifications. Whenever the said estimate or estimates of work done since the last previous estimate exceeds \$100 in amount, a percentage of such estimated sum shall be paid the CONTRACTOR on the next following month. Payment of the monthly estimate is determined at the Contract Item prices less any withholdings or deductions in accordance with the Contract. The monthly estimate may include acceptable nonperishable materials delivered to the work; such payment shall be allowed on the

same percentage basis of the net invoice value as provided hereinafter. The percent retained by the owner shall normally be up to the amount noted under the Item for Retainage, unless otherwise stated elsewhere in the contract documents. At the midpoint, or at any subsequent time, if the owner determines that the progress on the Contract is satisfactory in all respects, it may at its discretion cease to retain additional funds until the completion of the project, or until progress ceases to be satisfactory. The owner shall make the sole determination in this matter.

Except as otherwise provided by the Contract, between the 25th day and the last day of each month the CONTRACTOR shall make an estimate of the value of work done during this month under the specifications. The CONTRACTOR shall prepare the estimate on a form approved by the Engineer. The CONTRACTOR shall forward the estimate required above to the OWNER by not later than the last day of the month. The monthly estimate may include acceptable nonperishable materials delivered to and stored at the work site or a storage facility accessible to the OWNER; payment for such stored materials shall be allowed on the same percentage basis of the value as provided hereinafter. The monthly estimate shall also provide such supporting documentation as the Engineer or the other applicable provisions of the specifications may require. The OWNER shall verify that the CONTRACTOR's estimate matches the total value of work done and acceptable non-perishable materials delivered to the work site or storage facility, based upon the bid proposal prices and quantities measured or verified by OWNER. In the event of a discrepancy between quantities of work as shown in the CONTRACTOR'S estimate and measured quantities as shown in the OWNER'S verification, the OWNER's determination or measurement shall be final, and the CONTRACTOR's estimate shall be adjusted to reflect the quantities of work as shown by the OWNER'S verification. Payment shall be made by OWNER about thirty (30) days after receipt of the estimate from CONTRACTOR. OWNER shall not be liable for interest on any late or delayed payment caused by any claim or dispute, any discrepancy in quantities as described above, any failure to provide supporting documentation or other information required with the estimate or as a precondition to payment under the Contract, or due to any payment the OWNER has a right to withhold under the Contract. Measurement and payment shall be done per the design documents as designed by the Engineer.

The CONTRACTOR shall complete installation proposed improvements as shown on the drawings. Payment each month shall be done for a percentage complete of such items as measured in Square Yards, Cubic Yards, and Linear Feet of the total amount installed. All items paid per EACH will be paid per each individual item installed. Any approved deviation from the design documents will be paid per individual unit price shown. The OWNER provided unit measurements take into account small discrepancies up to 10% for all volume and weight measurements, 7% for all area measurements, and 5% for all linear measurements, compared to what may be found in the field. If CONTRACTOR notices considerable change then a change proposal request may be submitted for approval as noted herein.

The CONTRACTOR shall submit to the Engineer a Schedule of Values for each Lump Sum item of work for review and approval 20 days before the work is scheduled to be performed. The CONTRACTOR shall itemize in the Schedule of Values the actual costs to the CONTRACTOR to perform the various parts of the Lump Sum item work which shall include a reasonable overhead and profit cost item. Partial payment for Lump Sum items shall be made based on the value and percentage of the work in the bid item completed, as approved by the OWNER and as reflected in the Schedule of Values. The CONTRACTOR shall furnish to the OWNER such detailed information as OWNER may request to assist in the preparation of monthly estimates. It is understood that the monthly estimates shall be approximate only, and all monthly estimates and partial payments shall be subject to correction in the estimate rendered following the discovery of an error in any previous estimate, and such estimate shall not in any respect be taken as an admission of the OWNER of the amount of work done or of its quality or sufficiency nor as an acceptance of the work or the release of the CONTRACTOR of any of its responsibility under the Contract.

Owner shall not be obligated to make any progress payment or the final payment if the Surety objects to such payment or refuses to consent to such payment, or withdraws its consent to such payment. If requested by the Surety, or if Owner determines that it is advisable to do so, Owner shall have the right to make payments jointly to Contractor and Surety, or to Contractor and any subcontractor, supplier, or other person claiming payment for labor or materials. In the event of a dispute between Contractor and/or the Surety or persons

performing labor or supplying materials, as to whom payment of amounts held by Owner should be made, Owner shall have the right to interplead the funds held by it in the registry of a court having appropriate jurisdiction, and to withhold from the amounts held by it all attorney's fees and other costs incurred by Owner in connection with such dispute.

110.4.B. Retainage

As security for the faithful completion of the work by the CONTRACTOR, the OWNER shall retain 15-percent of the total dollar amount of work done on all contracts \$25,000 and less; 10 a-percent of the total dollar amount of work done on all contracts in excess of \$25,000 and less than \$400,000; five-percent of the total dollar amount of work done on all contracts of \$400,000 or more. On all contracts in excess of \$400,000, either of the following shall apply:

1. On all contracts in excess when work progress is 80-percent complete, retainage may, at the OWNER'S option, be reduced to two percent of the dollar value of all work satisfactorily completed to date (not to include material on hand), provided that the CONTRACTOR is making satisfactory progress and there is no cause of greater retainage as determined by the Engineer.
2. When work progress is substantially complete, the retainage may be further reduced to only that amount necessary to assure completion as determined by the Engineer.
3. If the OWNER determines that the CONTRACTOR is not making satisfactory progress or if there is other specific cause, the OWNER may, at its discretion, reinstate up to the five percent retainage.

110.4.C. Final Contractor's Report

The final CONTRACTOR'S Report of SUBCONTRACTOR / SUPPLIER Payment, evidencing that all indebtedness connected with the work and all sums of money due for any labor, materials, apparatus, fixtures or machinery furnished for or used in the performance of the work have been paid or otherwise satisfied, or that the person or persons to whom the same may be respectively due have consented to final payment. The OWNER may reasonably require other documentation, including but not limited to, additional affidavits, lien waivers, and other such documentation needed to protect the OWNER'S interest. In addition, the CONTRACTOR shall be required to execute the OWNER'S standard Affidavit of Final Payment and Release as a precondition to receipt of final payment. The acceptance by the CONTRACTOR of the final payment as aforesaid shall operate as and shall be a release to the OWNER from all claims or liabilities under the CONTRACT, including all SUBCONTRACTOR claims, for anything done or furnished or relating to the work under the CONTRACT or for any act or neglect of said OWNER relating to or connected with the CONTRACT. All warranties and guarantees shall commence from the date of the certificate of acceptance. No interest shall be due the CONTRACTOR on any partial or final payment or on the retainage.

110.4.D. Acceptance

The Contractor shall notify the ENGINEER when the list of outstanding items and Work are complete, and the Project Manager will arrange a final inspection with the Contractor and the Owner. If work completed is to the OWNER's satisfaction, then OWNER shall issue a letter or certificate of acceptance to the CONTRACTOR.

Upon completion of the Work in full and strict conformity to the Contract Documents and within 30 days after final acceptance of the Work by a Contracting Officer and Contractor's satisfaction of its obligations for final payment, Owner shall pay the unpaid balance of the Contract Amount less any sum that may be necessary to settle any claim Owner may have against the Contractor or that may be necessary to settle any outstanding obligations of the Contractor or of its Subcontractors arising out of or incident to the performance of the Contract or which is otherwise withheld pursuant to the terms of the Contract Documents.

Neither the Certificate of Substantial Completion, nor final acceptance payment, nor any other provisions in the Contract Documents, shall relieve the Contractor of its obligations under the Contract Documents or under any warranty.

110.4.E. Final Payment

Whenever the improvements provided for by the Contract shall have been completely performed on the part of the CONTRACTOR, as evidenced in the certificate of acceptance obtained according to Item of Acceptance, and all required submissions provided to the OWNER, a final estimate showing the value of the work shall be prepared by the Engineer as soon as the necessary measurements and computations can be made. All prior estimates upon which payments have been made are subject to necessary corrections or revisions in the final payment. The amount of the final estimate, less any sums that have been previously paid, deducted or retained under the provisions of this Contract, shall be paid to the CONTRACTOR within a reasonable period of time after final acceptance, provided that the CONTRACTOR has first furnished the OWNER:

1. Consent of surety to final payment.
2. The final CONTRACTOR's notarized Report of Subcontractor/Supplier Payment, evidencing that all indebtedness connected with the work and all sums of money due for any labor, materials, apparatus, fixtures or machinery furnished for or used in the performance of the work have been paid or otherwise satisfied, or that the person or persons to whom the same may be respectively due have consented to final payment.
3. Other affidavits, lien waivers and other documentation as the OWNER may reasonably require protecting its interests.
4. All warranties, instructions, documents and other submittals required by the Contract Documents, or otherwise required by Owner.
5. Furnish a release of all claims against Owner, in form satisfactory to Owner, whether of Contractor, Subcontractors or of others, arising under and by virtue of the Contract.
6. Deliver to Owner all As-Built Drawings and three Owner's Manuals containing all Contractor and Subcontractor names, addresses and phone numbers; all plumbing, electrical, and communication equipment/fixture product data; all special equipment product data; and all parts lists and operating, maintenance, and service manuals.
7. The Contractor shall arrange for a reasonable amount of instruction for the Owner's employees and representatives to insure proper operation of all equipment furnished. The Contractor shall not assume that the Owner's employees possess special expertise or have had any previous experience whatsoever in the operation and maintenance of equipment installed as part of the Project.

In addition, the CONTRACTOR shall be required to execute the OWNER's standard Affidavit of Final Payment and Release as a precondition to receipt of final payment. The acceptance by the CONTRACTOR of the final payment as aforesaid shall operate as and shall be a release to the OWNER from all claims or liabilities under the Contract, including all subcontractor claims, for anything done or furnished or relating to the work under the Contract or for any act or neglect of said OWNER relating to or connected with the Contract.

All warranties and guarantees shall commence from the date of the certificate of acceptance. No interest shall be due the CONTRACTOR on any partial or final payment or on the retainage.

110.4.F. Wire Transfer Payments

Payments to the CONTRACTOR may, at the discretion of the OWNER, be made by wire transfer to a bank of the CONTRACTOR'S choice. The CONTRACTOR must furnish the following information:

1. The ABA number of the bank.
2. The CONTRACTOR'S account number.

The request must be on the CONTRACTOR'S letterhead and signed by an authorized representative of the CONTRACTOR (cannot be a copy).

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201.1 INTRODUCTION

This Item shall govern the control measures necessary to define methods and limits of demolition, maintenance of streets during construction, street and channel excavations, landscaping and other structures protection, and dust control.

The OWNER reserves the right to have required temporary erosion sedimentation and water pollution prevention and control work performed by others should the CONTRACTOR fail to perform required temporary erosion, sedimentation, and water pollution prevention and control work in a timely fashion or should the CONTRACTOR fail to prevent and control soil erosion, damage control, safety, and water and air pollution which may degrade quality of air and water. All costs including engineering and right-of-way costs for the work required shall be borne by the CONTRACTOR. The CONTRACTOR shall reimburse the OWNER for all such costs within 30-days after receipt of the reimbursement request from the OWNER. Failure to submit payment for such reimbursement costs in the time prescribed above may result in the OWNER withholding the reimbursement due from the monthly progress payments to the CONTRACTOR until reimbursement to the OWNER is made.

201.2 ITEMS OF WORK AND MATERIALS

The items, estimated quantities, and locations of the control measures will be shown on the plans; however, the OWNER may increase or decrease the quantity of these items as needs arise. The materials will be shown on the plans and in the specifications. The OWNER may allow, in writing, the use of other materials and work methods as the need arises.

201.3 DAMAGE PRECLUSION

CONTRACTOR TO REPORT UTILITY LINE DAMAGE: CONTRACTOR shall protect and cause no damage to existing structures or other utilities as specified in Item under Existing Structures Location. If any utility, structure, line, service, or appurtenance to a utility is damaged, the CONTRACTOR shall notify the owner of that utility, structure, line, service, or appurtenance to a utility, immediately. *[NOTE: If there are specific local, state, or federal laws or regulations regarding damage notifications, the CONTRACTOR shall comply with those applicable laws or regulations in addition to following the requirements of this specification.]*

202 EXISTING STRUCTURES LOCATION AND PROTECTION

202.1 LOCATION

Determining the location of existing structures, utilities and appurtenances shall proceed according to the specifications herein. BIDDERS must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location and sizes of pipe or conduits of various kinds in place. Where the exact depth of any utility or obstruction is not shown on a plan, excavation shall be made prior to reaching the obstruction in order to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary.

Extra compensation shall not be paid for such delays.

202.2 PROTECTION

All existing structures, improvement and utilities designated to remain shall be adequately protected, at the expense of the CONTRACTOR, from damage that might otherwise occur due to construction operations. Where construction comes in close proximity to existing structures, utilities or appurtenances, or if it becomes necessary to move services, poles, guy wires, pipe lines or other obstructions, the CONTRACTOR shall notify and cooperate with the owner of the utility, structure, or appurtenance. The utility lines and other existing structures shown on the plans are for information only and are not guaranteed by the OWNER to be complete or accurate as to location and/or depth. The CONTRACTOR shall be liable for damage to any utilities resulting from the CONTRACTOR's operations. During construction, all fire hydrants, valve boxes, fire or police call boxes and other existing utility controls shall be left intact, unobstructed and accessible unless noted on the plan.

All water mains, wastewater collection mains, wastewater collection house laterals, storm drains, power conduits, gas mains, gas service laterals and other lines or appurtenances encountered during construction shall be supported or replaced as detailed on the plans. Water service lines shall not be removed during excavation, and the CONTRACTOR shall provide adequate support for the services across the open ditch.

202.2.A. Damage Report

The CONTRACTOR shall notify the OWNER within one-hour from the time the damage incident occurs. In the case of service disruption to an individual or in the case of an emergency, the CONTRACTOR shall notify the individual whose service is disrupted and adjacent property owners of the incident within one-hour. Failure to comply with this notification requirement will result in a one-day shut-down charged for each occurrence. The CONTRACTOR will not be prohibited from performing site cleanup or general maintenance on any mandatory shutdown day. The CONTRACTOR shall be responsible for all costs and delays incurred because of damage to any utility, structure, line, service, or appurtenance to a utility. NO SEPARATE PAY ITEM.

202.2.B. Utility Supports

Pipe capable of supporting its weight approximately at right angles to the ditch shall not require additional support, unless otherwise directed by the OWNER or shown on the plans, other than the exercise of care in placing new conduit under same and in placing backfill, except when the span is excessive. If directed by the OWNER, utilities shall be replaced with cast iron or any suitable piping to convey the contents, supported with concrete or a concrete utility support per details on the plans, as directed by the OWNER. After the new utility is laid, the backfill to the base of the concrete support shall be stabilized by the use of cement stabilized soil, if directed by the OWNER.

Pipes parallel to and in the edge of cut, shall be supported or rerouted if so indicated on the plans. Utilities parallel to and in edge of cut shall be adequately protected without additional compensation except as set out in the contract and proposal.

202.2.C. Utility Service

Water and wastewater service must be maintained. If a temporary main is required to accomplish continuous service, it shall be installed and removed by the CONTRACTOR at CONTRACTOR'S expense, unless a separate bid item for this work is established in the CONTRACT. This shall include furnishing all labor, tools, materials, equipment, testing and incidentals necessary to complete the work, including all excavation and disposal of surplus material, transfer of services, removal of temporary main after work is complete and transfer of services back to the existing system, and protection and repair of the temporary system.

202.3 REPLACING EXISTING STRUCTURES

Utility locations shall be obtained prior to the commencement of work according to Item for Existing Structures Location and Protection. Unless noted on plans that utilities are to be moved by others, any cost of temporarily or permanently relocating utilities shall be borne by the CONTRACTOR. The cost of these replacements shall be included in the CONTRACTOR's bid price for the various items of work, and no separate payment shall be made. In case damage to an existing structure or utility occurs, whether such damage results directly or indirectly from the CONTRACTOR'S operations, the CONTRACTOR shall be responsible to restore the structure or utility to its original condition and position without extra compensation. Temporary shutdown of water and/or storm or wastewater services shall not extend overnight, holidays or weekends. The OWNER shall approve all shut downs and may assist in the shut down operations.

When it is necessary to remove or adjust another utility, a representative of that utility shall be notified to decide method and work to be done. The CONTRACTOR shall make satisfactory arrangements with other utilities for the required cutting or adjustments at the CONTRACTOR'S own expense, other than for items that may be provided in the contract for such work. No extra compensation shall be paid due to delays caused by removal of public utility structures.

202.3.A. Wastewater Service Interruptions

All wastewater collection services damaged during construction shall be replaced at the CONTRACTOR'S expense. Cuts or breaks in wastewater collection mains and laterals, or service connections shall be restored at the earliest practicable moment. Temporary restoration of service shall be installed within 4-hours of damage. Permanent repairs shall be in place in agreement with the OWNER. Wastewater collection service reconnections, including necessary adjustments to a replacement, shall not require the services of a master plumber, if being replaced by an approved utility CONTRACTOR; however, in all cases, repair shall be inspected by the OWNER. It shall be the responsibility of the CONTRACTOR to maintain such services throughout the construction process.

Any spill of wastewater must be returned to the sanitary sewer and remediation of the spill is the responsibility of the CONTRACTOR. Spill and remediation will be reported by the OWNER to the TCEQ and USEPA. The CONTRACTOR shall be responsible for notifying customers of temporary interruption of service.

202.3.B. Sign Damage

The CONTRACTOR shall be responsible for all damage to street sign posts and signs, within the limits of the CONTRACTOR'S operations, which remain in place or are removed and replaced. In the event that street sign posts and signs are damaged or destroyed by the CONTRACTOR's operations, they shall be replaced at the CONTRACTOR'S expense.

202.3.C. Removal and Disposal Methods

Materials or parts of structures which are to be broken up, dismantled or removed, and which are to be salvaged, shall be removed, loaded, cleaned and unloaded at sites designated by the OWNER. Materials that are not salvageable shall become the property of the CONTRACTOR. Disposal of such materials, in accordance with applicable local, state, and federal regulations, shall be at the CONTRACTOR'S expense.

202.4 MEASUREMENT AND PAYMENT

No measurement shall be made for the removal and replacement of utility pipe even if the utility pipe is replaced with a different pipe. No payment shall be made except as provided specifically for in the Contract.

Concrete for piers and beam supports shall be measured per Item for Concrete Removal. No measurement shall be made for reinforcing steel. Cement stabilized backfill shall be measured for payment in cubic-yards in place. There shall not be a payment for a support as a unit, but the contract unit prices for the concrete and cement- stabilized backfill shall be the total compensation for the furnishing of all labor, tools, materials, equipment and incidentals necessary to complete the work, including excavation, furnishing, installation and removal of the piping, construction of piers and supports, stripping of forms, and disposal of surplus materials, in accordance with the plans and specifications.

203 MAINTENANCE OF STREETS DURING CONSTRUCTION

The CONTRACTOR shall at all times maintain the surfaces of streets on which work was or is being performed. The maintenance required shall include the filling of holes; blading or otherwise smoothing of the street surfaces (particularly in a trench area); cleaning and removal of surplus excavation material rubbish, etc.; sprinkling of streets to abate dust nuisances and the elimination of interference resulting from blocking the street to residents thereon. Any or all of such operations shall be performed by the CONTRACTOR upon demand by the OWNER, but the CONTRACTOR shall not wait for instruction from the OWNER before performing maintenance work obviously in need of being done to meet the requirements of these specifications. All costs of work covered by this paragraph shall be included in the price bid for the various items of work, and no separate payment shall be made.

In the event the CONTRACTOR fails or refuses to properly maintain the surfaces of streets on which work was or is being performed, the OWNER, after due notice to the CONTRACTOR, shall perform the necessary maintenance. All costs to the OWNER incurred in the performance of such work shall be deducted from any monies due or to become due to the CONTRACTOR for work performed, or the CONTRACTOR shall be billed for

such costs directly as the OWNER shall elect. Notice to the CONTRACTOR to be given by the OWNER shall be in writing, and it shall be delivered to the CONTRACTOR or an authorized agent. Except in emergency cases, where immediate action is required under the provisions of Item for Public Convenience and Safety or Item for Protection of Work, the CONTRACTOR shall have 24-hours in which to comply with the instructions from the OWNER. Should the CONTRACTOR fail to do so, the OWNER shall proceed with the work as set forth above.

203.1 TRAFFIC RESTRICTIONS

Where traffic must cross open trenches, such as street intersections and driveways, the CONTRACTOR shall provide suitable backfill bridges, protective barricades and such other safety equipment as required. The use of machinery must be so regulated as to preclude any unnecessary interference with traffic, utilities, etc. The CONTRACTOR shall abide by all applicable federal, state or local laws governing excavation work, including OSHA and USEPA regulations.

The CONTRACTOR will be responsible for barricading all projects. All barricades, warning signs, and traffic control devices shall conform, at a minimum, to the standards in the City of Dallas Traffic Barricade Manual and TxDOT Texas Manual on Uniform Traffic Control Devices (Texas MUTCD), latest edition.

When closing side streets, four working days notification is required for Fire and Police Departments. See contract for individual contact names and phone numbers.

203.1.A. Temporary Access Road

This item shall consist of construction, maintenance, and removal of all temporary access road construction within the project limits, and other materials, labor and other incidentals required to complete the work, as specified by the Engineer.

All materials shall comply with requirements set forth elsewhere in these Specifications.

All Temporary Access Road will be measured per square yard (SY) complete in place. Temporary Access Road, if included in the bid, shall be paid for at the contract unit price bid for "Temporary Access Road" which price shall be full compensation for all work herein specified, including the furnishing of all materials, equipment, tools and labor and incidentals necessary to complete the work.

203.1.A. Temporary Road

This item shall consist of construction, maintenance, and removal of all temporary roads required to provide traffic flow within the project limits, including all associated materials, labor and other incidentals required to complete the work, as specified by the Engineer.

203.1.A.1. Construction Methods: All materials shall comply with requirements set forth elsewhere in these Specifications. The Temporary Roadway shall be constructed to the sections shown in the construction drawings and to the lines and grades required to provide safe unobstructed traffic movements through the project. The Temporary Roadway shall be constructed in phases or sections, as required by the phasing of the project. Once any section of Temporary Roadway is no longer needed, the Contractor shall remove all items associated with the unnecessary sections of Temporary Roadway. Materials removed from unused sections of Temporary Roadway may be reused in the project as appropriate, subject to approval of the Engineer.

203.1.A.2. Measurement and Payment: All Temporary Roadway will be measured per square yard (SY) complete in place. Items, such as, but not limited to: stripping, subgrade preparation, flexible base, asphalt base, chip seal, two-course surface treatment, and asphalt will not be measured or paid separately, but are subsidiary to this item. which price shall be full compensation for all work herein specified, including the furnishing of all materials, equipment, tools and labor and incidentals necessary to complete the installation and complete removal of the Temporary Roadway in sections or phases as required.

203.2 PAVEMENT REMOVAL & REPAIR

Existing pavement shall be precut, sawed or scored so as to result in an even, 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 material shall then be replaced in three (3) inch layers tamped in place. Replaced base material shall comply with Item for Flexible Base, and in no case be less than 8 inches thick. 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, curb line, or perpendicular to road alignment. Removal of excess surfacing beyond the nominal limits of the ditch shall be kept to a minimum, and such areas shall be outlined with straight saw-cuts and included in areas to be repaired as described above. Base material shall be compacted to ninety-five (95) percent of maximum density as determined by TxDOT Test Method TX-113/114. The replaced surface course shall consist of a minimum 2" of HMA Type D in conformance with Item for Hot Mix Asphaltic Concrete.

In all paved streets the trench shall be finished in a workmanlike manner consistent 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.

203.3 MEASUREMENT AND PAYMENT

Unless otherwise noted in the bid form, all items under this Section shall be considered subsidiary to the facility being installed in the trench referenced by this Section. When a bid item is included for the work under this section, trench shall be measured by the linear foot for the trench width and depth required for installation of the pipe in accordance with the elevations indicated graphically and appropriate detail as specified in the construction documents.

If this item is included as a utility installation pay item on the bid form it shall be measured in linear feet (LF) in place, otherwise it shall be measured per square yards in place (SY), which price shall be full compensation for furnishing all labor, equipment, tools, supplies and incidentals necessary to complete the work.

204 SITE PREPARATION

204.1 DESCRIPTION

This Item shall consist of preparing the site and designated easements for construction operations by the removal and disposal of all obstructions from OWNER'S property, the right-of-way, and from designated easements, where removal of such obstructions is not otherwise provided for in the plans and specifications. Such obstructions shall be considered to include remains of houses not completely removed by others, foundations, floor slabs, concrete, brick, lumber, plaster, septic tanks, basements, abandoned utility pipes or conduits, equipment or other foundations, fences, retaining walls, outhouses, shacks and other debris.

This item shall also include the removal and disposal of curb and gutters, driveways, paved parking areas, miscellaneous stone, brick, concrete sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron, all rubbish and debris, whether above or below ground except live utility facilities. This Item shall also include the removal and disposal of designated trees, stumps, bushes, vegetation, roots, shrubs, brush, and logs. It is the intent of this specification to provide for the removal and disposal of all obstructions and objectionable materials not specifically provided for elsewhere in the plans and specifications. This Item does not include the removal and disposal of hazardous material.

204.2 CONSTRUCTION METHODS

The entire right-of-way for this project and such additional areas, including public or corporate areas and public or corporate lands, as made available for construction of this project, shall be cleared of all structures and

obstructions, as defined above, except that trees or shrubs shall be protected unless specifically designated by the OWNER for removal. Unless designated for removal without replacement, trees and shrubs shall be treated according to Item Landscape. Unless otherwise indicated on the plans, trees and stumps to be removed shall be cut off or otherwise removed as close to the natural ground as practicable on areas which are to be covered by at least 3-ft of embankment. On areas required for borrow sites and material sources, stumps, roots, etc., shall be removed to the complete extent necessary to prevent such objectionable matter becoming mixed with the material to be used in construction.

204.2.A. Removal Depth and Utility Abandonment

Unless otherwise indicated on plans, all foundations and underground obstructions shall be removed to the following depths:

1. In areas to receive embankment, 1-ft below natural ground or to bottom of structure.
2. In areas to be excavated, 1-ft below the lower elevations of the excavation, or to the bottom of structure.
3. In all other areas, 6-inches below natural ground or to bottom of structure.

All basement walls and floors, septic tanks and storage tanks within the limits of the right-of-way shall be removed and the resulting holes backfilled as directed by the OWNER. Holes remaining after removal of all obstructions, objectionable material, trees, stumps, etc., shall be backfilled. The CONTRACTOR shall complete the operation of preparing right-of-way so that the prepared right-of-way shall be free of holes, ditches and other abrupt changes in elevations and irregularities to contour.

The remaining ends of all abandoned-in-place storm sewers, culverts, sanitary sewers, conduits, and water or gas pipes shall be plugged with an adequate quantity of concrete to form a tight closure. All materials and debris removed shall become the property of the CONTRACTOR, unless otherwise provided for on the plans or in the specifications, and shall be removed from the right-of-way. Unless otherwise provided, all merchantable timber removed as previously specified shall become the property of the CONTRACTOR. Gravel, brick, stone or broken concrete, when permitted by special conditions and reduced to sizes permitted, may be used in the roadway embankment.

204.2.B. Over-Excavation

CONTRACTOR is required to avoid over-excavation of earth or over-break of rock. The CONTRACTOR shall replace any excavation or over-break with concrete fill or other material as directed by the OWNER to restore the strength of the foundation to its previous bearing and lateral support. There will be no additional compensation for this work.

204.2.C. Water for Construction

Unless otherwise noted in the construction documents, all water for construction of any item, including, but not limited to, grading, earthwork, landscaping, etc., must be supplied by the CONTRACTOR. No person shall open, turn on, turn off, interfere with, attach any pipe or hose to, or connect anything with any fire hydrant, stop valves, stop cock, or tap any water main belonging to the City, unless duly authorized to do so by the OWNER.

If elected to do so, for contracts awarded and administered by the City of Marble Falls, the OWNER may inform all bidders that water will be available as necessary for construction of water or sanitary sewer mains within the jurisdiction of the City. In such cases, water shall be furnished by the OWNER free from the nearest convenient City water main. CONTRACTOR must follow applicable public drinking water standards, such as using approved backflow preventer devices, to be able to draw water from Fire Hydrants or other sources.

If water from the OWNER is unavailable, CONTRACTOR shall be responsible for purchasing water from a local SUPPLIER or another city.

204.2.D. Embedment and Curbs

When pipe is to be installed in a proposed fill of any type, fill material shall be placed and compacted to the proposed grade elevation and then re-excavated for pipe installation.

In all open cut excavations beneath an existing curb, the CONTRACTOR shall remove the existing curb, backfill and compact the trench, and install a new curb.

204.2.E. Manhole Abandonment

When manholes are called out to be abandoned, they shall have the rings and covers removed and disposed of. The manholes shall then be backfilled with flowable fill as detailed in Item for Embedment.

Unless otherwise noted in the bid form, all items under this Section shall be considered subsidiary to the Item for Site Preparation.

If authorized, manhole abandonments shall be measured per each (EA) complete in place. If no separate bid item is provided for item, then such costs shall not be paid for directly but shall be considered as subsidiary work pertaining to the utility item installed or Item for Site Preparation.

The prices bid shall be full compensation for furnishing all labor, materials, tools, equipment, compaction, hauling and incidentals necessary to complete the work. Payment for unauthorized work shall not be made. All work required for disposing of waste, including haul shall not be paid for directly but shall be considered as subsidiary work pertaining to various contract items, and such costs shall be included in the unit prices bid for these items.

204.3 MEASUREMENT AND PAYMENT

General site preparation for right of ways shall be measured on per station basis (100 foot intervals).

Other general site preparation shall be measured lump sum basis (LS), or per acre (Ac), unless indicated otherwise. Measurement for payment shall be made only on areas indicated and classified on the plans as "General Site Preparation." All work performed and measured as prescribed by this Item shall be paid for at the lump sum price bid for "General Site Preparation" unless indicated otherwise, which price shall be full compensation for furnishing all labor, equipment, tools, supplies and incidentals necessary to complete the work.

205 UNCLASSIFIED STREET EXCAVATION

205.1 DESCRIPTION

Unclassified street excavation shall consist of all the required excavation within the limits of the right-of-way and areas adjacent thereto (except excavation specifically described and provided for elsewhere in the specifications); the removal, proper utilization or disposal of all excavated material; and the shaping and finishing of all earthwork in conformity with the lines and grades as shown on the plans or as established by the OWNER all in accordance with the specification requirements contained herein.

Without regard to materials encountered, all street excavations shall be unclassified and shall be designated as "Unclassified Street Excavation," which shall include all materials excavated. It is to be distinctly understood that any reference to rock or other material on the plans and/or in this specification is solely for the OWNER'S and CONTRACTOR'S information and is not to be taken as an indication of classification of excavation.

205.2 CONSTRUCTION METHODS

All excavation shall be in accordance with the lines, grades and typical sections as shown on the plans or as established by the OWNER. This item shall consist of removal of existing roadway from locations shown on plans. All existing asphalt and all cement or lime stabilized materials shall be completely removed from the existing roadbed. With the approval of the Engineer, material removed from the existing roadbed may be used as fill or subgrade in the construction of the proposed roadway. All unused material shall become the property of the Contractor and shall be removed and disposed in an approved manner.

Unless otherwise shown on the plans or established by the OWNER, the street excavation shall be made to the subgrade of the roadway. Where excavation to grades established in the field by the OWNER would terminate in unstable soil, the CONTRACTOR shall remove the unstable soil and backfill to the required grade.

Unless otherwise approved in writing by the OWNER, where excavation to grade established in the field by the OWNER terminates in loose or solid rock, the CONTRACTOR shall excavate 6-inches below the required subgrade elevations for the entire roadbed width and shall backfill with suitable selected materials approved by OWNER. Payment for such work will be made in accordance with the contract documents.

The CONTRACTOR shall conduct operations in such a manner that adequate measurements may be taken before any backfill, as required above, is placed. Dragging, pushing or scraping of material along or across the surface of the complete concrete improvements or pavements shall not be permitted.

205.2.A. Drainage

If it is necessary in the execution of the work to interrupt the natural surface drainage or the flow of artificial drains, the CONTRACTOR shall provide temporary drainage facilities that shall prevent damage to public or private interest and shall restore the original drains as soon as the work shall permit. The CONTRACTOR shall be held liable for all damages which may result from neglecting to provide for either natural or artificial drainage which its work may have interrupted.

205.2.B. Excess Excavation

The CONTRACTOR shall dispose of excavation in excess of that needed for construction. In general, suitable excess street excavation shall be used in construction of roadways, widening of embankments, flattening of slopes, etc., but, if it becomes necessary to waste any material, it shall be disposed of in such a manner as to present a neat appearance and to not obstruct proper drainage or cause injury to any street improvements or abutting property. If necessary to haul off excess or unsuitable material, the CONTRACTOR shall dispose of it in accordance with local, state, and federal guidelines.

205.2.C. Roadways

Roadways shall be finished as shown on plans. Whenever the adjacent property is lower than the design curb grade and drains away from the street, the parkway grade may be set level with the top of the curb, if approved by the OWNER. The OWNER may approve variations from these standards in special cases. Sprinklers that are damaged as a result of Work shall be repaired by the CONTRACTOR to pre-Work condition.

205.3 MEASUREMENT AND PAYMENT

All authorized street excavation shall be measured in its original position and the volume in cubic-yards (C.Y.) determined by the average end area method. Work performed for finishing of parkways shall not be measured directly, but shall be considered subsidiary to unclassified street excavation.

All work performed as prescribed by this item shall be paid for at the contract bid price per cubic-yard (C.Y.) for unclassified street excavation, which price shall constitute payment in full for furnishing and operating all equipment, excavation, placement, compaction, loading, hauling, and unloading and for satisfactory disposal of unsuitable and excess materials; finishing slopes, ditches and parkways; for all maintenance blading or scarifying the ground surface; and for furnishing all labor, fuel, tools, materials, equipment, implements, and incidentals necessary to the satisfactory performance of the work.

206 UNCLASSIFIED CHANNEL EXCAVATION

206.1 DESCRIPTION

Channel excavation shall consist of required excavation for channels within the limits of the OWNER's right-of-way, property, or designated easements; the removal and proper utilization or disposal of all excavated materials; compacting and refilling, after settlement of all excavated areas; and constructing, shaping and finishing of all earthwork involved in conformity with the required lines, grades and typical cross sections in accordance with specification requirements herein outlined.

All authorized channel excavation shall be "unclassified" and involves removal of all materials necessary to permit carrying on the completion of the work.

206.2 GENERAL INSTRUCTIONS

In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. Work shall be executed in a neat workmanlike manner. A trench safety plan shall be submitted in accordance with Item for Protection of Work and of Persons and Property. All excavation shall be to the line and grade as provided by the OWNER. The CONTRACTOR shall abide by all applicable federal, state and/or local laws governing excavation work.

The CONTRACTOR shall provide for the uninterrupted flow of storm and wastewater lines and surface waters during progress of the construction. Completed work shall conform to the established alignment, grades and cross sections.

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. All such bracing, relocation, removal and/or replacement of existing structures, including labor, materials, and all incidental items, shall be at the sole expense of the Contractor unless a pay item is specifically provided for such work.

206.2.A. Dewatering

During construction, the channel shall be kept drained, insofar as practicable, and the Work shall include the installation and operation of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from storm drains, wastewater collection systems, ditches, creeks and other sources. The CONTRACTOR shall grade as necessary to prevent surface water from flowing into trenches or other excavations. The CONTRACTOR shall remove all water from any source that may accumulate in the excavation. The embedment or pipe shall not be installed in water. No water shall be allowed to flow through or over unset concrete or through the completed line. All water removed from excavations shall be disposed of in a manner approved by the OWNER, and to avoid the discharge of solids into the storm drain or watercourse, so as not to create unsanitary conditions, injure persons or property, damage the work in progress, and/or interfere unduly with the use of streets, private driveways or entrances. Pumping, bailing and draining, underdrains, ditches, etc. shall be considered as incidental work and shall not be paid for as separate items, but their cost shall be included in such contract prices as are provided for in the contract.

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 OWNER may direct the Contractor when and where to place washed gravel.

206.2.B. Excavated Material

Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of the work.

All suitable materials removed from the excavation shall be used, insofar as practicable, in the formation of embankments as required by Item for Embankment, or shall be otherwise utilized. Desirable topsoil, sod, etc. shall be carefully removed and piled separately adjacent to the work when required. Suitable excavated materials may be piled adjacent to the work to be used for backfilling.

Unsuitable channel excavation and suitable channel excavation in excess of that needed for construction shall be known as "waste" and, unless specified otherwise, shall become the property of the CONTRACTOR to be disposed of outside the limits of the right-of-way in accordance with local, state, and federal guidelines. The excavated material in rock that is not suitable material for bedding or backfill shall similarly be disposed of by the CONTRACTOR.

Suitable bedding or backfill material shall be provided at no additional cost to the OWNER. In accordance with Item for Legal Relations and Contractor Responsibilities, the CONTRACTOR shall indemnify

and hold harmless the OWNER and all related officers, agents, and employees from all suits, actions or claims of any character resulting from arrangements for and disposal of soil.

206.3 OPEN CUT METHODS

206.3.A. Trench Bottom Elevation

All trenches for installation of water, storm water collection system and/or wastewater collection system lines shall be excavated to a point below the barrel of the pipe for the type of embedment specified and as described in Item for Embedment.

Install, in trenches and other excavations with vertical sides, sheeting and bracing necessary to support the sides. Sheeting and bracing shall be so installed as to place no undue or damaging strain on uncompleted work. Any damage resulting from settlement or lack of bracing shall be repaired by the Contractor at his own expense. The sides of all trenches shall be securely held by bracing and sheeting which may be removed in units when the level of backfilling has reached the elevation necessary to properly protect the work and adjacent property.

206.3.B. Trench Overcut

Should the CONTRACTOR excavate below the plan trench bottom for water or wastewater collection system lines, the CONTRACTOR shall backfill to trench bottom grade shown on the plans with approved aggregate, consolidated and compacted to meet the OWNER's approval.

If the CONTRACTOR elects to overcut the trench and use gravel and drain pipe as an underdrain in lieu of or in conjunction with pumping, draining or well pointing, the additional work shall be considered as incidental work and additional compensation shall not be allowed.

Where the character of the foundation material is such that a proper foundation cannot be prepared at the elevation shown on the plans, then, when directed by the OWNER, the CONTRACTOR shall deepen the excavation to where a proper foundation entirely satisfactory to the OWNER can be prepared. Such materials removed shall be replaced with foundation materials as specified in Item for Excavation and Foundation, or with other material satisfactory to the OWNER and thoroughly compacted in place to finish grade elevation in a manner satisfactory to the OWNER.

206.3.C. Excess Trench Width

When the plan trench width is not maintained to a point of 1-ft. above the top of the pipe, the CONTRACTOR shall provide embedment as directed by the OWNER, which shall provide adequate support at no additional cost to the OWNER.

206.3.D. Progress

The OWNER shall have the right to limit the amount of trenches that shall be opened, or partly opened, in advance of or following the pipe laying operation. Unless otherwise directed by the OWNER, the completion of backfill shall immediately follow the pipe laying. In the event the CONTRACTOR fails to comply with the requirement, the OWNER may stop the pipe laying until the requirements are met.

206.3.E. Excavation for Altered Grade

If excavation for the conduit or appurtenance due to the altered grade is altered more than 2-ft. and has not been classified as a separate contract pay item, the increased or decreased amount of excavation due to the altered grade may constitute a basis for revised consideration by either party to the contract.

206.3.F. Alternate Excavation Methods

Prior to commencing any excavation, the CONTRACTOR shall provide ample labor, equipment, shoring material and such other safety equipment as required to insure that the work shall be carried on without interruption or

damage to existing installations and to provide the least interruption of traffic commensurate with the project requirements.

206.3.F.1. Blasting: This item applies only to projects awarded and administered by the City of Marble Falls. In cases where the plans and specifications do not require the use of explosives, if (after written approval by the OWNER) the CONTRACTOR elects to use explosives in the performance of the work; utmost care shall be exercised so as not to endanger life or property.

For purposes of this specification, the term: Blaster shall be construed to refer to a company or individual who is conducting blasting operations or to the individual who is performing or providing substantial supervision of blasting operations, as the context of the discussion requires. The term: fire code official shall be construed to mean the Fire Marshal of the local governing authority, or anyone operating under the direction of the Fire Marshall or authorized fire official of the local governing authority.

The CONTRACTOR shall use only such methods as are currently utilized by persons, firms or corporations engaged in a similar construction business. The CONTRACTOR shall be solely responsible for the determination as to whether explosives shall be used and for any result from the use of explosives. No blasting will be allowed within any area under the jurisdiction of the local governing authority unless the Blaster has in his possession a valid, current blasting permit issued by the fire code official. Obtaining a blasting permit from the City's Fire Department does not constitute permission to use explosives. Permission to use explosives is not granted or denied prior to award. The CONTRACTOR shall not assume in its bid that permission to use explosives will be granted. Blasting will be considered for approval by the OWNER on a case-by-case basis. Denial by the OWNER of permission to use explosives shall not constitute a basis for a claim for additional costs.

Where use of explosives is permitted, the CONTRACTOR EXPRESSLY AGREES TO BE SOLELY RESPONSIBLE for the determination as to whether explosives shall actually be used, and for any result from the use, handling or storage of explosives, and shall DEFEND, INDEMNIFY AND HOLD COMPLETELY HARMLESS THE OWNER, its officers, agents and employees, and the Consulting Engineer against any and all claims, lawsuits, judgments, costs and expenses, for personal injury (including death), property damage or other harm for which recovery of damages is sought, suffered by any person or persons, as the result of the use, handling or storage of explosives by the CONTRACTOR or any SUBCONTRACTOR, REGARDLESS OF WHETHER SAID USE, HANDLING OR STORAGE WAS NEGLIGENT OR NOT, AND REGARDLESS OF WHETHER THE DAMAGE OR INJURY WAS CONTRIBUTED TO IN ANY WAY BY THE NEGLIGENCE OR FAULT OF THE OWNER, ITS OFFICERS, AGENTS OR EMPLOYEES, OR THE CONSULTING ENGINEER. In the event of conflict with any other indemnity paragraph in this CONTRACT, this paragraph controls. This indemnity paragraph is intended solely for the benefit of the parties and is not intended to create or grant any rights, contractual or otherwise, to any other person or entity. The CONTRACTOR shall furnish the OWNER and Consulting Engineer with evidence of insurance sufficient to cover possible damage or injury, which insurance shall either include the OWNER and Consulting Engineer as additional insured or be of such character as to fully protect the OWNER and Consulting Engineer.

The fire code official is authorized to limit the quantity of explosives, explosive materials, or fireworks permitted at a given location. No person, possessing a permit for storage of explosives at any place, shall keep or store an amount greater than authorized in such permit. Only the kind of explosive specified in such a permit shall be kept or stored. The following criteria with regard to the use of explosives and blasting shall be satisfied:

- a. **Certification:** Certification by the proper authorities for personnel involved with the actual use of explosives is required and must be obtained prior to the use of explosives.
- b. **Insurance:** The CONTRACTOR shall furnish the OWNER with evidence of insurance sufficient to cover any such possibility, which insurance shall either include the owner as an assured or be of such character as to protect the owner.
- c. **Restrictions:** No blasting shall be permitted within highway right-of-way or railroad right-of-way without written permission from TxDOT, the railroad involved, and the OWNER.

- d. **Limitations:** When blasting is authorized, the blast shall be covered with heavy timbers chained together, a rope mat, or some other equally effective method of blast effect protection, approved by the OWNER. All explosives shall be stored in a safe and secure manner and such storage places shall be clearly marked, "DANGEROUS — EXPLOSIVES." Blasting caps and explosives shall be stored separately. In addition to the "DANGEROUS — EXPLOSIVES" sign which must be displayed, at least two signs marked, "EXPLOSIVES, TURN ALL RADIOS OFF," shall be placed in a conspicuous location readily visible to vehicular traffic and not less than 350-ft. from electric explosive caps storage area. During each blast, the exposed end of the pipe shall be covered with planking.

Surface-blasting operations shall only be conducted between the hours of 8:00 A.M. through 5:00 P.M. Monday through Friday, holidays excluded. Blasting operations may be temporarily suspended at the order of the fire code official for reasons of public health or safety.

- e. **Notification:** The CONTRACTOR shall notify each utility company having structures in proximity to the site of the work of the intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to take such steps, as they may deem necessary to protect their property from injury. Such notice shall not relieve the CONTRACTOR of responsibility for any damage resulting from blasting operations.

Whenever a new explosive material storage or manufacturing site is established, including a temporary job site, the Blaster shall notify the following officials:

The local law enforcement agency at (830) 693-3611: The fire code official

These officials shall be notified 48 hours in advance, not including Saturdays, Sundays and holidays, of the type, quantity and location of explosive materials at the site.

Whenever blasting is being conducted in the vicinity of utility lines or rights-of-way, the Blaster shall notify the appropriate representatives of the utilities at least 24 hours in advance of blasting, specifying the location and intended time of such blasting. Verbal notices shall be confirmed with written notice.

In an emergency situation, the time limit shall not apply when approved. All blasting operations shall be preceded by a pre-blast notification to the owners or managers of all affected premises. The minimum range of the pre-blast notification shall be as required by the permit; at the Blaster's discretion, the pre-blast notification range may be expanded.

- f. **Laws and Ordinances:** The method of blasting, storing, and handling explosives must be carried on in full conformance with the requirements of all federal and state laws and municipal ordinances.
- g. **Permitting:** The blasting permit shall remain valid for the duration of the job not to exceed six months without written approval whichever comes first, or until the certificate of insurance expires. The permit shall not be assigned or transferred. The permit shall not be issued to a person under 21 years of age. All permit applications shall include the following information:
- (1) Site Plan of area to be blasted.
 - (2) Type and quantity of explosives and blasting agents to be used.
 - (3) Location and means of transportation and storage of all explosives and blasting agents.
 - (4) Length of time of blasting operations. (Approximate)
 - (5) Plan of all blasts to be performed under this permit. Blast plans shall address at least, but not be limited to, the means and methods of achieving the following requirements as well as all other requirements listed in this specification:

- a) Blast induced, particle velocities shall not exceed 1.7 inches per second measured at the nearest adjacent occupied structure(s). Air Over-pressures (blast pressures) shall not exceed 129 decibels at the nearest adjacent occupied structure(s). The fire code official shall be the sole judge in determining whether any structure is or is not an occupied structure for the purposes of this requirement.
 - b) There shall be no blasting within one hundred (100) feet of any structure or building.
 - c) Regardless of the distance to nearby facilities, buildings or other structures, the blasting operation shall be carried out in such a manner that they will not cause fly rock damage or damage from air blast over pressure or ground vibration.
 - d) The Blaster shall conduct seismic monitoring of all blasts.
 - e) Blast monitors, such as a seismic blast recording machine, are required for all blasting operations for which a permit is issued by the fire code official unless specifically exempted by the fire code official.
 - f) At the Blaster's expense, a Monitoring technician, shall be used whenever a blast monitor is required. Monitoring technicians shall be independent contractors or consultants, and shall be trained in proper placement of monitor sensors and proper functioning of the instrument to be used.
 - g) Approved blasting machines shall be used. All other equipment is prohibited.
 - h)
 - i) Minimum proposed pre-blast notification range and method for each blast. Minimum pre-blast notification requirements include 24-hour written notice using a standard flyer to all residents of occupied structures within five hundred (500) feet and to all utilities within three hundred (300) feet of blasting activities.
- (6) Other conditions may be set by the fire code official for the approval of a permit application that are necessary, in his opinion, to adequately protect the public health and safety. These conditions may include, but are not limited to, reduced allowable particle velocities, additional monitoring, increased insurance protection, hours of operation, type and amount of explosives used and engineered blasting plans.
- (7) The permit application shall be submitted to the fire code official for review. The Blaster shall remedy any deficiencies in the permit application or provide any additional information related to the specific blast area as required by the fire code official before the permit will be approved and granted.
- h. **Blasting Log:** The blasting log shall be kept at the project site and be made immediately available for review by the Owner, Engineer, or City Officials. Upon completion of the blasting operations described in the permit, the original blasting log shall be submitted to the fire code official for his permanent records. The Blaster shall maintain a blasting log containing at least the following information:
- (1) The full company name and contact information of the person who is responsible for the operations listed in the blasting permit.
 - (2) The blasting permit.
 - (3) The names, contact information, and qualifications of all persons who serve as the immediate supervisor(s) of each individual blast operation.
 - (4) All relevant technical data for each individual blast, including but not limited to: the specific location, time, date, explosives used, connection details, triggering devices and methods, charge depths, drilling depths and hole sizes, filler material, blast mats, padding, and any other safety measures used for each individual blast.
 - (5) All relevant information from the Blast Monitor, including technical data, measurements, conclusions, and recommendations.
 - (6) All comments, citations, and / or instructions received from City Officials related to the overall blasting operation or to individual blasts.

- i. **Financial Responsibility:** Before a permit is issued, the applicant shall file with the fire code official a corporate surety bond in the principal sum of \$5,000,000 or a public liability insurance policy for the same amount, for the purpose of the payment of all damages to persons or property which arise from, or are caused by, the conduct of any act authorized by the permit upon which any judicial judgment results. Government entities shall be exempt from this bond requirement.

- j. **Qualifications:** Persons in charge of magazines, blasting, fireworks display, or pyrotechnic special effect operations shall not be under the influence of alcohol or drugs which impair sensory or motor skills, shall be at least 21 years of age, and shall demonstrate knowledge of all safety precautions related to the storage, handling or use of explosives, explosive materials or fireworks and be able to demonstrate and / or document the minimum qualifications listed in this specification. Specifically each person who proposes to act as a Blaster within the jurisdiction of the local governing authority shall meet and be able to demonstrate that he meets the minimum qualifications listed below:
 - (1) A Blaster shall be able to understand and give written and oral orders.
 - (2) A Blaster shall be in good physical condition and not be addicted to narcotics, intoxicants, or similar types of drugs.
 - (3) A Blaster shall be qualified, by reason of training, knowledge, or experience, in the field of transporting, storing, handling, and use of explosives, and have a working knowledge of State and Local laws and regulations which pertain to explosives.
 - (4) A Blaster shall be required to furnish satisfactory evidence of competency in handling explosives and performing in a safe manner the type of blasting that will be required.
 - (5) A Blaster shall be knowledgeable and competent in the use of each type of blasting method used.
 - (6) Blasting operations shall be conducted only by approved, competent operators familiar with the required safety precautions and the hazards involved and in accordance with the provisions of the National Fire Protection Association code 495 (NFPA 495). This code is available on the internet from: <http://www.nfpa.org>

- k. **Minimum Safety Operations:** Loading explosives or blasting agents shall be performed using the minimum standards and procedures listed below. All explosive work will be done in accordance with Title 29 Code of Federal Regulation Part 1928, Safety and Health Regulations for Construction (OSHA).
 - (1) Procedures that permit safe and efficient loading shall be established before loading is started.
 - (2) All drill holes shall be sufficiently large to admit freely the insertion of the cartridges of explosives.
 - (3) Tamping shall be done only with wood rods or plastic tamping poles without exposed metal parts, but non-sparking metal connectors may be used for jointed poles. Violent tamping shall be avoided. The primer shall never be tamped.
 - (4) No holes shall be loaded except those to be fired in the next round of blasting. After loading, all remaining explosives and detonators shall be immediately returned to an authorized magazine.
 - (5) Drilling shall not be started until all remaining butts of old holes are examined for unexploded charges, and if any are found, they shall be re-fired before work proceeds.
 - (6) No person shall be allowed to deepen drill holes which have contained explosives or blasting agents.
 - (7) No explosives or blasting agents shall be left unattended at the blast site.

- (8) Machines and all tools not used for loading explosives into bore holes shall be removed from the immediate location of holes before explosives are delivered. Equipment shall not be operated within 50 feet of loaded holes.
- (9) No activity of any nature other than that which is required for loading holes with explosives shall be permitted in a blast area.
- (10) Power lines and portable electric cables for equipment being used shall be kept a safe distance from explosives or blasting agents being loaded into drill holes. Cables in the proximity of the blast area shall be de-energized and locked out by the Blaster.
- (11) Holes shall be checked prior to loading to determine depth and conditions. Where a hole has been loaded with explosives but the explosives have failed to detonate, there shall be no drilling within 50 feet of the hole.
- (12) Explosives will be delivered to the job by a licensed explosive supplier in a vehicle which meets ATF and DOT rules and regulations for transportation of explosives over public roads. All explosives will be under constant visual observation of a licensed blaster while on the job.
- (13) Any remaining explosive materials will be picked up by the supplier and returned to his magazine. There will be no on-site storage of explosives.
- (14) When loading a long line of holes with more than one loading crew, the crews shall be separated by practical distance consistent with efficient operation and supervision of crews.
- (15) No explosive shall be loaded or used underground in the presence of combustible gases or combustible dusts.
- (16) No explosives other than those in Fume Class 1, as set forth by the Institute of Makers of Explosives, shall be used; however, explosives complying with the requirements of Fume Class 2 and Fume Class 3 may be used if adequate ventilation has been provided.
- (17) All blast holes in open work shall be stemmed to the collar or to a point which will confine the charge.
- (18) Warning signs, indicating a blast area, shall be maintained at all approaches to the blast area. The warning sign lettering shall not be less than 4 inches in height on a contrasting background.
- (19) A bore hole shall never be sprung when it is adjacent to or near a hole that is loaded. Flashlight batteries shall not be used for springing holes.
- (20) Drill holes which have been sprung or chambered, and which are not water-filled, shall be allowed to cool before explosives are loaded.
- (21) No smoking shall be permitted within fifty 50 feet (15.25m) of any location where explosives are being handled or used.
- (22) No blasting operation shall be conducted in a manner contrary to the instructions of the manufacturer of the explosive materials being used.
- (23) When blasting is done in a congested area or in close proximity to a structure, railway or highway, or any other installation, precautions shall be taken to minimize earth vibrations and air blast effects. Blasting mats or other protective means shall be used to prevent fragments from being thrown.
- (24) No loaded holes shall be left unattended or unprotected.
- (25) The Blaster shall keep an accurate, up-to-date record of explosives, blasting agents, and blasting supplies used in a blast and shall keep an accurate running inventory of all explosives and blasting agents stored on the operation.
- (26) When loading blasting agents pneumatically over electric blasting caps, semi-conductive delivery hose shall be used and the equipment shall be bonded and grounded.
- (27) Motor vehicles or conveyances transporting explosives shall only be driven by, and be in the charge of, a licensed driver who is physically fit. He shall be familiar with the Local, State, and Federal regulation governing the transportation of explosives. He will have a CDL with an Hazmat endorsement.

- (28) No person shall smoke, or carry matches or any other flame-producing device, nor shall firearms or loaded cartridges be carried while in or near a motor vehicle or conveyance transporting explosives.
- (29) Explosives, blasting agents, and blasting supplies shall not be transported with other materials or cargoes. Blasting Caps (including electric) shall not be transported in the same cargo space with other explosives.
- (30) Vehicles used for transporting explosives shall be strong enough to carry the load without difficulty, and shall be in good mechanical condition.
- (31) When explosives are transported by a vehicle with an open body, a Class II magazine or original manufacturer's container shall be securely mounted on the bed to contain the cargo.
- (32) All vehicles used for the transportation of explosives shall have tight floors and any exposed spark-producing metal on the inside of the body shall be covered with wood or other non-sparking material, to prevent contact with containers of explosives.
- (33) Every motor vehicle or conveyance used for transporting explosives shall be marked or placarded on sides, the front, and the rear.
- (34) Each vehicle used for transportation of explosives shall be equipped with a fully charged fire extinguisher, in good condition. An Underwriters Laboratory-approved extinguisher of not less than 10-ABC rating will meet the minimum requirement. The driver shall be trained in the use of the extinguisher on his vehicle.
- (35) Motor vehicles or conveyances carrying explosives, blasting agents, or blasting supplies, shall not be taken inside a garage or shop for repairs or servicing.
- (36) No motor vehicle transporting explosives shall be left unattended.

During the time that holes are being loaded or are loaded with explosive materials, blasting agents or detonators, only authorized persons engaged in drilling and loading operations or otherwise authorized to enter the site shall be allowed at the blast site. The blast site shall be guarded or barricaded and posted. Blast site security shall be maintained until after the post-blast inspection has been completed.

Persons authorized to prepare explosive charges or to conduct blasting operations shall use every reasonable precaution, including but not limited to warning signals, flags, barricades, mats, or other equally effective means to ensure the safety of the public and workers.

Holes drilled for the loading of explosive charges shall be made and loaded in accordance with NFPA 495. After loading for a blast is completed and before firing, excess explosive materials shall be removed from the area and returned to the proper storage facilities. **The initiation of blasts** shall be by means conforming to the provisions of NFPA 495.

- l. **Post-Blast Procedures:** After the blast, no person shall return to the blast area until allowed to do so by the Blaster in charge. The blasting personnel shall give the "All Clear" signal before any other person or equipment is permitted inside the Blast Safety Zone. The Blaster shall allow sufficient time for smoke and fumes to dissipate and for dust to settle before returning to or approaching the blast area. The Blaster shall inspect the entire blast site for misfires before allowing other personnel to return to the blast area. The local governing authority, at its expense, through the fire code official or other appropriate officials or representatives, reserves the right to inspect, monitor, review, and otherwise evaluate the results of the blasting operation(s) on an ongoing basis using any reasonable methods, means, and schedules. If in the opinion of the fire code official, the observed results of the blasting operations indicate any possible threat to public health or safety or property damage, the fire code official may cancel the existing blasting permit and require that the Blaster request a new blasting permit that contains adequate revisions fully addressing the fire code official's concerns.
- m. **Misfires:** All explosives charges will be provided with multi or looped detonation paths to reduce the possibility of misfire. Following blast detonation the licensed blaster will visually

inspect all charges to confirm complete detonation prior to resuming site work. If any demolition charge did not detonate the charge will be recapped and the detonation procedure repeated.

Where a misfire is suspected, all initiating circuits shall be traced and a search made for unexploded charges. Where a misfire is found, the Blaster shall provide proper safeguards for excluding all personnel from the blast area. Misfires shall be reported to the blasting supervisor immediately. Misfires shall be handled under the direction of the person in charge of the blasting operation in accordance with NFPA 495.

- n. **Measurement and Payment:** Blasting operations are considered subsidiary to any related items, such as excavation or trenching. Blasting will be paid directly only in the case where the Contract Documents contain a Special Provision to this Specification Item detailing the means of measurement and payment.

206.3.F.2. Tunneling: When the CONTRACTOR installs a utility line by jacking, boring, or tunneling, the CONTRACTOR shall comply with the provisions of Item for Trenchless Installation. When shown on the plans or proposal or as directed by the OWNER, the CONTRACTOR shall be paid for tunneling work as outlined in the bid proposal.

If approved by the OWNER, the CONTRACTOR may voluntarily elect to install by tunneling, boring or jacking any portion of the work that is designated on the plans for open cut installation. The CONTRACTOR shall be paid for only the pay items that would have been paid for if the work had been done by open cut.

206.3.F.3. Cofferdam: Where shown and/or detailed on the plans, excavation shall be performed within a cofferdam. The CONTRACTOR shall install and securely brace the cofferdam in accordance with Item for Cofferdams and shall remove the excavation within the area so protected without damage to or displacement of the cofferdam and bracing.

206.4 MEASUREMENT AND PAYMENT

Unless otherwise noted this item shall be subsidiary to the utility installation item. If authorized, channel excavation shall be measured in its original position and the volume in cubic yards (C.Y.) determined by the average end area method. All work performed as prescribed by this Item shall be paid for at the contract unit price per cubic yard for unclassified channel excavation. If no separate bid item is provided for unclassified channel excavation, then such costs shall not be paid for directly but shall be considered as subsidiary work pertaining to the utility item installed.

The prices bid shall be full compensation for furnishing all labor, materials, tools, equipment, compaction, hauling and incidentals necessary to complete the work. Payment for unauthorized work shall not be made. All work required for disposing of waste, including haul shall not be paid for directly but shall be considered as subsidiary work pertaining to various contract items, and such costs shall be included in the unit prices bid for these items.

207 BORROW

207.1 DESCRIPTION

Borrow shall consist of required excavation, removal, and proper utilization of materials obtained from designated or approved sources. All authorized borrow shall be "unclassified" unless otherwise noted.

207.2 MATERIALS

All authorized borrow shall conform to one of the following classes:

- a. **Class A (Select Borrow):** This material shall consist of sand or other suitable granular material, free from vegetation or other objectionable matter reasonably free from lumps of earth and when tested by standard TxDOT laboratory methods, shall meet the following requirements:
- | | |
|---|----|
| The Liquid Limits shall not exceed | 45 |
| The Plasticity Index shall not be less than | 4 |
| nor more than | 15 |
- b. **Class B:** This material shall consist of suitable non-swelling (soils with plasticity index less than 20) earth material such as loam, clay or other such materials that will form a stable embankment.
- c. **Topsoil:** This material shall consist of approved topsoil material and shall be clean, friable soil capable of supporting plant life. This material shall also be free of stones and all other debris.

Where shown on the plans, selected materials shall be utilized in the formation of embankment, embedment or backfill, or to improve the roadbed, in which case the work shall be performed in such manner and sequence that suitable material may be selected, removed separately and deposited in the roadway within limits and all elevations required. When required, acceptable borrow material, tested by standard laboratory methods, and shall meet the requirements indicated on the plans.

Additional material necessary to complete the work described above shall be "Borrow" of the class specified. The Contractor shall arrange for borrow from one of the following sources:

1. Existing borrow pit,
2. New borrow pit, or
3. Surplus excavated material from a site that has a site development permit.

The Contractor shall notify the Engineer three (3) weeks prior to opening pit to permit necessary testing for approval of materials. All borrow sites shall comply with the requirements of the permit.

During construction, the borrow sources shall be kept drained, insofar as practicable, to permit final cross sections to be taken, when required. The Engineer shall be notified sufficiently in advance of opening any borrow source to permit necessary testing for approval of materials.

Borrow sites shall be managed to minimize the impact of the appearance of the natural topographic features and at no time create a potential hazard to the public.

207.3 CONSTRUCTION METHODS

Prior to commencing this work, all erosion control and environmental measures required shall be in place. All suitable materials removed from the excavation shall be used, insofar as practicable, in the formation of the embankment as required by the governing item for embankment; or shall otherwise be utilized as indicated on the plans or as directed. The completed work shall conform to the established alignment, grades and cross section. Site of the borrow operations shall be left in a suitable and acceptable condition, such as to provide proper drainage where practicable. Where indicated on the plans, the sides and/or ends of borrow pits shall be sloped to the dimensions indicated on the plans.

207.4 MEASUREMENT AND PAYMENT

Borrow shall be measured in a compacted condition in its final position and the volume computed in cubic-yards (C.Y.) by the method of average end areas, or as specified otherwise. All work performed as required herein and in the Item for Embankment, and measured as provided in this Item shall be paid for at the unit price bid. Payment shall not be allowed for excavation for any material which is used for purposes other than those designated. The unit price shall be full compensation for furnishing all labor, for materials, tools, equipment, compaction, hauling and incidentals necessary to complete the work, as well as for all royalties.

208 EMBANKMENT

208.1 DESCRIPTION

Embankment shall consist of the placement and compaction of all suitable materials obtained from excavation, borrow or any other approved excavation.

208.2 CONSTRUCTION METHODS

Prior to the placing of any embankment, all clearing and grubbing, or site preparation shall have been completed. Stump holes or other small excavations within the limits of the embankment shall have been backfilled before commencing the embankment construction. The surface of the ground, including plowed or loosened ground or small ditches or washes, shall be restored to approximately its original slope.

The surface of hillsides shall be loosened by the scarifying or plowing to a depth of not less than 8-in. or cut into steps before embankment materials are placed. The embankment shall then be placed in layers as hereinafter specified, beginning at the low side in part widths as the embankment is raised. The material which has been loosened shall be re-compacted simultaneously with the embankment material placed at the same elevation. Where embankment is to be placed over or adjacent to the existing roadbeds, the slopes shall be plowed or scarified to a depth not less than 8-in. and the embankment built up in successive layers, as hereinafter specified, to the level of the old roadbed before its height is increased. Then the old roadbed shall be scarified and re-compacted with the next layer of embankment. The total depth of the scarified and added materials shall not exceed the permissible depth of the layer.

All embankments for roadbeds shall be constructed in layers approximately parallel to the finished grade of the street and shall be so constructed as nearly as possible to conform to the cross section of the subgrade section.

Embankments shall be constructed to the established grade and to the shape of the typical section shown on the plans, and each section shall conform to the detailed sections of slopes. After completion of the embankment, it shall be continuously maintained to its finished section and grade until the project is accepted.

Construction equipment shall not be operated within the drip line of trees, unless indicated. Construction materials shall not be stockpiled under the canopies of trees. No excavation or embankment shall be placed within the drip line of trees until tree wells are constructed. Prior to placing any embankment, all trees protection, tree wells, and erosion control devices shall be in place.

All embankments shall be constructed in layers approximately parallel to the finished grade and unless otherwise indicated, each layer shall be so constructed as to provide a uniform slope of $\frac{1}{4}$ inch per foot from the centerline of the roadbed to the outside, except that on super-elevated curves, each layer shall be constructed to conform to the super-elevation indicated.

The embankment shall be continuously maintained at its finished section and grade until that portion of the work is accepted. After completion of the embankment to the finished section and grade, vegetation procedures must commence immediately to minimize the soil loss and air pollution.

208.2.A. Earth Embankments

Earth embankments shall be constructed in successive layers, for the full width of specified depth or cross sections; and in such lengths as are suitable for the sprinkling and compaction methods to be used. Each layer of earth embankment shall be uniform as to material, density, and moisture content before beginning compaction. Prior to compaction, the layers shall not exceed 6-in. in depth for pneumatic tire rolling or 8-in. in depth for rolling with other types of rollers.

Except in utility construction, minor quantities of rocks not larger than 4 inches, encountered in constructing earth embankment may be incorporated in the earth embankment layers, provided such placement of rock is not immediately adjacent to structures, and with prior permission by OWNER. If CONTRACTOR requests incorporating small amounts of rocks less than 4 inches into the embankment of utility

construction, then embankment layer containing rocks shall be no closer than 18 inches from outside surface of the utility.

208.2.A.1. Embankment over Pipes: Earth embankment placed adjacent to and over pipes, culverts, arches and bridges shall be of suitable material and shall be placed in successive layers approximately horizontal. Layers of embankment shall be brought up uniformly on each side of the structure, and special care shall be taken to prevent any wedging action against the structure. For such distances along embankments adjacent to structures where it is impracticable to obtain compaction by rolling, the embankment material shall be placed in layers not exceeding 6-in. in depth of loose material wetted uniformly to the moisture content directed; and shall then be compacted by methods approved by the OWNER, maintaining the required moisture content by additional sprinkling, if necessary, supplemented by such hand work as is necessary to secure a uniform and thoroughly compacted fill, until each layer has been uniformly compacted to the satisfaction of OWNER.

208.2.A.2. Compaction: Each layer shall be compacted to the required density by any method, type and size of equipment which will give the required compaction. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.

For each layer of earth embankment and select material, it is the intent of this specification to provide the density as required herein, unless otherwise indicated. Soils shall be sprinkled as required and compacted to the extent necessary to provide not less than 95 percent nor more than 105 percent of the maximum density as determined in accordance with TxDOT Test Method Tex-114-E at optimum moisture content or within 3 percent of the optimum moisture content. Care shall be taken to avoid over-compacting high PI expansive clays.

208.2.B. Rock Embankments

Rock embankments shall be composed principally of rock and shall be constructed in successive layers for the full width of the specified depths or cross sections, and each layer shall be 18-in. or less in depth. Each layer shall be constructed by starting at one end, dumping the rock on top of the layer being constructed and then pushing the dumped material ahead in such a manner that the larger rock shall be placed on the ground or preceding rock embankment layer; and the interstices between the larger stones shall be filled with smaller stones and spalls both by this operation and from the placing of succeeding loads of rock materials. The upper 3-ft shall contain no stones larger than 4-in. in their maximum dimension, and insofar as such is available by selection of the excavation, this layer shall be composed of materials so graded that the maximum density and uniformity of the surface layer may be secured. Each rock embankment layer shall be rolled as directed by the OWNER.

In the sole determination of the engineer larger rock might be used in areas requiring substantial fill depth, however in no case shall any rock over 2 feet in its greatest dimension be placed in the embankment. All oversized rocks which are otherwise suitable for construction shall be broken to the required dimension and utilized in embankment construction where indicated, except that when preferred by the Contractor and acceptable to the Engineer, such rocks may be placed at other points where the embankment layer is of greater depth, thus requiring less breakage.

In addition to the foregoing selection of materials and utilization of the materials in the embankment, the embankment shall be constructed in the proper sequence to receive select materials as specified or as shown on the plans, with any modifications as may be directed by the OWNER. The layer of embankment immediately preceding the upper layer of select material shall be constructed to the required cross section and the proper elevation within a tolerance of not more than 0.1-ft. from the established cross section or elevation after proper compaction and shall be finished as necessary to receive the select material.

208.2.C. Density

For each layer of earth embankment and select material, the relative compaction of the embankment shall be as shown on the plans. Unless otherwise indicated on plans or elsewhere in the contract documents the compaction criteria of Item for Earth Embankment shall apply.

After each layer of earth embankment or select material is complete, nuclear density testing shall be performed at random locations within the cross section at a rate of one test per 500' per lane. If the material fails to meet the density specified, the course shall be reworked as necessary to obtain the specified compaction and moisture content.

208.3 MEASUREMENT AND PAYMENT

Embankment shall not be measured or paid for as a separate contract pay item, but the cost of construction of the embankment complete in place shall be included in such contract pay items as described in standard specifications Item for Unclassified Street Excavation or Item for Unclassified Channel Excavation, or Item for Borrow. The contract pay items provided shall be full compensation for the furnishing of all labor, material, tools, equipment and incidentals necessary to complete the embankment, including cost of water, sprinkling or wetting, rolling, compaction, etc., in accordance with the plans and specifications.

209 DUST CONTROL

209.1 DESCRIPTION

Sprinkling for dust control shall consist of the authorized application of water or other material approved by the OWNER on those portions of the projects as shown on the plans or as directed and as herein specified. It shall be the responsibility of the CONTRACTOR to take preventive measures to eliminate, reduce, or alleviate any dust nuisance in the work area. This control of dust nuisance is most important in populated areas. The OWNER will approve the method used. Should the CONTRACTOR fail to control dust as outlined above, the OWNER may suspend the work until corrective measures are taken.

The CONTRACTOR shall maintain all excavations, embankment, stockpiles, haul roads, and access roads within or outside the project boundaries free from dust, which would cause a hazard or nuisance to adjacent Property Owners. The CONTRACTOR shall use sprinkling or other methods acceptable to the OWNER to control dust.

209.2 MATERIALS

Water or other material approved by the OWNER shall be furnished by the CONTRACTOR and shall be clean, free from industrial waste and other objectionable matter. Emulsions shall meet the requirements of Item for Emulsions for Priming, Curing and Erosion Control.

209.3 CONSTRUCTION METHODS

The CONTRACTOR shall furnish and operate a sprinkler equipped with positive and rapidly working cutoff valves and approved spray bars, which shall insure the distribution of material in a uniform and controllable rate of application. It shall be the CONTRACTOR's continuous responsibility to be on call at all times including nights, holidays, weekends, etc. and respond in a timely manner, until acceptance of the project by the OWNER, to maintain the project free of dust in a manner which shall cause the least inconvenience to the public.

209.4 MEASUREMENT AND PAYMENT

Sprinkling performed as provided above shall be measured by the 1,000-gallons (gal) as delivered on the project. Sprinkling provided in the proposal and the contract as a separate pay item shall be paid for in accordance with the contract unit price. When sprinkling is not classified separately for payment, then such sprinkling shall be considered as incidental work and shall not be paid for as a separate item; the cost thereof shall be included in such contract pay items as are provided. In either case, such pay items shall be the total compensation for all labor, materials, tools, machinery, equipment and incidentals necessary to complete the work in accordance with the plans and this specification.

210 CLEARING AND GRUBBING

210.1 DESCRIPTION

This item shall be in lieu of Item for Site Preparation. This item shall consist of removing and disposing of all trees, stumps, brush, roots, shrubs, vegetation, logs, rubbish and other objectionable material.

210.2 CONSTRUCTION METHODS

Prior to commencing this work, all erosion control and tree protection measures required shall be in place and all utilities located and protected as set forth in the Contract Documents. Areas within the construction limits or as indicated shall be cleared of all trees, stumps, brush, etc., as defined above; except trees or shrubs indicated for preservation which shall be carefully trimmed as directed and shall be protected from scarring, barking or other injuries during construction operations. Exposed ends of pruned limbs or scarred bark shall be pruned, trimmed and treated with an approved asphaltic material within 24 hours of the pruning or injury.

210.2.A. Excavation Near Trees

Construction equipment shall not be operated within the drip line of trees, unless indicated. Construction materials shall not be stockpiled under the canopies of trees. No excavation or embankment shall be placed within the drip line of trees until trees wells are constructed.

Within the construction limits or areas indicated, all obstructions, stumps, roots, vegetation, abandoned structures, rubbish and objectionable material shall be removed to the following depths:

- a. In areas to receive 6 inches or more embankment, a minimum of 12 inches below natural ground.
- b. In areas to receive embankment less than 6 inches and areas to be excavated, 18 inches below elevation of the embankment, structure or excavation.
- c. All other areas, 12 inches below natural ground.

Holes remaining after removal of all obstructions, objectionable material, trees, stumps, etc., shall be backfilled with select embankment material and tamped.

All cleared and grubbed material shall be disposed of in a manner satisfactory to the Engineer. Unless otherwise provided, all materials as described above shall become the property of the Contractor and removed from the site and disposed of at a permitted disposal site.

Burning materials at the site shall be subject to the approval of the Fire Marshall and the Engineer.

210.2.B. Selective Clearing and Grubbing

Selective Clearing and Grubbing shall be performed in accordance with the requirements established above and shall consist of removal of **only the minimum** amount of trees, brush, or foliage required for the Contractor to complete his operations. The Contractor **shall not clear cut** any areas within the limits of construction. The Contractor shall make all reasonable efforts to avoid damage to existing trees or existing tree limbs. Where it is absolutely required to provide clearance, the Contractor may remove tree limbs by using a chain saw to provide a clean cut.

The Contractor shall not remove any trees shown on the plans with Tree Protection. For all such trees shown with Tree Protection, the contractor shall use rock hammers and excavators to excavate as close to the tree as required as opposed to using trenchers, which cannot pass close to the tree without damaging the limbs or trunk.

210.3 MEASUREMENT AND PAYMENT

"Clearing and Grubbing," when included in the contract as a pay item, will be measured by the acre, 100 foot stations, or lump sum regardless of the width of the right of way.

"Selective Clearing and Grubbing," when included in the contract as a pay item, will be measured by the acre, 100 foot stations, or lump sum regardless of the width of the right of way.

This item will be considered subsidiary to Item for Site Preparation, unless included as a separate pay item in the contract. When included for payment, it shall be paid under one of the items listed below, which price shall be full compensation for all work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment, when included as a contract pay item, for both "Clearing and Grubbing," as well as "Selective Clearing and Grubbing," will be made under one of the following: per Acre (Ac), per Station (STA), or per Lump Sum (LS).

211 SURFACE STRIPPING

211.1 DESCRIPTION

This item shall consist of scarifying, blading and removing the top 4" of vegetation, soil and other materials to obtain a uniform texture and provide as nearly as practicable a uniform density for the subgrade, or other depths as may be called out in the plans or the bid form, as identified by the Engineer.

211.2 CONSTRUCTION METHODS

Surface stripping shall be performed prior to or in conjunction with clearing and grubbing. The natural ground shall be scarified to a depth of 4" below the natural ground in the proposed right of way. At the Engineer's discretion and with the Engineer's approval, stripped material may be stockpiled on site and reused as topsoil. All unused stripped material shall become the property of the Contractor and shall be removed and disposed in an approved manner.

211.3 MEASUREMENT AND PAYMENT

All Surface Stripping within street right of way will be measured per 100 foot station regardless of the width of the right of way. Measurements other than street right of way will be made either per Acre (Ac) or per Lump Sum (LS).

Surface Stripping, if included in the bid, shall be measured as specified above and paid as described above, which price shall be full compensation for all work herein specified, including the furnishing of all materials, equipment, tools and labor and incidentals necessary to complete the work.

212 MAILBOX REMOVAL & RECONSTRUCTION

212.1 DESCRIPTION

This item shall govern removal of all mailboxes, installation of all temporary mailboxes, and reconstruction of all permanent mailboxes and appurtenances throughout the entirety of the project.

Prior to bidding the contractor shall review all mailboxes, materials and methods of construction.

212.2 MATERIALS

All materials required for installation of permanent mailboxes under this specification shall be new and equivalent to the existing materials subject to approval by the owner. All materials from mailboxes to be removed shall become the property of the contractor and shall be disposed of in an approved manner.

212.3 CONSTRUCTION METHODS

In order to comply with the phasing requirements of the project, the contractor is required to implement temporary installations of existing mailboxes for each phase. The Contractor is required to insure that each temporary mailbox installation complies with the requirements of the United States Postal Service, in addition to the requirements in the contract documents.

Mailboxes that are temporarily relocated through the course of the project may be installed on approved temporary mountings, subject to the approval of the Engineer. All methods of construction shall produce a mailbox equivalent to the existing structure at completion of the project. All temporary and permanent mailbox construction and location shall meet all requirements of the United States Postal Service, in addition to the requirements in the contract documents.

212.4 MEASUREMENT AND PAYMENT

The removal, temporary installation, relocation(s), and reconstruction of all mailboxes throughout the entirety of the project will be measured Each (EA) complete in place. All removals, relocations, temporary installations, and permanent reconstruction shall be included as a single item.

The work performed and material furnished as prescribed by this item and measured as provided above will be paid per Each (EA). The price shall include full compensation for furnishing, preparing, hauling and installing all required materials, labor, tools, equipment and incidentals necessary to complete work as required.

213 SIGN REMOVAL & RECONSTRUCTION

213.1 DESCRIPTION

This item shall govern removal of all utility, directional, roadway, and other similar signs, installation of all temporary, and reconstruction of all permanent signs and appurtenances as indicated in the construction plans.

Prior to bidding the contractor shall review all signs, materials and methods of construction.

213.2 MATERIALS

The items and methods addressed in this Item shall conform to the specifications, except as otherwise detailed in this Special Specification or in the plans. Sign materials shall be replaced with materials of like kind as approved by the Engineer.

213.3 CONSTRUCTION METHODS

In order to comply with the phasing requirements of the project, the contractor is required to implement temporary installations of roadway signs as needed. The Contractor is required to insure that each temporary sign comply with requirements in the contract documents.

213.4 MEASUREMENT AND PAYMENT

The removal and reconstruction of roadway signs as indicated in the plans will be measured per each complete in place. All removals, reconstruction, and temporary signs shall be will be measured Each (EA) complete in place.

The work performed and material furnished as prescribed by this item and measured as provided above will be paid per each. The price shall include full compensation for furnishing, preparing, hauling and installing all required materials, labor, tools, equipment and incidentals necessary to complete work as required.

The work performed and material furnished as prescribed by this item and measured as provided above will be paid per Each (EA).

214 CONCRETE REMOVAL

214.1 DESCRIPTION

Break, remove, and salvage or dispose of existing concrete structures whether pavements, floors, porches, patios, riprap, medians, foundations, sidewalks, driveways, and other appurtenances.

214.2 CONSTRUCTION METHODS

Remove existing concrete from locations shown on the plans. Avoid damaging concrete that will remain in place. If concrete structure is partially removed, then saw-cut and remove the existing concrete to neat lines. Replace any concrete damaged by the Contractor at no expense to the Owner. Unless otherwise shown on the plans, all removed concrete shall become the property of the Contractor and shall be disposed of in an acceptable manner. If specifically noted in the Construction Documents or otherwise at the Engineer's discretion, broken concrete may be reused as riprap within the project limits. Such reuse of broken concrete will require specific written approval from the Engineer.

214.4 MEASUREMENT AND PAYMENT

This item will be considered subsidiary to Item for Site Preparation, unless included as a separate pay item in the Bid Documents. If and only if included for payment, it shall be paid for at the contract price bid under one or more of the items below. This price is full compensation for breaking the concrete; loading, hauling and salvaging or disposing of the material; and equipment, labor, tools, and incidentals necessary to complete the work.

Removing concrete pavement, floors, porches, patios, riprap, medians, foundations, sidewalks, driveways, and other appurtenances will be measured by the square yard (regardless of thickness) or by the cubic yard of calculated volume, in its original position.

Removing curb, curb and gutter, and concrete traffic barrier will be measured by the linear foot in its original position. The removal of monolithic concrete curb or doweled concrete curb will be included in the concrete pavement measurement.

Removing retaining walls will be measured by the square yard along the front face from the top of the wall to the top of the footing.

The work performed and material furnished as prescribed by this item and measured as provided above will be paid per Square Yard (SY), per Cubic Yard (CY), or per Linear Foot (LF) in place.

215 POWER POLE REMOVAL AND DISPOSAL

215.1 DESCRIPTION

This item shall consist of all work necessary to remove and properly dispose of all existing power poles, guy wires, and overhead utility lines as indicated in the construction plans. The Contractor shall be responsible for all damage to items that are to remain in place.

All demolition and disposal of existing power poles and appurtenances shall be performed in compliance with the requirements of the appropriate utility provider, Owner, TCEQ and any other entity that has jurisdiction. This includes disposal of any materials considered to be hazardous waste at an approved

disposal site. Alternatively, the removed material and poles shall become the property of the Contractor, who shall then take full responsibility for complying with all applicable TCEQ regulations.

Furthermore, all work shall be coordinated with the Engineer and the utility provider, prior to disturbing any existing poles or appurtenances.

215.2 MEASUREMENT AND PAYMENT

Removal and Disposal of Power Poles shall be measured per each (EA) (of any type) removed. Payment for all items and tasks described in this Item, whether paid directly or indirectly, shall include the cost of all materials, equipment, tools, hauling, labor, fees, and incidentals necessary to complete the work and meet all requirements as indicated. Work shall be for of removed pole and restore site in place including incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing poles, structures, or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing anchors, concrete, drilling, connecting to and installing guy wires, etc., for oversized depths and supports, including testing for completion of the Work.

Payment for this item and tasks described in this Specification Item shall be measured as described above and paid per each (EA).

216 TEMPORARY POWER POLE RELOCATION

216.1 DESCRIPTION

This item shall consist of all work necessary to temporarily relocate all existing power poles that conflict with the proposed improvements.

216.2 CONSTRUCTION METHODS

Prior to completion of the project, all poles shall be reconstructed to their existing location and to a condition equal to, or better than the pre-construction condition. All work shall be performed to the satisfaction of the Engineer and utility provider. Furthermore, all work shall be coordinated with the Engineer and the utility provider, prior to disturbing any existing poles or appurtenances. It is expected that the utility provider will perform the actual pole relocation, and the Contractor shall be required to reimburse the utility provider for all such work. The Contractor shall perform other associated minor site work and adjustments with the Contractor's forces at the Contractor's expense.

216.3 MEASUREMENT AND PAYMENT

Measurement and Payment for all items of Temporary Relocation of Power Poles shall be per Item 903.2 for Power Poles.

217 DISPOSAL OF WELLS

217.1 DESCRIPTION

This item shall consist of all work necessary to remove and dispose of contaminated and uncontaminated water, petroleum, or sulfur wells. Remove appurtenances, seal and plug wells, and restore the area. Prepare and file required documents with applicable agencies.

217.2 CONSTRUCTION METHODS

CONTRACTOR shall follow legal responsibilities, construction requirements, and methods in accordance with Item for LEGAL AND CONTRACT RESPONSIBILITIES.

CONTRACTOR shall remove all pump equipment to 3 ft. below the finished subgrade or the existing grade, whichever is lower, and within construction limits. Pump equipment includes pump, piping, motor,

housing, well structures, foundations, flumes, windmills, casing, and other projecting objects associated with the well. All removed items and appurtenance become the property of the Contractor, excluding existing contaminated soil and liquids, after necessary cleaning and disassembling. Dispose of these items in accordance with applicable laws and regulations. Testing, removal, and disposal of hazardous materials will be in accordance with Item for Hazardous Materials.

Cap remaining pipe. When required by the TCEQ, the TDLR, or the RRC, submit a "Plugging Report" to the appropriate agency. Furnish a copy to the Engineer. Backfill shall be done in accordance with Item for Unclassified Channel Excavation of Item for Embankment, after removing all appurtenances.

217.2.A. Water Wells

CONTRACTOR shall remove all removable casing from water wells, including dry wells and abandoned wells. Pressure-fill the well with a mixture of hydraulic cement and water at a rate of not more than 7 gallons of water per sack of cement from the bottom of the well to the natural ground surface or 3 ft. below the finished subgrade, whichever is lower, according to the requirements of the TDLR. Alternative procedures require written approval by TDLR and the Engineer. Plug any well located in a cut section up to the proposed earthwork elevation before excavating the cut. Immediately after plugging a well in a cut section, backfill the remainder of the well above the proposed earthwork elevation as described in Item for Embankment.

217.2.B. Petroleum and Sulfur Wells

CONTRACTOR shall have a contractor from the RRC approved list plug the well. Empty the contents of petroleum or sulfur wells into approved containers according to applicable regulations. Transport and dispose of the filled containers at an approved disposal facility or recycling center according to applicable regulations. Approved plugging methods include protecting water-bearing strata with cement plugs when shown on the plans, or completely cementing the well.

217.3 MEASUREMENT AND PAYMENT

This Item will be measured by each properly plugged and disposed well. The work performed and materials furnished in accordance with this Item and measured as provided under this Item will be paid for at the unit price bid for "Disposal of Water Wells" or "Disposal of Petroleum or Sulfur Wells." This price is full compensation for removing and disposing of appurtenances; plugging; furnishing records; furnishing and placing any material or items; site restoration; and equipment, labor, tools, and incidentals.

Payment for this item and tasks described in this Specification Item shall be measured as described above and paid per each (EA).

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EROSION CONTROL
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301.1 INTRODUCTION

This Item shall govern the control measures necessary to prevent and control soil erosion, sedimentation, and water pollution that may degrade receiving waters including rivers, streams, lakes, reservoirs, groundwater, and wetlands. The control measures contained herein shall be installed and maintained throughout the construction contract and coordinated with any permanent or temporary pollution control features specified elsewhere on the plans and in the specifications to assure effective and continuous water pollution control throughout the construction and post construction periods. These control measures shall not be used as a substitute for the permanent pollution control measures unless otherwise directed by the OWNER in writing. The controls may include silt fences, check dams, diversion dikes, interceptor swales, sediment traps and basins, pipe slope drains, inlet protection, stabilized construction entrances, seeding, sodding, mulching, soil retention blankets, or other structural or non-structural storm water pollution controls. Additional information regarding these and other controls can be found on City of Marble Falls NPS and Drainage Criteria Manuals.

The OWNER reserves the right to have required temporary erosion sedimentation and water pollution prevention and control work performed by others should the CONTRACTOR fail to perform required temporary erosion, sedimentation, and water pollution prevention and control work in a timely fashion or should the CONTRACTOR fail to prevent and control soil erosion, damage control, safety, and water and air pollution which may degrade quality of air and water. All costs including engineering and right-of-way costs for the work required shall be borne by the CONTRACTOR. The CONTRACTOR shall reimburse the OWNER for all such costs within 30-days after receipt of the reimbursement request from the OWNER. Failure to submit payment for such reimbursement costs in the time prescribed above may result in the OWNER withholding the reimbursement due from the monthly progress payments to the CONTRACTOR until reimbursement to the OWNER is made.

301.2 ITEMS OF WORK AND MATERIALS

The items, estimated quantities, and locations of the control measures will be shown on the plans; however, the OWNER may increase or decrease the quantity of these items as needs arise. The materials will be shown on the plans and in the specifications. The OWNER may allow, in writing, the use of other materials and work methods as the need arises.

301.3 PRECONSTRUCTION SUBMITTALS

Prior to the start of construction, the CONTRACTOR shall submit to the OWNER'S representative for acceptance schedules for implementing stormwater pollution control measures in accordance with the erosion and sediment control plan or the construction Stormwater Pollution Prevention Plan (SWPPP). Work on the project shall not begin until the schedules for implementation of the controls and methods of operations have been reviewed and accepted by the OWNER. The CONTRACTOR shall provide the OWNER, for information purposes, proposed methods of stormwater pollution control for CONTRACTOR operations in areas which are outside the limits of the erosion control plan or the SWPPP (such as construction and haul roads, field offices, equipment and supply storage areas, portable process plants, and source material storage), as well as a plan for disposal of waste materials.

301.4 STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

The SWPPP is a document which consists of a plan to manage site water, sediment, and erosion, spill response, waste management plan, and the site parameters and techniques to be employed to reduce the release of sediment and pollution from the construction site. The SWPPP also documents regular inspections and maintenance of these measures and any changes made to maintain site compliance. All Operators involved in a shared SWPPP must maintain a complete copy of the SWPPP for three years following the completion of the project. Additional information regarding these and other controls can be found on City of Marble Falls NPS and Drainage Criteria Manuals.

The SWPPP will be included in the contract documents. The CONTRACTOR shall submit a schedule for implementation of the SWPPP (i.e. grading, utilities, and stabilization plans). Deviations from the plan must be submitted to the OWNER for approval. The SWPPP is not warranted to meet all the conditions of design plans

since the actual construction activities may vary from those anticipated during the preparation of the SWPPP. Modifications may be required to conform to the requirements of the Permit. A copy of the most current SWPPP must be kept at the construction site by the CONTRACTOR. Any alterations to the SWPPP proposed by the CONTRACTOR must be prepared and submitted by the CONTRACTOR to the OWNER for review and approval.

The CONTRACTOR must use control measures necessary to prevent and control soil erosion, sedimentation, and water pollution. The control measures shall be installed and maintained throughout the construction to assure effective and continuous water pollution control. The controls may include, but are not limited to: silt fences, straw bale dikes, rock berms, diversion dikes, interceptor swales, sediment traps and basins, pipe slope drains, inlet protection, stabilized construction entrances, seeding, sodding, mulching, soil retention blankets, or other structural or non-structural stormwater pollution controls. Prior to beginning construction, the CONTRACTOR must submit to the OWNER for approval the proposed pollution control devices to be used and schedule of implementation. This submittal shall include on site and off site areas such as equipment and material storage areas, staging sites, and other areas subject to water pollution that support the construction effort.

302 CONSTRUCTION REQUIREMENTS

302.1 GENERAL

The CONTRACTOR shall provide control measures to prevent or minimize the impact of the CONTRACTOR's operations to receiving waters as required by the plans or Storm Water Pollution Prevention Plan (SWPPP) and/or as directed by the OWNER in writing.

In any disturbed area where construction activities have ceased, permanently or temporarily, the CONTRACTOR shall initiate stabilization of the area by the use of seeding, mulching, soil retention blankets or other appropriate measures within 14-days, except in areas where construction activities are scheduled to resume within 21-days.

The CONTRACTOR shall effectively prevent and control erosion and sedimentation on the site at the earliest practicable time as outlined in the approved schedule. Control measures, where applicable, will be implemented prior to the commencement of each construction operation. The CONTRACTOR shall limit the amount of disturbed earth to the area(s) shown on the plans or as directed by the OWNER. The OWNER has the authority to limit the disturbed surface area exposed by construction operations. If, in the opinion of the OWNER, the CONTRACTOR is not able to effectively control soil erosion and sedimentation resulting from construction operations, the OWNER will limit the amount of disturbed area to that which the CONTRACTOR is able to control.

Should the control measures fail to function effectively, the CONTRACTOR shall act immediately to bring the erosion and sedimentation under control by maintaining existing controls or by providing additional controls as directed by the OWNER. When, in the opinion of the OWNER, the site is adequately stabilized, the control measures, except mulches and soil retention blankets, will be removed and properly disposed of by the CONTRACTOR. Soil retention blankets shall be removed only when, in the opinion of the OWNER, final permanent perennial seeding would be adversely affected by the presence of an existing soil retention blanket.

302.1.A. Inspection and Maintenance

All erosion, sediment, and water pollution controls will be maintained in good working order. The CONTRACTOR and OWNER will inspect the entire project to determine the condition of the control measures using one of the following inspection schedules:

1. A rain gauge provided by the CONTRACTOR will be located at the project site. Inspection will occur every fourteen (14) calendar days, and also within 24-hours of a rainfall event of 0.5-in. or more as measured by the project rain gauge.
2. Inspection will occur at least once every seven (7) calendar days on a specifically defined day, regardless of whether or not there has been a rainfall event since the previous inspection.
3. Sediment will be removed and devices repaired as soon as practicable but no later than seven (7) calendar days after the surrounding exposed ground has dried sufficiently to prevent further damage from equipment operations needed for repairs.

In the event of continuous rainfall over a 24-hour period, or other circumstances that preclude equipment operation in the area, the CONTRACTOR will install additional backup devices, as determined by the OWNER, by other appropriate methods. The CONTRACTOR will remove silt accumulations and deposit the spoils in an area approved by the OWNER as soon as practical. Any corrective action needed for the control measures will be accomplished in the sequence directed by the OWNER; however, areas adjacent to receiving waters shall generally have priority, followed by devices protecting storm sewer inlets.

In the event of conflict between these requirements and storm water pollution control laws, rules or regulations of other Federal, State, or Local agencies, the more restrictive laws, rules or regulations shall apply.

302.1.B. Location and Construction of Auxiliary Areas

Disposal areas, stockpiles, and haul roads shall be constructed in a manner that will minimize and control the amount of sediment that may enter receiving waters. Disposal areas shall not be located in any floodplain or receiving waters. Construction roads may not be located in or cross any receiving waters without prior approval of the OWNER and shall be done in compliance with applicable rules and regulations. Staging areas and vehicle maintenance areas shall be constructed by the CONTRACTOR in a manner to minimize the runoff of pollutants and at a location approved by the OWNER. The CONTRACTOR shall prevent pollution of receiving waters with petroleum products or other hazardous or regulated substances.

302.1.C. Activity Near Waters

Construction operations in receiving waters shall be restricted to those areas where it is necessary to perform the work shown on the plans. Wherever streams are crossed, temporary bridges, timber mats, or other structures shall be used and approved by the OWNER. When work areas or material sources are located adjacent to receiving water, control measures such as diversion dikes or rock berms shall be used to keep sediment and other contaminants from entering the adjacent receiving water. Care shall be taken during the construction and removal of such barriers to minimize down-gradient sedimentation. All receiving waters shall be cleared as soon as practicable of temporary embankment, temporary bridges, matting, falsework, piling, debris, or other obstructions placed during construction operations that are not a part of the finished work.

302.1.D. Good Housekeeping Practices

Protected storage for paints, chemicals, solvents, fertilizers, and other potentially toxic materials will be provided by the CONTRACTOR at a location approved by the OWNER.

Disturbance of vegetation shall be minimized and limited to only what is shown on the construction plans or as directed by the OWNER in writing.

The CONTRACTOR shall clean paved surfaces, as necessary, to remove sediment that has accumulated on the roadway.

The project will not be accepted until the CONTRACTOR has cleaned up as described in Item for Project Clean-up to the satisfaction of the OWNER. The project will also not be accepted until the CONTRACTOR provides a uniform perennial vegetative cover with a density of 70-percent of the native background vegetative cover or, if in the opinion of the OWNER, permanent measures (such as riprap, gabions, geotextiles, or other stabilization methods approved by the OWNER), supplemented by temporary measures (such as mulching with seed, silt fences, earth dams, etc.) have been employed that will control erosion, sedimentation, and water pollution until sufficient vegetative cover can be established.

303 MATERIALS

303.1 SILT FENCE

Silt Fence is a barrier consisting of geotextile fabric supported by posts to prevent soil and sediment loss from a site. This includes all labor and materials associated with installation and maintenance of the silt fence as shown in the construction drawings or similar document.

303.1.A. Description

The purpose of a silt fence is to intercept and detain water-borne sediment from unprotected areas to a limited extent. Silt fence is used during the period of construction near the perimeter of a disturbed area to intercept sediment while allowing water to percolate through. This fence shall remain in place until the disturbed area is permanently stabilized. Silt fence shall not be used where there is a concentration of water in a channel or drainage way or where soil conditions prevent a minimum toe-in depth of 6-inches or installation of support post to depth of 12-inches. If concentrated flow occurs after installation, corrective action shall be taken such as placing a stone overflow in the areas of concentrated flow.

303.1.B. Materials

The materials used in silt fence installation shall comprise of the items below. The following is intended to be a minimum guideline to the CONTRACTOR.

1. **Geotextile:** Silt Fence fabric must meet the following minimum criteria:
 - a. Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 90-lbs.
 - b. Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 60-lbs.
 - c. Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 280-psi.
 - d. Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 30 (max) to 100 (min).
 - e. Geotextile fabric to be 4.5 oz. minimum non-woven, 36" wide min. width.
2. **Posts:** Fence posts shall be galvanized steel and may be T -section, 1.3 pounds per linear foot minimum, and 4 feet in length minimum.
3. **Wire Support:** Silt fence shall be supported by galvanized steel wire fence fabric as follows:
 - a. 4" x 4" mesh size, W1.4 /1.4, minimum 14-gauge wire fence fabric;
 - b. Hog wire, 12 gauge wire, small openings installed at bottom of silt fence;
 - c. Standard 2" x 2" chain link fence fabric; or
 - d. Other welded or woven steel fabrics consisting of equal or smaller spacing as that listed herein and appropriate gauge wire to provide support.

303.1.C. Construction Methods

Silt Fence shall consist of synthetic fabric supported by wire mesh and steel posts set a minimum of 1-foot depth and spaced not more than 6-feet on center. A 6-inch wide trench is to be cut 6-inches deep at the toe of the fence to allow the fabric to be laid below the surface and backfilled with compacted earth or gravel. This entrenchment prevents any bypass of runoff under the fence. Fabric shall overlap at abutting ends a minimum of 3-feet and shall be joined such that no leakage or bypass occurs.

The silt fence shall be removed by the Contractor upon completion of construction as per instructions of the Engineer. Accumulated silt shall be removed and properly disposed of when it reaches a depth of 6 inches in such a manner as not to contribute to additional siltation.

303.1.D. Measurement and Payment

If included in the Contract as a unit price item, measurement for payment for Silt Fence will be made by the linear foot (LF), complete, in place and ready for use inclusive of all components necessary for a complete and working installation. Such measurements will be made between the ends of the fence including the full length around any J-hooks. Payment shall be full compensation, in accordance with the pay items set in the bid, for furnishing all materials including fabric, wire and posts for performing all operations necessary to complete the work.

303.2 TRIANGULAR FILTER DIKE

The purpose of a triangular sediment filter dike is to intercept and detain water-borne sediment from unprotected areas of limited extent.

303.2.A. Description

Triangular filter dikes are used in place of silt fence, treating sediment flow at the perimeter of construction areas and at the perimeter of the site. Also, the dikes can serve as stream protection devices by preventing sediment from entering the streams. This measure can be effective on paved areas where installation of silt fence is not possible. The work shall consist of installing a temporary triangular sediment filter dike as shown on the plans during the construction period to control sedimentation.

303.2.B. Materials

The materials used in installation shall comprise of the items below. The following is intended to be a minimum guideline to the CONTRACTOR. Refer to City of Marble Falls NPS Manual for additional installation and material information.

1. **Geotextile:** Refer to Item for Silt Fence.
2. **Wire Mesh Support:** The dike structure shall be 6-gauge 6" x 6" wire mesh folded into triangular form being 18-inches on each side.

303.2.C. Construction Methods

Triangular sediment filter dikes shall be installed across exposed slopes during construction with ends of the dike tied into existing grades to prevent failure. Filter material shall lap over ends 6- inches to cover dike-to-dike junction; each junction shall be secured by shoat rings. Place sandbags on 3 foot intervals to fasten filter dike to the ground.

303.2.D. Inspection

Inspection shall be made weekly or after each rainfall event. Repair or replacement shall be made by CONTRACTOR at no additional cost to OWNER. Inspector shall look for alignment changes, gaps being formed, silt accumulation over 6-inches. Silt should be removed promptly and disposed in a manner that will not cause additional silt accumulation.

303.2.E. Measurement and Payment

If included in the Contract as a unit price item, measurement for payment for triangular sediment filter dike shall be made by the linear foot (LF), complete, in place and ready for use inclusive of all components necessary for a complete and working installation.

303.3 ROCK CHECK DAM

The purpose of a check dam (or ROCK BERMS) is to reduce the velocity of small concentrated flows, provide a limited barrier for sediment and help disperse concentrated flows, reducing potential erosion. Check dams are typically used early in construction in swales for long linear projects such as roadways. They can also be used in short swales with a steep slope to reduce unacceptable velocities. Check dams shall not be used in live stream channels.

303.3.A. Description

The work shall consist of constructing temporary check dams as shown on the plans during the construction period to control erosion and sedimentation. This includes all labor and materials associated with installation and maintenance of the check dam as shown in the construction drawings or similar document.

303.3.B. Materials

The materials used in installation shall comprise of the items below. The following is intended to be a minimum guideline to the CONTRACTOR. Refer to City of Marble Falls NPS Manual for additional installation and material information.

1. **Stone:** Stone shall be well graded with size range from 3-inches to 5-inches in diameter aggregate shall be used where stream velocities are less than 4 fps. 5-inches to 8-inches in diameter aggregate shall be used where anticipated stream velocities are more than 4 fps.
2. **Wire Mesh:** Woven wire sheathing shall be used to secure the berm shall have a minimum wire diameter of 20-gauge galvanized with a maximum opening of 1-inch.
3. **Geotextile:** Fabric must meet the following minimum criteria:
 - a. Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 250-lbs.
 - b. Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 135-lbs.
 - c. Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 420-psi.
 - d. Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 20 (max).
4. **Posts:** Fence posts shall be galvanized steel and may be T -section, 1.3 pounds per linear foot minimum, and 4 feet in length minimum.

303.3.C. Construction Methods

Check dams should be placed at a distance and height to allow small pools to form between each one. Typically, dam height should be between 18" and 36". Dams should be spaced such that the top of the downstream dam should be at the same elevation as the toe of the upstream dam. Rock check dams should be triangular in cross section with side slopes of 1:1 or flatter on the upstream side and 2:1 or flatter on the downstream side. Locate woven wire sheathing perpendicular to the flow line and Place aggregate along the sheathing to a minimum height of 18-inches. Wrap the sheathing around the aggregate and secure the ends with tie wire (ends should overlap a minimum of 2"). Verify stability of berm by walking across it (if the berm moves when walked on, then needs to be better stabilized). Use geotextile filter fabric under check dams exceeding 18 inches in height. Berms shall be embedded minimum 4-inches into adjacent grade, and the mesh shall be folded upstream over the aggregate and tightly secured unto itself on the downstream side with using hog rings or wire ties.

1. **Type I Berm:** 18-inch high stone berm only without wire mesh or geotextile. This type will require 4-inch deep (min.) sandbags to be installed at the embedded foundation for better filtering efficiency. This type shall be used at the toe of slopes, around inlets, in small ditches, and at swale outlets. When Type I is used flow velocities are anticipated to be less than 4 fps, and less than 5 Acres of drainage area.
2. **Type II Berm:** 18-inch high stone berm with wire mesh. This type shall be used on small channels, at dikes and at swale outlets. When Type II is used flow velocities are anticipated to be less than 8 fps but more than 4 fps.
3. **Type III Berm:** 36-inch high stone berm with wire mesh. This type shall be used on small channels, at dikes and at swale outlets. When Type III is used flow velocities are anticipated to be more than 8 fps.
4. **Type IV Berm:** This type consists of sack gabions and may be used on in channel to form an erosion control dam.
5. **High Service Berm:** This berm can be any of the previous 3 types with Geotextile and minimum height of 24-inches. This type shall be used when high level of sedimentation is anticipated, or if project is located within 1-mile from a lake.

303.3.D. Inspection and Maintenance

The check dam shall be inspected regularly in accordance with the SWPPP. The check dams shall be reshaped or replaced as needed during inspection. When the silt reaches 1/3 the height of the berm or 1-foot, whichever is less, the accumulated silt shall be removed and disposed of at an approved site in a manner that will not contribute to additional siltation. The check dam shall be left in place until all upstream areas are stabilized and accumulated silt removed; removal shall be done by hand tools only.

303.3.E. Measurement and Payment

If included in the Contract as a unit price item, measurement for payment for rock check dam shall be made by the linear foot (LF), complete, in place and ready for use inclusive of all components necessary for a complete and working installation, including maintenance and inspection.

303.4 CONSTRUCTION ENTRANCE/EXIT

The purpose of a construction entrance is to facilitate the removal of sediment and other debris from construction equipment prior to exiting the construction site.

303.4.A. Description

The work shall consist of constructing a temporary stabilized construction entrance and/or exit as shown in the plans and remaining in place for the duration of the construction period. This includes all labor and materials associated with installation, maintenance, and removal of the stabilized construction entrance and/or exit as shown in the construction drawings or similar document.

303.4.B. Materials

The materials used in installation shall comprise of the items below. The following is intended to be a minimum guideline to the CONTRACTOR. Refer to City of Marble Falls NPS Manual for additional installation and material information.

1. **Stone:** Stone material shall consist of 3 to 5-inch minimum coarse aggregate. Riprap and shall be placed in a layer of at least 12-inches thickness.
2. **Geotextile:** If required, fabric must meet the following minimum criteria:
 - a. Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 300-lbs.
 - b. Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 120-lbs.
 - c. Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 600-psi.
 - d. Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 40 (max).

303.4.C. Construction Methods

A temporary stabilized construction entrance shall be installed at any point where traffic will be entering or leaving a construction site to or from a paved surface such as a street, alley, sidewalk or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking or flowing of sediment onto paved surfaces. The entrance shall be properly graded or incorporate a drainage swale to prevent runoff from leaving the construction site. The length of the entrance shall be as shown on the plans but no less than 50-foot in length and 14-foot in width.

303.4.D. Inspection and Maintenance

The temporary stabilized construction entrance shall be maintained in a condition that will prevent tracking or flowing of sediment onto paved surfaces. This may require periodic top dressing with additional stone as

conditions demand. All sediment spilled, dropped, washed or tracked onto public rights of way shall be removed immediately by the CONTRACTOR.

When necessary, vehicles must be cleaned to remove sediment prior to entrance onto paved roads, streets, or parking lots. When washing is required, it shall be done on a constructed wheel wash facility that drains into an approved sediment trap or sediment basin or other sedimentation/filtration device.

303.4.E. Measurement and Payment

If included in the Contract as a unit price item, measurement for payment for stabilized construction entrance/exit will be made per each (EA), complete, in place and ready for use inclusive of all components necessary for a complete and working installation, including inspection and maintenance.

303.5 STONE OUTLET SEDIMENT TRAP

The purpose of a sediment trap is to intercept sediment-laden runoff and trap the sediment in order to protect drainage ways, properties and rights-of-way below the sediment trap from sedimentation. A sediment trap is usually installed at points of discharge from disturbed areas. Refer to City of Marble Falls NPS Manual for additional information.

303.5.A. Description

A stone outlet sediment trap is an impoundment created by the placement of a stone embankment to prevent soil and sediment loss from a site. This includes all labor and materials associated with installation and maintenance of the stone outlet sediment trap as shown in the construction drawings or similar document. The drainage area for a sediment trap shall be less than 100-acres but more than 5-acres.

303.5.B. Materials

The materials used in installation shall comprise of the items below. The following is intended to be a minimum guideline to the CONTRACTOR. Refer to City of Marble Falls NPS Manual for additional installation and material information.

1. **Stone:** Stone material shall consist of 6 to 12-inch minimum in diameter. Riprap and shall be placed in a layer of at least 12-inches thickness.
2. **Filler Stone:** The filter stone covering the face of the embankment shall consist of ½ to 2-inch (1-½ inch nominal) well graded filter stone.
3. **Geotextile:** The embankment shall be placed on geotextile fabric meeting the following minimum criteria:
 - a. Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 250-lbs.
 - b. Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 135-lbs.
 - c. Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 420-psi.
 - d. Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 20 (max).

303.5.C. Construction Methods

The maximum embankment height shall be 6 feet as measured from the toe of the slope on the downstream side. If required the stone shall be enclosed in wire mesh or gabion basket and anchored to the channel bottom to prevent washing away. The minimum width of the embankment at the top shall be 2 feet. Embankment slope shall be 1.5:1 or flatter if enclosed in wire mesh and 3:1 without wire mesh. The embankment shall have a depressed area to serve as the outlet with a minimum width of 4 feet. Filter stone shall be placed over the face of the embankment to a minimum depth of 6 inches.

The outlet shall be designed to have a minimum freeboard of 6" at design flow. Basins and outfall structure(s) shall be sized to pass the 10-year design storm. A 48 hour drawdown time is required to effectively detain the 1-year 3 hour storm event.

CONTRACTOR shall submit to OWNER the following information for review and approval:

1. Contributing drainage area.
2. Design flow rates and sizing calculations.
3. Details for outfall structure(s).
4. Other information and details required to reasonably construct the sediment basin as determined by the City Engineer.

303.5.D. Inspection and Maintenance

Accumulated silt shall be removed when the depth of sediment is equal to one third of the height of the embankment as measured from the original toe of slope to the crest of the outlet, or has reached a depth of one foot, whichever is less.

303.5.E. Measurement and Payment

If included in the Contract as a unit price item, measurement for payment for stone outlet sediment trap shall be made per each (EA), complete, in place and ready for use, according to the Standard Drawings and these Specifications, inclusive of all components necessary for a complete and working installation, including inspection and maintenance. When required, embankment, geotextile fabric, and stone will be subsidiary to the price of the stone outlet sediment trap.

303.6 INLET PROTECTION

The purpose of inlet protection (including curb, grate, and "Y" inlets) is to provide a barrier for sediment.

303.6.A. Description

Inlet protection consists of a variety of methods of intercepting sediment at inlets through the use of stone, filter fabric, inlet inserts, and other materials. This is normally located at the inlet, providing either detention or filtration to reduce sediment and floatable materials in storm water. Clogging can greatly reduce or completely stop the flow into the inlet.

Special caution must be exercised when installing inlet protection on publicly traveled streets or in developed areas. Ensure that inlet protection is properly designed, installed and maintained to avoid flooding of the roadway or adjacent properties and structures.

The different measures are used for different site conditions and inlet types. These measures include all labor and materials associated with installation and maintenance of inlet protection as shown in the construction drawings or similar document.

1. **Filter Barrier Protection:** Silt Fence is used for drop/grate inlets when the drainage area is less than 1-acre and the basin slope is less than 5-percent. This type of protection is not applicable in paved areas.
2. **Block and Gravel Protection:** This method is used for curb and drop inlets when flows exceed 0.5 cfs, and it is necessary to allow for overtopping to prevent flooding. This form of protection is also useful for curb type inlets as it works well in paved areas.
3. **Excavated Impoundment Protection:** This method is used around a drop/grate inlet for protection against sediment entering a storm drain inlet. With this method, it is necessary to install weep holes to allow the impoundment to drain completely. The impoundment shall be sized such that the volume of excavation shall be 1800 to 3600 cubic-feet per acre of disturbed area entering the inlet.

303.6.B. Materials

The materials used in installation shall comprise of the items below. The following is intended to be a minimum guideline to the CONTRACTOR. Refer to City of Marble Falls NPS Manual for additional installation and material information.

1. **Concrete Blocks:** Concrete blocks shall be standard 8" x 8" x 16" concrete masonry units and shall be in accordance with ASTM C139, Concrete Masonry Units for Construction.
2. **Wire Mesh:** Woven wire backing used to support the filter fabric shall be galvanized 2" x 4" welded wire, 12 gauge minimum.
3. **Geotextile:** Fabric must meet the following minimum criteria:
 - a. Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 90-lbs.
 - b. Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 60-lbs.
 - c. Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 280-psi.
 - d. Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 30 (max) and 100 (min).
4. **Posts:** Fence posts shall be galvanized steel and may be T -section, 1.3 pounds per linear foot minimum, and 4 feet in length minimum.
5. **Filter Gravel:** Filter gravel shall be ½ inch (Block and Gravel Protection) or 1- ½ to 2 inch (Excavated Impoundment Protection) washed stone containing no fines. Angular shaped stone is preferable to rounded shapes.
6. **Sand Bags:** The sand bag material shall be polypropylene, polyethylene, polyamide, or cotton burlap woven fabric. The bag shall have a length of 24"-30" with a width of 16"-18" and a thickness of 6"-8". The sandbags shall be filled with coarse grade sand and free of deleterious material. The sand shall be capable of passing through a No. 10 Sieve. The filled bag should have an approximate weight of 40 pounds and be sealed by staples or tied with cord.

303.6.C. Construction Methods

1. **Filter Barrier Protection:** Silt Fence shall consist of geotextile supported by galvanized steel posts set a minimum of 1-foot depth and spaced not more than 6-feet on center. A 6-inch wide trench is to be cut 6-inches deep at the toe of the fence to allow the fabric to be laid below the surface and backfilled with compacted earth or gravel. This entrenchment prevents any bypass of runoff under the fence.
2. **Block and Gravel Protection:** Concrete blocks are to be placed on their sides in a single row around the perimeter of the inlet, with ends abutting. Openings in the blocks should face outward, not upward. Wire mesh shall then be placed over the outside face of the blocks covering the holes. Filter stone shall then be piled against the wire mesh to the top of the blocks with the base of the stone being a minimum of 18-inches from the blocks. Alternatively, where loose stone is a concern (streets, etc.), the filter stone may be placed in appropriately sized geotextile fabric bags. Periodically, when the stone filter becomes clogged, the stone shall be removed and cleaned in a proper manner or replaced with new stone and piled back against the wire mesh.
3. **Excavated Impoundment Protection:** An excavated impoundment shall be sized to provide a storage volume of between 1800 and 3600 cubic-feet per acre of disturbed area. The trap shall have a minimum depth of 1-foot and a maximum depth of 2-feet as measured from the top of the inlet and shall have side slopes of 2:1 or flatter. Weep holes shall be installed in the inlet walls to allow for the complete dewatering of the trap. When the storage capacity of the impoundment has been reduced by one-half, the silt shall be removed and disposed in a proper manner.
4. **Other Curb, Grate, "Y" Inlet Protection:** Refer to City of Marble Falls NPS Manual for additional information.

303.6.D. Inspection and Maintenance

Inlet protection inspection shall be made weekly or after each rainfall event. Repair or replacement shall be made promptly as needed by the CONTRACTOR at no additional cost to OWNER. Accumulated silt shall be removed if depth reaches 4-inches, and disposed in a manner as not to create additional siltation.

303.6.E. Measurement and Payment

If included in the Contract as a unit price item, measurement for payment for inlet protection shall be made per each (EA), complete, in place and ready for use inclusive of all components necessary for a complete and working installation, including maintenance and inspection.

303.7 EROSION CONTROL BLANKETS

The purpose of an erosion control blanket (ECB) is to temporary degradable erosion prevention product placed over disturbed areas to limit the effects of erosion due to rainfall impact and runoff across barren soil.

303.7.A. Description

Blankets are typically constructed of natural materials such as coir (coconut husk) fibers, excelsior (wood) or straw covered on both sides by degradable synthetic netting. Erosion control blankets are manufactured by a wide variety of vendors addressing a wide variety of conditions such as slope and functional longevity.

303.7.B. Materials

The materials used in installation shall comprise of the items below. The following is intended to be a minimum guideline to the CONTRACTOR.

1. **Blanket:** Erosion control blanket shall be of a type and class appropriate to site-specific requirements as determined by the Engineer. Installed materials shall meet the applicable "Minimum Performance Standards for TxDOT" as published by TxDOT in its "Erosion Control Report" unless materials are otherwise approved by the OWNER. Proving compliance with TxDOT standards is the responsibility of the CONTRACTOR and may be proven by official listing on the most current annual "Approved Products List for TxDOT" applicable to TxDOT Item for Soil Retention Blanket and its Special Provisions.
2. **Fasteners:** Fasteners shall conform to the recommendations shown within the manufacturer's published literature for the approved soil retention blanket. In the absence of manufacturer's recommendation for fasteners, a minimum 11-gauge wire staples 6-inches in length and 1-inch in width shall be used.

303.7.C. Construction Methods

Prior to the installation of any erosion control blankets, all rocks, dirt clods, stumps, roots, trash and any other obstructions that would prevent the mat from lying in direct contact with the soil shall be removed. Anchor trenching shall be located along the entire perimeter of the installation area, except for small areas with less than 2% slope. These trenches shall be 6-inches deep and 6-inches wide and the blanket shall be laid into the trench then backfilled with compacted soil or gravel. Blankets shall be fastened to the ground according to the manufacturer's instruction. CONTRACTOR shall submit staple pattern to the OWNER. Installations shall be in accordance with manufacturers recommended guidelines with the exception of the minimum criteria stated herein.

303.7.D. Inspection and Maintenance

Blankets must be inspected on a weekly basis, and after each significant rainfall event to locate bare spots caused by weather or other events. Missing or loosened blankets shall be promptly replaced or re-anchored.

303.7.E. Measurement and Payment

If included in the Contract as a unit price item, measurement of erosion control blankets will be made by the square yard (SY) of material installed, in place and ready for use as an erosion control surface treatment, including maintenance and inspection.

303.8 MULCHING

303.8.A. Description

Mulching provides protection for bare soil by absorbing the energy of each raindrop prior to the point when this energy would dislodge individual soil particles and begin the erosion process. Mulching fosters plant growth by providing insulation from temperature extremes and retaining valuable moisture necessary for proper germination.

303.8.B. Materials

The materials used in installation shall be only organic mulches and be comprised of the items below. The following is intended to be a minimum guideline to the CONTRACTOR.

1. **Straw:** The best quality straw mulch comes from wheat, oats or barley and shall be free of weed and grass seed that may not be desired vegetation for the area to be protected. Straw mulch is light and therefore shall be properly anchored to the ground.
2. **Wood Chips:** Wood chips are suitable for areas that will not require mowing frequently and are heavy enough that they do not require anchoring. They do however deplete nitrogen from the soil, which is a necessary nutrient for all plants. To alleviate this condition, wood chips must be treated with 12-pounds of ammonium nitrate per ton of mulch used.
3. **Bark Chips:** Bark chips are popular for ornamental applications as they do not require anchoring, do not decompose very rapidly and serve as an excellent insulation material. When using bark chips, it is not necessary to treat for nitrogen deficiency or to fertilize.
4. **Compost and Wood Mulch Mixture:** Compost and wood mulch mixtures should be a blend of 50% untreated wood mulch with 50% compost measured by volume. Wood mulch should be less than or equal to 5 inches in length with 95% passing a 2-in. screen and less than 30% passing a 1-in. screen. The compost shall meet the Physical Requirements specified in Table 1 of TxDOT Special Specification 1058, Compost.

303.8.C. Construction Methods

Prior to the placement of any mulch, the area to be protected shall be graded completely in accordance with plans. Fertilization and soil treatment shall then be done prior to placement of mulch with the exceptions of when seed is to be applied by means of hydraulic seeding or when seed is distributed following straw mulch spreading during winter months.

Organic mulches may be distributed by hand or by mechanical means, so long as a complete covering is achieved. The application of straw mulch should be approximately 2 tons dry straw per acre spread uniformly across the area. Other forms of mulch, such as wood chips or chopped site vegetation, should be placed in thicknesses of two-inches or greater over the area. Straw mulch should be anchored by application of a fiber mulch binder, by the application of a synthetic liquid mulch binder, by using a tractor-drawn crimper to punch into the soil, or by placing netting above the mulch stapled to the ground, as required.

303.8.D. Inspection and Maintenance

All mulching materials shall be inspected on a weekly basis, and after each significant rainfall event to locate areas of erosion. Where erosion has occurred, either additional mulch shall be applied or an alternative method shall be considered and implemented, as required by the Engineer.

303.8.E. Measurement and Payment

If included in the Contract as a unit price item, measurement of organic mulches will be made by the square yard (SY) of material installed, in place and ready for use as an erosion control surface treatment, including maintenance and inspection.

303.9 CONCRETE WASHOUTS

303.9.A. Description

This item shall include the construction, maintenance, and removal of all Concrete Washout construction within public right-of-way, and all of the materials, labor, and other incidentals required to complete the work for the duration of the project. Concrete washout shall be installed prior to any concrete placement on site.

303.9.B. Materials

The materials used in installation shall be only organic mulches and be comprised of the items below. The following is intended to be a minimum guideline to the CONTRACTOR.

1. **Construction Fence:** Fence must be highly visible.
2. **Plywood Sign:** Sign shall be 4'x2' painted black on white background shall be written "CONCRETE WASHOUT."
3. **Posts:** Fence posts shall be galvanized steel and may be T-section, 1.3 pounds per linear foot minimum, and 6 feet in length minimum.
4. **Liner:** Liner shall be heavy duty and impervious plastic material.

303.9.C. Construction Methods

Concrete washout shall include a subsurface pit that shall be 8' wide by 8' long, and shall be at least 3' deep. Construction fence shall be installed along the top of the pit perimeter. Install liner throughout the bottom and sides. Liner shall be large enough to extend 24" beyond the top perimeter. Secure liner on top of pit via stones, fence posts, or other suitable material.

The Contractor is required to insure that every concrete truck or equivalent that unloads on the project must be routed from the unloading point to a concrete washout, then across a construction access point before leaving the construction zone and entering the public roadway. The Contractor shall be required to install additional concrete washouts as needed, regardless of whether they are actually shown on the plans.

303.9.D. Inspection and Maintenance

Inspection shall occur after installation and once daily for the duration that the washout remains on site. Concrete washout material shall be removed and disposed of once the materials have reached 2/3 of the pit depth. Concrete washout shall remain in place until all concrete for the project is placed.

Concrete washout shall be removed and disposed of properly. The pit shall be filled with suitable compacted fill, free of any organics. Surface shall then be seeded as per specifications.

303.9.E. Measurement and Payment

No separate compensation shall be set for Concrete Washout. Measurement and compensation shall be subsidiary to other erosion control items.

If included in the Contract as a unit price item, measurement of Concrete Washout will be made per each (EA) of material installed, in place and ready for use as an erosion control surface treatment, including maintenance and inspection.

304 MEASUREMENT AND PAYMENT

Measurement for payment for temporary erosion, sedimentation and water pollution prevention and control work shown on the plans, SWPPP and/or directed by the OWNER, when payment is specified in the plans and

special provisions with separate pay items, shall be as provided in this specification using the separate contract pay items provided and the quantities of work actually performed for initial installation and for replacement during the course of the construction, provided that replacement is not due in whole or part to negligence of the CONTRACTOR. No separate compensation shall be provided for maintenance of erosion, sedimentation, and water pollution prevention and control measures during the construction of the project but such cost shall be considered incidental to pay items provided.

Unless otherwise provided in the Contract or bid proposal as separate pay items, no separate payment shall be made for temporary erosion, sedimentation, and water pollution prevention and control work required in the plans, SWPPP, special provisions or this specification, but such work shall be considered as incidental work and the cost thereof shall be included in the Contract pay items provided in the proposal and Contract.

When provided for in the bid proposal and Contract, payment for temporary erosion, sedimentation, water pollution prevention and work performed under this specification shall be made at the unit price bid per linear foot (LF), square yard (SY), per each (EA), per lump sum (LS), or units bid as specified for the Contract pay items provided which price shall be considered full compensation for:

1. all clearing and grubbing, removals, excavation and backfill required for installation,
2. installation, maintenance, removals and restoration, and
3. all materials, labor, tools, equipment, overhead, profit and incidentals necessary to complete the work in accordance with plans, SWPPP, special provisions and this specification.

All temporary erosion, sedimentation, and water pollution prevention and control work required by the OWNER due in whole or in part to CONTRACTOR negligence, carelessness, lack of maintenance, or failure to install permanent controls called for in the plans, specifications, or SWPPP in a timely fashion, shall not be paid for under this Contract. All costs to do such required temporary erosion, sedimentation, and water pollution prevention and control work shall be borne by the CONTRACTOR. All such remedial work shall be performed in compliance with the requirements of this specification as directed by the OWNER.

If CONTRACTOR fails to implement controls as required by OWNER, OWNER will take steps to implement controls and costs shall be borne as described in Item 301.

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401 INTRODUCTION

This Section shall govern the replacement, rehabilitation, or new construction of roadways, including items such as structures, signage, and other items not applicable to other sections.

402 SUBGRADE PREPARATION

402.1 DESCRIPTION

Subgrade is that portion of the roadbed upon which the subbase, base or the pavement is to be placed. It includes 12-in. beyond the back of the curb for streets, which are to be paved with concrete.

This item shall consist of scarifying, blading and rolling the subgrade to obtain a uniform texture and provide as nearly as practicable a uniform density for the top 6-in of the subgrade, or other depths as may be called out in the plans or the bid form. These specifications shall govern for the preparation of the subgrade except as otherwise provided or specified.

402.2 EQUIPMENT

All equipment necessary for the construction of this item shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used. Any equipment that achieves the desired results in the time frame allowed is acceptable. Compaction equipment shall conform to the requirements of Item for Proof Rolling.

In lieu of the subgrade equipment specified, the CONTRACTOR may, upon written permission from the OWNER, operate other subgrade equipment that will produce equivalent results in the same period of time as the specified equipment. If the substituted subgrade equipment fails to produce the desired results within the same period of time as would be expected of the specified equipment, as determined by the OWNER, its use shall be discontinued.

402.3 CONSTRUCTION METHODS

After the excavation of embankment has been substantially completed, the subgrade shall be shaped so that after rolling as specified in Item for Proof Rolling and subsequent finishing operations, it shall conform to the correct alignment, cross section and elevation. Rolling and sprinkling, as needed, shall be performed when and to the extent directed and the roadbed shall be completed to or above the plane of the typical section shown on the plans and the lines and grades established by the OWNER. All preparing of the right of way and/or clearing and grubbing and removal of concrete curbs, all organics (i.e., roots, trees, grass, and other humus materials) and any other deleterious materials, shall be complete before starting the subgrade preparation. All unsuitable material shall be removed and replaced with approved material. All foundations, walls or other objectionable material shall be removed to a minimum depth of 18 inches under all structures and 12 inches under areas to be vegetated. Subgrade shall be scarified at least 6 inches of the cut soil subgrade, and re-compacted to standard as shown below.

In the event that fill material is required to be placed over the subgrade to achieve required grades, approved material shall be placed in 8 inch loose lifts and compacted and tested in accordance with Section for Embankment requirements.

After completion of the compaction and immediately before the application of subbase, base or pavement, the subgrade preparation equipment shall be operated using approved methods in a manner to finish the subgrade to the required section. The subgrade shall then be tested with the approved template, operated and maintained by the CONTRACTOR. All irregularities which develop in excess of ½-in. in a length of 10-ft. measured longitudinally shall be corrected by loosening, adding or removing material; reshaping; and re-compacting by sprinkling and rolling. The completed subgrade shall have a uniform density of not less than 95-percent Standard Proctor density (ASTM D 698). Density tests shall also be performed on any utility trench backfill

beneath the proposed roadway to verify that adequate compaction levels have been achieved. Moisture content shall be within -2 to +4 of optimum.

The Contractor will be required to set blue tops for the subgrade and any required fill material on centerline, at quarter points and curb lines or crown lines at intervals not exceeding 50 feet. Subgrade shall be prepared and tested at a rate of one test per 500 feet per lane prior to placement of embankment or select fill material.

The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade, until the subbase, base or pavement is placed, and shall be kept wetted down sufficiently in advance of placing any subbase, base or pavement to insure its being in a firm and moist condition for at least 2-in. below surface of the prepared subgrade. Only such subgrade as is necessary for the satisfactory execution of the work shall be completed ahead of the placement of base or pavement. Hauling or operating of unnecessary equipment on the completed subgrade shall be kept to a minimum. If equipment is operated on recent work, the OWNER may inspect and require subgrade replacement for such defects as fractures, rutting, or any other failure. Complete drainage of the subgrade shall be provided at all times. Finishing of the subgrade by other methods shall be permitted on pavement widening projects, on sections where the pavement width is not uniform, at intersections and elsewhere where the operation of certain equipment would not be practical. Subgrade finished by hand or other methods shall conform to the requirements above specified.

402.4 MEASUREMENT AND PAYMENT

Unless otherwise noted in the contract documents the preparation of subgrade shall not be measured for payment as a separate contract pay item. This item shall be considered subsidiary to other paving items. Item shall furnish of all labor, tools, materials, equipment and incidentals necessary to complete the work, including disposal or surplus material, all in accordance with the plans and these specifications.

If required the preparation of subgrade shall be measured by the square yard (SY) regardless of the required depth of preparation; and cost thereof shall be included in such contract items as are provided, which pay items shall be the total compensation for the furnishing of all labor, tools, materials, equipment and incidentals necessary to complete the work, including disposal or surplus material, all in accordance with the plans and these specifications.

403 FLEXIBLE BASE OR SUBBASE PREPARATION

403.1 DESCRIPTION

Subbase is that layer of specified material of plan thickness between a base and a subgrade. Base is that layer of specified material of plan thickness placed immediately below the pavement course surfacing. flexible base or subbase includes 12-in. beyond the back of the curb for streets, which are to be paved with concrete.

This item shall consist of scarifying, blading and rolling the subgrade to obtain a uniform texture and provide as nearly as practicable a uniform density for a minimum of 6-inches, or other depths as may be called out in the plans or the bid form. The base layer shall be constructed as herein specified in one course for depths less than 6" and two courses for depths greater than 6", in conformity with the typical sections and to the lines and grades as indicated or as established by the OWNER.

These specifications shall govern for the preparation of the subbase except as otherwise provided or specified. This item shall consist of a foundation course for a surface course or for other subbase or base courses; shall be constructed as herein specified in one or more courses in conformity with the typical section shown on the plans and to the lines and grades as established by the OWNER.

403.2 EQUIPMENT

All equipment necessary for the construction of this item shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used. Any equipment that achieves the desired results in the time frame allowed is acceptable.

In lieu of the subgrade equipment specified, the CONTRACTOR may, upon written permission from the OWNER, operate other subgrade equipment that will produce equivalent results in the same period of time as the specified equipment. If the substituted subgrade equipment fails to produce the desired results within the same period of time as would be expected of the specified equipment, as determined by the OWNER, its use shall be discontinued.

403.3 MATERIALS

The flexible base delivered shall be free of all foreign material or debris (i.e. reinforcement steel, dirt, plastic, trash). Material shall consist of durable particles of crushed limestone or crushed concrete and shall be free of thin, laminated, or elongated pieces, or an excess of shale, dirt, organic matter or other materials that would be harmful to the production of a homogenous base coarse. Should the CONTRACTOR elect to produce the material from local pits, the material shall be secured from sources approved by the OWNER. The pits as utilized shall be opened up in such a manner as to immediately expose the vertical faces of all the strata of acceptable material in the depth mined. Unless otherwise directed, the material shall be secured in successive vertical cuts extending through all of the exposed strata, in order that a uniform mixed material shall be secured.

Aggregate that fails to meet the requirements of these specifications may be rejected by the OWNER. Such rejection shall incur no cost to the OWNER. Aggregate sources from which materials are delivered with properties not meeting these specifications may be rejected as further supply sources to the project by the OWNER.

403.3.A. Testing

Tests base materials shall be in accordance with the following TxDOT standard laboratory test procedures:

- | | |
|--|---------------------|
| 1. Preparation for Soil Constants and Sieve Analysis | Tex-101-E |
| 2. Liquid Limit | Tex-104-E |
| 3. Plastic Limit | Tex-105-E |
| 4. Plasticity Index | Tex-106-E |
| 5. Sieve Analysis | Tex-110-E |
| 6. Wet Ball Mill | Tex-116-E |
| 7. Triaxial Test | Tex-117-E (Part II) |

When a magnesium soundness value is shown on the plans the material shall be tested in accordance with Test Method Tex-411-A Soundness of Aggregate Using Sodium Sulfate or Magnesium Sulfate.

Base material will be stockpiled after crushing, tested by the testing agency designated by the Owner and reviewed by the Owner prior to being hauled to the project site.

403.3.B. Gradation

Gradation shall meet the requirements in Table 403.3.B.1 Flexible Base or Subbase Gradation, according to specified grade and properties according to Table 403.3.B.2.

Table 403.3.B.1 Flexible Base or Subbase Gradation

Sieve Size	Percent Retained
2 ½ inch	0
1¾ inch	0-10
No. 4	45-75
No. 40	60-85

Table 403.3.B.2 Physical Properties

Physical Property	Max. Percentage
Liquid Limit (LL)	35
Plasticity Index (PI)	4 - 12
Wet Ball Mill	50
Increase in passing No. 40 sieve	20

* Tests shall be made in accordance with A.S.T.M. latest methods and Texas State Highway Department testing. Minimum compressive strength when subjected to the triaxial test: 35 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure, unless otherwise indicated.

403.3.C. Material Storage

Prior to stockpiling of aggregates, the area shall be cleaned of trash, weeds and grass and be relatively smooth. Stockpiles should be constructed to between 20,000 and 40,000 cubic yards in size. The size should be limited to the ability of the available equipment to construct, mix and test the pile. The stockpile shall be constructed utilizing equipment such as a scraper, a bottom dump or other acceptable equipment that allows spreading when dumped without re-handling. The stockpile shall be constructed to allow dump spreading in 1 direction only. Height of stockpile shall not exceed the capabilities of available machinery to make a full cut (bottom to top) on any of the 4 sides.

The Contractor will furnish tests on a completed stockpile. Tests shall be performed by a qualified provider of material testing services. The stockpile shall not be added to after it has been tested.

403.4 CONSTRUCTION METHODS

After the excavation of embankment has been substantially completed and the subgrade operations have been completed per specifications set forth herein, the subbase and/or base layer shall be shaped and shall conform to the correct alignment, cross section and elevation.

403.4.A. Placing

Immediately before placing the subbase or base course material, the subgrade shall be checked as to conformity with grade and section. A minimum of 2 inches of depth of the existing base material shall be uniformly scarified and mixed with the first course of base prior to compaction.

The material shall be delivered in vehicles of a uniform capacity. It shall be the charge of the CONTRACTOR that the required amount of specified material shall be delivered to secure the proper thickness of the completed subbase or base course.

Material deposited on the subgrade shall be spread and shaped the same day. All material shall be moved at least once from the original position in which it is deposited. In the event of inclement weather or other unforeseen circumstances which render impracticable the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed by the OWNER. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped to conform to the typical section as shown on the plans.

All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material as directed by the OWNER. If additional binder is considered desirable or necessary after the material is spread and shaped, it shall be furnished and fully incorporated with the material in place by

scarifying, harrowing, brooming or by other approved methods. The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as specified in Item for Density. In addition to the requirements specified for density, the full depth of flexible subbase or base shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each course is completed, tests as necessary shall be made by the OWNER unless otherwise specified in the special provisions or in the plans. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements.

Throughout the entire operation, the shape of the course shall be maintained by blading. The surface, upon completion, shall be smooth and in conformity with the typical sections shown on the plans to the established lines and grades. On the surface on which pavement is to be placed, any deviation in excess of $\frac{1}{4}$ -in. in cross section in a length of 16-ft. measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and re-compacting by sprinkling and rolling. All fractures, settlement, or segregation that develops shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and re-compacting by sprinkling and rolling. Should the subbase or base course, due to any reason or cause, lose the required stability, density and finish before the surfacing is complete, it shall be re-compacted and refinished at the sole expense of the CONTRACTOR.

403.4.B. Courses

Non full depth asphalt pavements, paving types with flexible base under the curb and gutter shall be placed and compacted at the same time and in the same operation as the flexible base under the pavement. Where the subbase or base course exceeds 6-in. in thickness, it shall be constructed in two or more courses of equal thickness as indicated on the typical section. Course depth shall be a minimum of 3-in. and maximum of 6-in. The first course shall be placed and compacted under the curb and gutter and under the pavement. The curb and gutter shall then be built upon the first course. The final course of the flexible base shall be placed following the curing time as specified in Item for Concrete Curb and Gutter.

In addition to the requirements specified for density, the full depth of flexible base shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base is completed, tests as necessary will be made by the Contractor. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Should the base course, due to any reason or cause, lose the required stability, density and finish before the surfacing is complete, it shall be re-compacted and refinished at the sole expense of the Contractor.

403.4.C. Density

Each course of flexible base shall be compacted to not less than 95 percent of optimum density, as determined by TxDOT test method Tex-114, in accordance with ASTM D2167 Nuclear Test Method. In no case shall the base be worked at more than 2 percent above or below optimum moisture. Field density determinations shall be made in accordance with approved methods. Tests shall be performed at intervals not exceeding 500 feet at random points on the roadway cross section.

403.5 MEASUREMENT AND PAYMENT

Preparation of base and subbase shall be measured by the square yard (SY) regardless of the required depth of preparation.

1. For flexible base paid as measured in place, the quantity shall be computed by the average end area method based on cross sections taken before beginning of any construction operations, and equivalent cross sections taken after completion and acceptance of the flexible base. The contractor shall be required to provide cross sections of the existing topography before beginning of any construction operations, and shall be required to provide cross sections immediately following completion and acceptance of the flexible base. The manner, location, and level of detail of the cross sections shall be as approved by the OWNER. The contractor shall calculate the total flexible base volume and submit both sets of cross sections and the calculations to the OWNER for review and approval.

2. For flexible base paid as a plans quantity item, no field measurement shall be made, and payment shall be at the unit price bid for the quantity shown on the plans. No adjustment of quantities shall be made except in the instance of design changes by the OWNER.
3. Where no curb and gutter is in place or is to be constructed in connection with the base, measurement shall be made to the lines shown on the plans or established as the edge of the base to be constructed.
4. Where curb and gutter is in place or is proposed to be constructed in connection with the placing of the base material, measurement shall be made to 12-in beyond the back of curb. Material placed under the curb and gutter or behind the curb shall not be measured separately but in conjunction with the rest of the roadway base material.

Preparation of the base and/or subbase shall be paid for as a separate contract pay item; and cost thereof shall be included in such contract items as are provided, which pay items shall be the total compensation for the furnishing of all labor, tools, materials, equipment and incidentals necessary to complete the work, including disposal or surplus material, all in accordance with the plans and these specifications. Price shall be full compensation for preparation of subgrade, furnishing of material, hauling, blading, sprinkling, compacting and furnishing all of labor and equipment necessary to complete the work.

404 ROLLING OF EMBANKMENT, SUBGRADE OR FLEXIBLE BASE

404.1 DESCRIPTION

Rolling shall consist of the compaction of embankment, subgrade, subbase, or flexible base by the operation of approved power rollers, as herein specified and as directed by the OWNER. The embankment, subgrade or base course shall be sprinkled as directed by the OWNER. Rolling patterns and speeds shall be established per project and indicated on the plans. Any soft or compressible areas detected during the proof rolling process shall be undercut to firm soil and backfilled as required by the OWNER with acceptable soil to make the final grade.

404.2 EQUIPMENT

All equipment necessary for the construction of this item shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used. Any equipment that achieves the desired results in the time frame allowed is acceptable. Sufficient rollers shall be provided to compact the material in a manner satisfactory to the OWNER. When operations are so isolated from one another that one roller unit cannot perform the required compaction satisfactorily, the CONTRACTOR shall provide additional roller units.

If equipment fails to produce the desired result within the required time frame, its use shall be discontinued and the CONTRACTOR will be required to furnish equipment, as determined by the OWNER, at no additional cost to the OWNER.

In lieu of the equipment specified, the CONTRACTOR may, upon written permission from the OWNER, operate other compaction equipment that will produce equivalent results in the same period of time as the specified equipment. If the substituted equipment fails to produce the desired results within the same period of time as would be expected of the specified equipment, as determined by the OWNER, its use shall be discontinued.

404.3 MEASUREMENT AND PAYMENT

This item shall be considered subsidiary to other paving items; and shall be the total compensation for all labor, materials, tools, machinery, equipment and incidentals necessary to complete the work in accordance with the plans and this specification.

If included in the contract documents as a separate contract pay item, rolling shall be measured for payment by the actual hours the roller is in operation (Hrs), as ordered by the OWNER. Rolling provided in the proposal and the contract, as a separate pay item, shall be paid for in accordance with the contract unit price.

405 PAVEMENT SECTION TREATMENT

This item shall consist of treating embankment, subgrade, subbase, and base courses by addition of lime, cement, or asphalt; mixing and compacting the material to the required density.

405.1 LIME TREATMENT

This item shall consist of treating subgrade, subbase, and base courses by the pulverization, addition of lime, mixing and compacting the mixed material to the required density. This item applies to natural ground, embankment, or pulverized recycled asphalt pavement base or subbase courses placed under this contract, which shall be constructed as specified herein and in conformity with the typical section, lines and grades as shown on the plans.

405.1.A. Materials

Materials for Lime Treatment shall consist of Hydrated Lime (Slurry) and Quicklime.

405.1.A.1. Hydrated Lime (Slurry): Hydrated lime slurry shall be a pumpable suspension of solids in water. The solids portion of the mixture, when considered on the basis of "solids content," shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following requirements as to chemical composition and residue.

405.1.A.1.a. Gradation: The "solids content" of the lime slurry shall have a hydrate alkalinity Ca(OH)_2 of not less than 90-percent by weight. The percent by weight of residue retained in the "solid content" of lime slurry shall conform to the requirements in Table 405.1.A.1.a.(1) Hydrated Lime Residue.

Table 405.1.A.1.a.(1) Hydrated Lime Residue

Sieve Size	Residue Retained by Weight
No. 6	None
No. 10	Max.1.0%
No. 30	Max. 2.5%

Slurry shall be Type B, commercial lime slurry, shall conform to one of the following three grades:

Grade 1: The "dry solids contents" shall be at least 31-percent by weight of the slurry.

Grade 2: The "dry solids contents" shall be at least 35-percent by weight of the slurry.

Grade 3: The "dry solids contents" shall be at least 46-percent by weight of the slurry.

When Type B, commercial lime slurry, is specified, the CONTRACTOR shall select, prior to construction, the grade to be used and shall notify the OWNER in writing before changing from one grade to another.

405.1.A.2. Quicklime: Quicklime is a dry material consisting essentially of calcium oxide. It shall be furnished either in "pebble" gradation suitable for dry placing and slurry placing, or as a dry powder suitable only for slurry placing. Powdered quicklime is restricted to slurry placing, as the possibility of appreciable amounts of finely divided powdered quicklime makes it unsuitable for dry placing.

CAUTION: HANDLING AND USE OF QUICKLIME CAN BE DANGEROUS. QUICKLIME SHOULD BE PRESCRIBED BY A REGISTERED PROFESSIONAL OWNER FAMILIAR WITH ITS USE.

Quicklime shall conform to the chemical requirements of ASTM C977 Quicklime and Hydrated Lime for Soil Stabilization. Water shall conform to the requirements of section for Water under Item for Portland Cement Concrete Pavement.

405.1.A.3. Testing: If the minimum design strength or percent lime to be used is specified, it shall be determined by preliminary laboratory tests at the OWNER's expense. Optimum lime addition percentage shall

be determined by Tex-112-E Admixing Lime to Reduce Plasticity Index of Soils (Atterberg Limits Soil-Lime Series) and/or by ASTM 06276 Test Method for using pH to Estimate the Soil-Lime Proportion Requirement for Soil Stabilization (pH Soil-Lime Series).

405.1.A.4. Delivery and Storage: If hydrated lime is furnished in bags, each bag shall bear the manufacturer's certified weight. Bags varying more than 5-percent by weight may be rejected; the average weight of the bags in any shipment, as shown by weighing 50 bags taken at random, shall not be less than the manufacturer's certified weight. If lime is furnished in trucks, each truck shall bear the weight of lime measured on certified scales, or the CONTRACTOR shall place a set of standard platform truck scales or hopper scales at a location approved by the OWNER.

Hydrated lime and quicklime shall be stored and handled in closed, weatherproof containers until immediately before distribution on the road. If storage bins are used, they shall be completely enclosed. Hydrated lime bags shall be stored in weatherproof buildings with adequate protection from ground dampness. Quicklime, when permitted, shall be shipped only in bulk; bagged material shall not be acceptable.

Any materials that do not conform to the requirements of this specification shall be rejected.

405.1.B. Equipment

Machinery, tools and equipment necessary for proper performance of the work shall be on the project and approved by the OWNER prior to the beginning of construction operations. When permitted, quicklime shall be slurred in agitated slurry tanks. The distributor truck used for slurry placing need not necessarily be equipped with an agitator. However, the slurry at the time of distribution must meet the consistency requirements specified.

All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

405.1.C. Construction Methods

It is a primary requirement of this specification to secure a completed course of treated material containing a uniform lime mixture, free from loose or segregated areas, or uniform density and moisture content, well bound for its full depth, and with a smooth surface and suitable for placing subsequent courses. It shall be the responsibility of the CONTRACTOR to regulate the sequence of work, to use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

Prior to beginning any lime treatment, the roadbed shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the OWNER.

In cases where groundwater is present, application of lime for stabilization shall be evaluated by the OWNER.

Mixing procedure shall be the same for "dry placing" or "slurry placing" as hereinafter described.

405.1.C.1. Treatment for Materials in Place: Materials to be treated shall be excavated to the secondary grade (proposed bottom of lime treatment) and removed or windrowed to expose the secondary grade. Any wet or unstable material below the secondary grade shall be corrected by scarifying, adding lime and compacting until it is of uniform stability. The excavated material shall then be spread to the desired cross section.

If the CONTRACTOR elects to use a cutting or pulverizing machine that shall remove the subgrade material accurately to the secondary grade and to pulverize the material at the same time, CONTRACTOR shall not be required to expose the secondary grade or windrow the material. However, the CONTRACTOR shall be required to roll the subgrade before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method shall be permitted only where a machine is provided which shall insure that the material is cut uniformly to the proper depth and which has cutters that shall place the secondary grade to a smooth surface over the entire width of the cut. The machine shall be of such design that a visible indication is given at all times that the machine is cutting to the proper depth.

405.1.C.1.a. Mixing: Mixing procedure shall be the same for "dry placing" or "slurry placing" as hereinafter described.

Material and lime shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing continued until a homogeneous, friable mixture of material and lime is obtained, free from all clods or lumps. Materials containing plastic clay or other materials which shall not readily mix with lime shall be mixed as thoroughly as possible at the time of the lime application, brought to the proper moisture content, sealed with a pneumatic roller, and left to cure 1- to 4-days as directed by the OWNER. During the curing period, the material shall be kept moist. After the required curing time, the material shall be uniformly mixed by approved methods. If the soil binder lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that when all non-slaking aggregates obtained on the No. 4 sieve are removed, the remainder of the material shall meet the requirements of Table 405.1.C.4.a.(1) Mixing Lime Treated Materials-In-Place when tested dry by laboratory sieves.

Table 405.1.C.4.a.(1) Mixing Lime Treated Materials In Place

Sieve Size	Minimum Passing
1 ³ / ₄ -in	100%
No. 4	60%

1. Recycled asphalt pavement shall be pulverized so that 100% shall pass a 2-in. sieve.

During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6-hours or more, or to excessive loss due to washing or blowing, shall not be accepted for payment.

In addition to the above, when pebble quicklime is used, the material and lime shall be mixed as thoroughly as possible at the time of application. Sufficient moisture shall be added during the mixing to hydrate the quicklime. After mixing, and prior to compaction, the mixture of material, quicklime and water shall be moist cured for 2- to 7-days, as approved by the OWNER. After curing, mixing shall continue until the pulverization requirements are met.

405.1.C.2. Treatment for New Materials: The base and subbase materials, as provided in the governing specifications, shall be delivered, placed and spread in the required amount per station. The material shall be manipulated as specified and thoroughly mixed prior to the addition of the lime.

405.1.C.2.a. Mixing: Mixing procedure shall be the same for "dry placing" or "slurry placing" as hereinafter described. The base or subbase material, lime and required water shall be thoroughly mixed and blended by approved road mixers or other approved equipment and the mixing continued until a homogeneous, friable mixture is obtained. When lime is placed as a slurry and mixed by the use of blades, the material shall be bladed as the lime water mixture is applied; after the total amount has been placed, the mixture shall be thoroughly blended to the satisfaction of the OWNER.

During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6-hours or more, or to excessive loss due to washing or blowing, shall not be accepted for payment.

405.1.C.3. Lime Application: Lime shall be spread only on that area where the first mixing operation can be completed in the same working day, except that quicklime shall be mixed at the time of application. The application and mixing of lime with the materials shall be accomplished by the methods hereinafter described unless otherwise approved by the OWNER.

405.1.C.3.a. Dry Placing: Quicklime may be placed dry if it is in pebble form. A spreader or motor grader shall be used to spread pebble Quicklime.

405.1.C.3.b. Hydrated Lime: Lime shall be mixed with water and applied as a thin water suspension or slurry. Type B, commercial lime slurry shall be applied with a lime percentage not less than that applicable for the grade used. The distribution of lime at the rate shown on the plans shall be attained by

successive passes over a measured surface of roadway until the proper moisture and lime content have been achieved.

405.1.C.3.c. Quicklime: When Quicklime is applied as a slurry, the amount of dry quicklime shall be 80% of the amount shown on the plans. The residue from the Quicklime slurring procedure shall be spread uniformly over the length of the roadway currently being processed unless otherwise approved by the OWNER. This residue is primarily inert material with little stabilizing value, but may contain a small amount of Quicklime particles that slake slowly. A concentration of these particles could cause the compacted stabilized material to swell during slaking.

405.1.C.4. Compaction: Compaction of the mixture shall begin immediately after final mixing and in no case later than three (3) days after final mixing. The material shall be aerated or sprinkled as necessary to provide optimum moisture. Compaction shall begin at the bottom and shall continue until the entire depth of the mixture is uniformly compacted as shown on the plans or specified by the OWNER. The compacted mixture shall have a uniform density of not less than 98-percent of the maximum density as determined by ASTM D 698. Moisture content shall be within minus 2 to plus 4 percent of optimum. After each section is completed, such tests as are necessary shall be made by the OWNER. If any portion fails to meet the density specified, it shall be reworked as necessary to obtain the specified density. After the mixture has been compacted, the surface shall be shaped to the required line, grades, and cross sections and then thoroughly rolled sufficiently lightly to prevent hairline cracking.

405.1.C.5. Maintenance: The CONTRACTOR shall be required to maintain the completed soil lime base within the limits of its contract in good condition, satisfactory to the OWNER as to grade, crown, and cross section until such time as the surface course is constructed. Only lime treated soil shall be used for fine grading proposed street pavement subgrade where lime treatment has been specified. The subgrade of low areas shall be lightly scarified to a depth of from two to 3 inches before fine grading is performed to insure the resulting subgrade is a homogeneous, monolithic layer throughout. Use of sand or sandy soil for fine grading beneath proposed street pavement areas is strictly prohibited.

The surface of the compacted layer shall be kept moist until covered by other base or paving material or application of a curing seal of emulsified asphalt conforming to requirements of Item for Emulsions. If a curing seal is used, it should be applied as soon as possible after completion of final rolling, at a rate of between 0.10- and 0.20-gallons-per-square-yard, the exact rate to be determined by the OWNER. No equipment or traffic shall be permitted on lime treated material for 72-hours after curing seal is applied, unless otherwise permitted by the OWNER. In cases where subgrade treatment or subbase sets up sufficiently to prevent objectionable damage from traffic, such layers may be opened to traffic 2-days after compaction. The CONTRACTOR shall immediately repair all irregularities or other defects that may occur at the CONTRACTOR'S expense. Repairs are to be made as directed by the OWNER and in a manner to insure restoration of a uniform surface and durability of the portion repaired.

405.1.D. Measurement and Payment

Lime treatment shall be measured for payment in square-yards (SY) for the thickness shown in the plans for the surface area of completed and accepted work.

The measurement for lime shall be by the ton (2000-pounds) of dry weight. The measured tonnage of (dry) quicklime shall be multiplied by the conversion factor 1.25 to give the equivalent quantity of hydrated lime (dry) which shall be the basis of payment.

Lime treatment shall be paid for at the contract unit price per square-yard (SY), as provided in the proposal and contract.

The contract unit price shall be the total compensation for preparing the roadbed; for loosening, pulverizing, application of lime, water content in the slurry mixture and the mixing water; mixing, shaping, sprinkling, compacting, finishing, curing and maintaining; for manipulations required; and for all labor, equipment, fuels, tools and incidentals necessary to complete the work, all in accordance with the plans and specifications.

Lime material measured as provided in the this item shall be paid for at the unit price bid for "lime material" which price shall be full compensation for furnishing the material; for all freight involved; for all unloading, storing and handling; and for all labor, equipment, fuels, tools and incidentals necessary to complete the work.

405.2 PORTLAND CEMENT TREATMENT

This item shall consist of the treatment of the subgrade, subbase or base course which is to be composed of a compacted mixture of soil, and/or pulverized recycled asphalt pavement, Portland cement and water and shall be constructed as herein specified and in conformity to the cross sections, lines and grades as established by the OWNER. In the event new materials are placed, rather than using in-situ soils, the subbase or base shall be constructed as herein specified and in conformity with the items governing the base or subbase courses.

405.2.A. Materials

Materials for Portland Cement Treatment involve Portland Cement, Water, and Soil or Base Material. 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.

1. Cement shall be ASTM C150 Type I, II, III, or IP and conform to the requirements of Item for Portland Cement Pavement.
2. Water shall conform to the requirements of Item for Portland Cement Pavement.
3. The soil shall consist of the in-situ soil or approved soil, free from vegetation, roots, or other objectionable matter. It may be either the material encountered in the existing section, material secured from approved sources shown on the plans or as designated by the OWNER, or a combination of existing and additional soil from approved sources, as shown on the plans, or as directed by the OWNER.
4. Base Material shall conform to the requirements of Item for Flexible Base or Subbase Preparation.

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.

405.2.B. Equipment

All equipment necessary to properly prosecute, perform and complete the work within the contract time shall be on the project and shall be approved by the OWNER as to type and condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used. The cement-modified soil layer may be constructed with any machine or combination of machines and auxiliary equipment that shall produce the results meeting the requirements for soil pulverization, cement application, water application, mixing, incorporating of materials, compaction, finishing and curing as specified herein. The CONTRACTOR shall at all times provide sufficient equipment to enable continuous performance of the work and its completion in the required number of working days.

405.2.C. Construction Methods

The primary requirement of this specification is to secure a complete course of treated material containing a uniform Portland cement mixture, free from loose or segregated areas, of uniform density and moisture content, well bound and compacted for its full depth with a smooth surface suitable for placing additional subbase, base or surface courses. It shall be the responsibility of the CONTRACTOR to regulate the sequence of work, to process a sufficient quantity of material so as to provide full depth as shown on plans, to use the proper amount of Portland cement, maintain the work and to rework the courses as necessary to meet the foregoing requirements.

Cement stabilized base shall not be mixed or placed when the air temperature is below 40°F and falling, but may be mixed or placed with the air temperature is above 35°F and rising, the temperature being taken in the shade and away from artificial heat, and with the further provisions that cement stabilized base shall be mixed or placed only when weather conditions, in the opinion of the OWNER, are suitable.

405.2.C.1. Treatment for Materials in Place: Before other construction operations are begun, the roadbed shall be graded and shaped as required to construct the Portland cement treatment for material in place in conformance with the lines, grades, thickness and typical cross sections shown on the plans. Unsuitable soil or material shall be removed and replaced with acceptable soil. The subgrade shall be firm and able to support without displacement the construction equipment and achieve the compaction herein specified. Soft or yielding subgrade shall be corrected and made stable before construction proceeds. The soil and/or recycled asphalt pavement shall be so pulverized that at the completion of moist-mixing, it meets the gradation in Table 405.2.C.1.a. Cement Treated Materials in Place.

Table 405.2.C.1.a. Cement Treated Materials in Place

Sieve Size	Minimum Passing
1-in	100%
No. 4	80%

1. Recycled asphalt pavement shall be pulverized so that 100% shall pass a 2-in. sieve.
2. Exclusive of gravel or stone retained on these sieves.

405.2.C.1.b. Application: Portland cement shall be spread by an approved dry or slurry method uniformly on the soil at the rate specified on the plans or as determined by preliminary laboratory tests. If a bulk cement spreader is used, it shall be positioned by string lines or other approved method during spreading to insure a uniform distribution of cement. Cement shall be applied only to such an area that all the operations can be continuous and completed in daylight within 6-hours of such application.

The percentage of moisture in the soil at the time of cement application shall not exceed the quantity that shall permit uniform and intimate mixture of soil and cement during dry-mixing operations, and it shall not exceed the specified optimum moisture content for the soil and cement mixture. In the event of high soil-moisture contents, cement may be applied at one-half the specified rate when approved by the OWNER. The remainder of the application rate of cement shall be applied the following day(s), not to exceed 48-hours. The usual construction sequence shall then be resumed.

No equipment, except that used in the spreading and mixing, shall be allowed to pass over the freshly spread cement until it is mixed with the soil or base material.

Any mixing method used to achieve the specified results is acceptable. Mixing shall continue until a homogeneous, friable mixture of the material and cement is obtained, free from all clods or lumps. The mixture shall be kept within moisture tolerances throughout the operation.

405.2.C.1.c. Compaction: Compaction shall begin after mixing and after gradation and moisture requirements have been met. The material shall be compacted to at least 95-percent of the maximum density as determined by ASTM D698. At the start of compaction, the percentage of moisture in the mixture and in un-pulverized soil lumps, based on oven-dry weights, shall be within 2-percentage points of the specified optimum moisture content and shall be less than the quantity which shall cause the soil-cement mixture to become unstable during compaction and finishing. When the un-compacted soil-cement mixture is wetted by rain so that the average moisture content exceeds the tolerance given at the time of final compaction, the entire section shall be reconstructed in accordance with this specification at the sole expense of the CONTRACTOR. The specified optimum moisture content and density shall be determined in the field on the representative samples of soil-cement mixture obtained from the area being processed. Final moisture content shall be within -2 to +4 of optimum.

Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth. Compaction shall begin at the bottom and shall continue until the entire depth of the mixture is uniformly compacted. The loose mixture shall then be uniformly compacted to the specified density within 2-hours. After the soil and cement mixture, except the top mulch, is compacted, water shall be uniformly applied as needed and thoroughly mixed in. The surface shall then be reshaped to the required lines, grades and cross section and then lightly scarified to loosen any imprint left by the compacting or shaping equipment.

The resulting surface shall be thoroughly rolled with a pneumatic tire roller and "clipped," "skinned," and "tight-bladed" by a power grader to a depth of approximately ¼-in., moving all loosened soil and cement from the section. The surface shall then be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. When directed by the OWNER, surface finishing methods may be varied from this procedure, provided a dense, uniform surface, free of surface material, is maintained at its specified optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 2-hours, a smooth, closely knit surface, free of cracks, ridges or loose material, conforming to the drawn grade and line shown on the plans.

OWNER shall conduct In-place density tests shall as outlined in ASTM D2922 in Place by Nuclear Methods (Shallow Depth). In-place density tests shall be performed at the rate of one-per-300-linear-ft. of paving for two lanes. The suitability of the modification shall be confirmed by Atterberg Limit testing at the rate of one-test-per-2,500-cubic-yards of processed material.

In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be made by the OWNER. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the stability, density and finish before the next course is placed or the work is accepted, it shall be re-compacted and refinished at the sole expense of the CONTRACTOR.

405.2.C.2. Plant Mixed Material: Cement Treated Base (CTB) shall consist of aggregate, cement and water uniformly mixed in a central plant, transported to the project, spread, compacted, shaped, finished, and cured in accordance with these specifications. It shall conform to the lines, grades, thicknesses, and typical cross-section shown on the plans.

Unsuitable subgrade soil or material shall be removed and replaced with acceptable soil. The subgrade shall be firm and able to support without displacement of the construction equipment and compaction. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

405.2.C.2.a. Mixing: The aggregate, cement and water shall be mixed in a pug mill as approved by the OWNER. The plant shall be equipped with feeding and metering devices that add the aggregate, cement and water into the mixer in the specified quantities to produce a mixture that meets or exceeds the mix design criteria. Aggregate and cement shall be mixed sufficiently to prevent cement balls from forming when the mix water is added. Mixing time shall be sufficient to assure an intimate, uniform mixture of aggregate, cement and water. The percentage of moisture in the aggregate, at the time of cement application shall be the amount that assures a uniform and intimate mixture of aggregate and cement during mixing operations. It shall not exceed the specified moisture content required for adequate compaction.

Free access to the plant shall be provided to the OWNER for construction quality control. The mixture shall be hauled to the paving area in trucks having beds cleaned of deleterious material.

405.2.C.2.a.(1) Aggregate: The aggregate may be any granular material or combinations of aggregates that will, when mixed with adequate amounts of cement and water, produce laboratory mix design Unconfined Compression Test strengths as specified in the paragraph below in accordance with ASTM D1632. The preceding tests will utilize the Moisture-Density Relation as determined by ASTM D558: AASHTO T134. The maximum size of aggregate shall pass a 2-inch sieve.

405.2.C.2.a.(2) Mix Design: The CONTRACTOR shall submit a mix design for the proposed CTB to the OWNER for approval in advance of the proposed work. Unconfined compression strength test results shall be submitted with the mix design by the SUPPLIER of the Cement Treated Base (CTB) material. Work shall not begin until the mix design is approved by the OWNER.

405.2.C.2.b. Placement: The mixture shall be placed on a moistened subgrade in a uniform layer by any approved method of spreading that will deposit the required quantity per lineal foot, without segregation, to produce a uniformly compacted base conforming to the grade and cross-section. Not more than 30-minutes shall elapse between placement of cement treated base in adjacent lanes at any location except at longitudinal and transverse construction joints.

Compaction shall start as soon as possible after spreading. Elapsed time between the addition of water to the cement treated base mixture and the start of compaction shall not exceed 60-minutes under normal conditions. The OWNER may alter this time if environmental conditions, such as temperature, humidity or wind conditions would justify such a change. Laboratory tests may be required to verify changes in compaction time limits.

405.2.C.2.c. Compaction: At the start of compaction, the percentage of moisture in the mixture shall not be more than 1% below or 2% above the specified optimum moisture content, and shall be less than that quantity which will cause the cement treated base mixture to become unstable during compaction and finishing. The specified optimum moisture content and density shall be determined in the field by a Moisture-Density Test AASHTO T134 or ASTM D558, on representative samples of cement treated base mixture obtained from the area prior to compaction. Prior to compaction, the mixture shall be in a loose condition for its full depth. The loose mixture shall then be compacted uniformly to the specified density.

During compaction operations, initial shaping may be required to obtain uniform compaction and required grade and cross-section. When initial compaction is completed, the surface of the cement treated base shall be shaped to the required lines, grades and cross-section. The moisture content of the surface material shall be maintained at not less than its specified optimum moisture content during finishing operations. If any reshaping of the surface is necessary, it shall be lightly scarified to remove any compaction planes, scales or smooth surfaces left by equipment. Final compaction shall then be continued until uniform and adequate density is obtained. Cement treated base shall be uniformly compacted to a minimum of 95-percent of maximum density. Compaction and finishing shall be done in such a manner as to produce, in not longer than two-hours, a smooth, dense surface free of compaction planes, cracks, ridges, or loose material.

405.2.C.3. Finishing: After the final layer or course of the cement modified soil has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling as directed with a pneumatic tire or other suitable roller sufficiently light to prevent hair cracking. Preparation for final surfacing may begin immediately.

405.2.C.3.a. Protection and Cover: After the roadway has been finished as specified herein, it shall be immediately protected against rapid drying by applying a curing seal of emulsified asphalt at the rate of 0.2-gallon per square yard. The curing seal shall consist of emulsified asphalt conforming to requirements of Item for Emulsions (PCE). Immediately prior to application of the curing seal, the section shall be wetted by the use of pressure water distributors so that all voids in the soil-cement surface are filled with water, but without free water standing on the surface. The curing seal shall be applied while this moisture condition exists so that undue asphalt penetration of the soil-cement surface shall be prevented; and at the same time aided in complete coverage by the curing seal.

Should it be necessary for construction equipment or other traffic vehicles to pass over the section before the curing seal has dried sufficiently to prevent pickup, it shall be the responsibility of the CONTRACTOR to dust or sand the surface before such use. The CONTRACTOR shall also maintain the curing cover for 7-days so that all of the soil-cement base course shall be covered effectively with curing seal during this period. The curing seal shall remain in place for the additional asphalt-wearing surface.

405.2.C.3.b. Usage: The CONTRACTOR shall not be permitted to drive heavy equipment over completed portions. Pneumatic-tired equipment required for hauling cement and water may be permitted to drive over after the surface has hardened sufficiently to prevent the equipment from marring the surface, provided that protection and cover are not impaired. The soil-cement course may be opened to local traffic as soon as the curing seal has been applied and dusted or sanded as necessary to prevent it from being picked up by traffic. Completed portions may be opened to all traffic after 7-days.

405.2.C.3.b. Maintenance: The CONTRACTOR shall be required within the limits of its contract to maintain the soil-cement treatment in good condition from the time it first starts work until all work shall have been completed. Maintenance shall include immediate repairs of any defect that may occur after the cement is applied. Such maintenance work shall be done by the CONTRACTOR at the CONTRACTOR'S expense and repeated as often as necessary to keep the area continuously intact. Repairs are to be made in such a manner as to insure restoration of a uniform surface for the full depth of treatment. Any low area of treated subgrade shall be remedied by scarifying the surface to a depth of at least 2-in., filling the area with treated material and compacting. Any low area of subbase or base shall be remedied by replacing the material for the full depth of subbase or base treatment rather than adding a thin layer of stabilized material to the completed work.

405.2.D. Measurement and Payment

Portland cement treatment shall be measured by the square-yard (SY) of completed and accepted cement treated course. Measurement for cement shall be by the ton (2000-pounds) of dry weight, as determined by certified weight tickets. No allowance shall be made for any materials used or work done outside the limits as established by the OWNER.

The work performed and material furnished as prescribed by this item and measured as provided in this item shall be paid for at the unit price bid for soil-cement treated subgrade, subbase, or base course, which price shall be full compensation for pulverizing or providing the soil material; handling, hauling and spreading dry or slurry cement, mixing the cement with the soil either in-place or in a mixing plant; furnishing, hauling and mixing water with the soil-cement mixture; spreading and shaping the mixture; compacting the mixture, including all rolling required for this compaction; surface finishing; curing; and for all manipulation, labor, equipment, appliances, tools and incidentals necessary to complete the work and carry out the maintenance provisions in this specification.

Cement material measured as provided in this item shall be paid for at the unit price bid for cement material, which price shall be compensation for furnishing the material, for all freight involved, for all unloading and storing, and for all labor, equipment, fuels, tools and incidentals necessary to complete the work, all in accordance with the plans and these specifications.

406 ASPHALT PAVEMENT

This Item establishes the requirements for asphalt construction. This item shall consist of a surface course to be composed of a compacted mixture of mineral aggregate and asphaltic material. The pavement shall be constructed on the previously completed and approved base in accordance with the detail indicated.

406.1 HOT MIX ASPHALT (HMAC)

This item shall consist of a surface course to be composed of a compacted mixture of mineral aggregate and asphaltic material. The pavement shall be constructed on the previously completed and approved base in accordance with the detail indicated.

406.1.A. Materials

The Contractor shall furnish materials to the project meeting the following requirements and such that the final mixture, prior to being placed, shall be as specified herein. The Contractor shall be solely responsible for the quality and control of his materials.

406.1.A. Aggregates: Aggregates for Surface Treatments shall be provided in accordance with TxDOT Item 302 in conformance to the type, grade, and surface aggregate classification (SAC) shown on the plans.

406.1.B.1. Asphalts, Oils, and Emulsions: Asphaltic Material shall be provided in accordance with TxDOT Item 300 and as shown on the plans.

406.1.B.1.a Prime Coat: If a prime coat is indicated use cutback (MC-30 or MC-70) or emulsion asphalt. Cutback asphalt shall be applied at a rate of 0.35 gal/sy, and emulsified asphalts shall be applied at a rate of 0.2 gal/sy conforming to materials and methods of TxDOT Item 310 "Prime Coat".

406.1.C.1. Mixtures: Mixture Design shall be performed in accordance with TxDOT Item 340 to satisfy Materials and Type specified on the plans.

The paving mixture shall consist of a uniform mixture of coarse aggregate, fine aggregate, asphaltic material and mineral filler, if required. When properly proportioned, the mineral aggregate shall produce a gradation which will conform to the limitations for the type specified. The gradation will be determined in accordance with TxDOT Test Method Tex-200-F (Dry Sieve Analysis) and shall be based on aggregate only. The amount of asphaltic material shall conform to the limitations shown for the paving type specified and materials and mixture design specified in TxDOT Item 340.

406.1.B. Construction Methods

Design, produce, store, transport, place, and compact the specified paving mixture in accordance with the requirements of TxDOT Item 340.

406.1.B.1. Testing: The OWNER may require the performance of random tests to determine if the materials and the construction procedures produce a product which meets the specifications. The primary sampling point by the testing laboratory will be at the project site at the paving machine ahead of all rollers. Other testing may be at the job site, plant or in the trucks as determined by the OWNER.

The OWNER will determine the sampling schedules for random testing. Gradation and stability samples will be taken at the plant or on the project site as determined by the OWNER. A minimum of 3 samples may be obtained for each project. Field density shall be determined by taking either 6 inch cores or sections of asphaltic pavement at locations selected by the OWNER of completed asphaltic pavement lifts for approximately every 2,000 square yards or part thereof. Acceptability will be based on the mean of the job values.

Any sampling and testing, as required by the OWNER or OWNER, of in place asphalt concrete will be at the cost of the Contractor.

406.1.B.1.a. Surface Tests: The surface of the pavement, after compaction, shall be smooth and true to the established line, grade and cross section, and when tested with a 10 foot straightedge placed parallel to the centerline of the roadway or tested by other equivalent and acceptable means, except as provided herein, the maximum deviation shall not exceed 1/8 inch in 10 feet and any point in the surface not meeting this requirement shall be corrected. The completed surface shall meet the approval of the OWNER for riding surface, finish and appearance.

406.1.B.2. Compaction: The mix shall be thoroughly compressed and uniformly compacted immediately after placing to the required density. All vibratory and flat wheel compaction rolling shall be complete before the mat cools below 175° F. Pneumatic tire rolling may be undertaken on the mat below 175° F.

All rollers must be in good mechanical condition. Necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing.

It is the intent of this specification that the material be placed and compacted to between 91 and 95 percent of the maximum theoretical density as determined by TxDOT Tex-227-F. The OWNER may secure 6 inch core

samples or sections of completed asphaltic pavements lifts for approximately every 2,000 square yards or part thereof, of asphaltic concrete pavement placed. The in place density at the sampled locations shall be determined by the following equation:

$$\text{Percent in place Density} = (GA \times 100)/GT$$

Where GA = Bulk specific gravity of core when tested in accordance with Tex-207-F

GT = Maximum theoretical specific gravity of combined cores when tested in accordance with Tex-277-F

The Contractor shall patch the surface where specimens are taken with no extra payment being made for this work. The OWNER may remove the asphaltic concrete pavement specimen on the day following placement or as soon as practicable thereafter. Other methods of determining in place density which correlate satisfactorily with those results obtained by cores or sections may be used.

406.1.C. Measurement and Payment

Asphaltic concrete pavement will be measured by the square yard (SY) of the specified total thickness, or per Ton (2000-lbs), of the type actually used in the completed and accepted work in accordance with the plans and specifications.

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement and Payment" will be paid for at the unit prices bid or the pay adjusted unit price for "Hot Mix Asphaltic Concrete" of the type and lift specified, which prices shall be full compensation for furnishing all materials, freight involved; for all heating, mixing, hauling, cleaning the existing base course or pavement, saw cutting, placing asphaltic concrete mixture, rolling and finishing, for all manipulations, labor, tools, equipment, temporary pavement markings and incidentals necessary to complete the work. Correcting defective work and the subsequent retesting shall be considered subsidiary to Item for Asphalt Pavement.

The prime coat, or tack coat, when required, will not be measured or paid for directly but shall be considered subsidiary to Item for Asphalt Pavement.

All templates, straightedges, scales and other weighing and measuring devices necessary for the proper construction, measuring and checking of the work shall be furnished, operated and maintained by the Contractor at his expense.

When not included as a specific payment item, installation of all items under this section shall be subsidiary to other items in the contract. Payment, when included as a specific pay item, for work meeting the requirements of this section shall be made either per square yard (SY) or per Ton (2000 lbs) of material installed in place.

406.2 TWO COURSE ASPHALT PAVEMENT

This item shall consist of a wearing surface composed of one or more applications of asphaltic material, each covered with aggregate constructed on the prepared base course herein specified and in accordance with the Contract Documents.

406.2.A. Description

All specifications in this item shall be in conformance with the TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges 2004, herein referred to as TxDOT 2004 Highway Standards.

Two course surface treatment shall not be applied when the air temperature is below 60° F and is falling, but it may be applied when the air temperature is above 50°F and is rising. Air temperature shall be taken in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the OWNER, are not suitable.

406.2.B. Materials

406.2.B.1. Aggregates: Aggregates to be composed of sound and durable particles of gravel, crushed gravel, crushed stone, crushed slag, burned clay, burned shale or natural limestone rock asphalt. These materials shall contain no more than 1 percent (1%) by weight of organic matter (other than native bitumen), clays, loam or pebbles coated therewith and shall contain no more than 5 percent (5%) by weight of any one combination of slate, shale, or soft particles of sandstone when tested in accordance with Test Method TEX-217-F. The percent of wear on natural limestone rock asphalt aggregate as determined by Test Method TEX-410-A shall be made on that portion of the material retained on the #4 sieve, having naturally impregnated asphalt content of less than 1 percent (1%). When tested by Test Method TEX-200-F the percent by weight shall be as follows:

Table 406.2.B.1.a. Gradation (Grade 4)

Sieve Size	Percent Retained
5/8"	0
1/2"	0-5
3/8"	20-40
No. 4	95-100
No. 8	98-100

Application Rate - Min. 1 CY covers 90 SY, max. 1 CY covers 110 SY, 1-110.

406.2.B.2. Asphalts, Oils, and Emulsions: Unless specified otherwise on the Construction Plans, asphaltic materials shall be AC-5 Asphaltic Cement or EA-HVRS, Anionic Emulsion, as specified by TxDOT Item 300 of TxDOT 2004 Highway Standards. Application Temperature for AC-5 shall be between 275 -375°F and for EA-HVRS shall be between 110 - 150°F. Rate of Application shall be 0.35 - 0.45 gal. per square yard for the first course and 0.25 - 0.35 gal. per square yard for the second course.

If AC-5 Asphaltic Cement is used, it shall contain a Latex Additive as specified in the above mentioned TxDOT Item 300. The base shall be prime coated in accordance with TxDOT Item 310 at a rate of 0.10 gal. per square yard min. prior to application of the paving.

406.2.C. Construction Methods

406.2.C.1. Chip Seal: Chip Seal shall be installed as follows: the area to be treated shall be cleaned of dirt, dust, or other deleterious matter by sweeping or other approved methods. If it is found necessary by the OWNER, the surface shall be lightly sprinkled just prior to the first application of asphaltic material.

Asphaltic material, as specified above, shall be applied on the clean surface by an approved type of self-propelled pressure distributor so operated as to distribute the material in the quantity specified, evenly, smoothly, under a pressure necessary for proper distribution. The Contractor shall provide all necessary facilities for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two distributor loads. The distributor shall have been recently calibrated and the OWNER shall be furnished an accurate and satisfactory record of such calibration. After beginning work, if the yield of the asphaltic material appears to be in error, the distributor shall be recalibrated in a manner satisfactory to the OWNER before proceeding with the work.

Asphaltic material for each course may be applied for the full width of the surface treatment in one application, unless the width exceeds twenty-six feet (26'). No traffic or hauling will be permitted over the freshly applied asphaltic material. Asphaltic material shall not be applied until immediate covering is assured.

Aggregate, of the type and grade shown on the plans for the first course, shall be immediately and uniformly applied and spread by an approved self-propelled continuous feed aggregate spreader, unless otherwise shown on the plans or authorized by the OWNER in writing. The aggregate shall be applied at the approximate rates

indicated on the plans and as directed by the OWNER. The Contractor shall be responsible for the maintenance of the surface of the first course until the second course is applied.

The entire surface shall then be broomed, bladed or raked as required by the OWNER and shall be thoroughly rolled with power rollers of the three-wheel or tandem, self-propelled type, weighing not less than 3 tons nor more than 6 tons. All wheels shall be flat.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the OWNER, operate the other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period as would be expected of the specified equipment, as determined by the OWNER, its use shall be discontinued.

Rollers shall be maintained in good repair and operating condition and shall be approved by the OWNER.

406.2.C.2. Two Course Surface Treatment: Two Course Surface Treatment shall consist of an initial installation of Chip Seal as detailed in the preceding paragraph, followed by installation of a second course as follows: the second course shall consist of asphaltic material and aggregate of the type and grade indicated on the plans for the second course. The asphaltic material and aggregate for this second course shall be applied and covered in the manner specified for the first application. The surface shall then be broomed, bladed or raked as required by the Engineer, and thoroughly rolled as specified for the first course. Asphaltic materials and aggregates for both courses shall be applied at the approximate rates indicated on the plans and as directed by the Engineer.

The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer and regulatory agency. The Contractor shall be responsible for the proper preparation of all stockpile areas before aggregates are placed thereon, including leveling of the aggregate to prevent any contamination thereof.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic materials shall be kept clean and in good operating condition at all times and they shall be operated in such manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

The Engineer will select the temperature of application based on the temperature-viscosity relationship that will permit application of the asphalt within the limits recommended in TxDOT Item 300, "Asphalts, Oils, Emulsions." The recommended range for the viscosity of the asphalt is 50 seconds to 60 seconds, Saybolt Furol. The Contractor shall apply the asphalt at a temperature within 15°F of the temperature selected.

406.2.D. Measurement and Payment

All acceptable Chip Seal or Two Course Surface Treatment will be measured by the square yard (SY) for completed and accepted work in accordance with the plans and specifications.

The work performed and materials furnished as prescribed by this item will be paid for at the unit price bid or the pay adjusted unit price for "Chip Seal" or "Two Course Surface Treatment" of the type and lift specified, which prices shall be full compensation for furnishing all materials, freight involved; for all heating, mixing, hauling, cleaning the existing base course or pavement, saw cutting, placing asphaltic concrete mixture, rolling and finishing; for all manipulations, labor, tools equipment, temporary pavement markings and incidentals necessary to complete the work. Correction of defective work and the subsequent retesting shall be included at CONTRACTORS expense; no separate pay item shall be provided.

The prime coat, when required, will not be measured or paid for directly but shall be considered subsidiary to this Section.

All templates, straightedges, scales and other weighing and measuring devices necessary for the proper construction, measuring and checking of the work shall be furnished, operated and maintained by the Contractor at his expense.

407 CONCRETE PAVEMENT

This item shall consist of finished pavement constructed of Portland cement concrete on the prepared subgrade or other base course, in conformity with the plans, as herein specified and as supplemented and/or amended by special provisions and to the lines and grades as established by the OWNER. Concrete shall be considered of satisfactory quality and made of materials acceptable to the job and these specifications, in the proportions approved by the OWNER; and mixed, placed, finished and cured in accordance with the requirements of these specifications and any special provisions.

407.1 MATERIALS

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.

407.1.A. Aggregates

Aggregates for Portland cement concrete shall conform to the requirements contained in this Item and shall be approved by the OWNER prior to use. Aggregates shall be of such character that it shall be possible to produce workable concrete within the limits contained in this specification.

407.1.A.1. Storage: The manner of handling and storage of aggregates shall be such as to prevent intrusion of foreign materials and segregation of sizes. If materials are stored on the ground, the stockpile sites shall be grubbed, cleaned of all vegetation and leveled. In this case, the bottom six-in. layer of aggregate shall not be disturbed and shall not be used in the work.

Where two or more sizes or types of aggregates are delivered to the job, each size or type shall be stored separately. Aggregates shall be stockpiled on the job or at a central batching plant for a minimum of 24-hours prior to use in the project. At the plant, the aggregate shall be wetted to a uniform moisture content of not less than three-percent below saturated surface dry condition before or while being loaded for shipment. Care shall be exercised to maintain this uniformity of moisture until the aggregates are used in the mix. Wetting of stockpiles to maintain the required percent moisture shall be performed at least 12-hours prior to use. At the time of use, the aggregates shall be free from frozen material and foreign matter. All grass, wood, sticks, burlap, paper or other material which may have become mixed with the aggregates while stockpiled or in handling must be removed.

407.1.A.2. Measurement: Fine and coarse aggregates shall be measured loose and separately. Aggregate weighing equipment shall conform to the requirements of ASTM C94 Standard Specification for Ready-Mixed Concrete and shall be approved by the OWNER prior to use.

The volume measuring equipment shall consist of approved boxes, pans or mechanical devices, which, while in operation, shall give the required volumes of the different kinds of aggregates required for the several classes of concrete. Equipment shall also be so marked and designed that the OWNER can accurately and conveniently check the quantities of each aggregate being used. Concrete made by continuous mixing shall conform to ASTM C685 Concrete Made by Volumetric Batching and Continuous Mixing.

407.1.A.3. Testing: All fine and coarse aggregates testing shall be done per TxDOT Item 360 "Concrete Pavement."

407.1.A.4. Gradation: The fine aggregate shall be well graded from fine to coarse and shall meet the requirements of Table 407.1.A.4.a. Fine Aggregates Gradation Requirements. Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof, conforming to the current ASTM Specification C-33. Stone dust or crushed sand may be added as mineral filler, if so directed by the OWNER. Amounts of mineral filler shall not exceed 5-percent of the fine aggregate to improve the workability or quality specified for fine or coarse aggregates. Aggregates shall be free from injurious amounts of salt, alkali, vegetable matter, or other objectionable material either free or as an adherent coating. At the time of their use, aggregates shall be free from frozen and/or all foreign material that may have become mixed with them in the stockpile.

Table 407.1.A.4.a. Fine Aggregates Gradation Requirements

Sieve Size	Percent Retained
3/8"	0
No. 4	0-5
No. 8	0-20
No. 16	15-30
No. 30	35-75
No. 50	70-90
No. 100	90-100
No. 200	97-100

When subjected to the color test for organic impurities, TxDOT Test Method Tex-408-A, the fine aggregate shall not show a color darker than standard.

Coarse aggregate shall consist of gravel or crushed stone meeting the requirements of the current ASTM Specifications C-33. Coarse aggregate shall consist of durable particles of gravel, crushed blast furnace slag and/or crushed stone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter or other objectionable material, either free or as an adherent coating on the aggregate. It shall not contain more than 0.25 percent by weight of clay lumps nor more than 1.0 percent by weight of shale nor more than 5.0 percent by weight of laminated and/or friable particles when tested in accordance with TxDOT Test Method Tex-413-A.

Coarse aggregate shall have a wear of not more than 45 percent when tested according to TxDOT Test Method Tex-410-A and when tested by standard laboratory methods shall meet the requirements of Table 407.1.A.4.b. Coarse Aggregates Gradation Requirements.

Table 407.1.A.4.b. Coarse Aggregates Gradation Requirements

Aggregate Grade No.1	Nominal Size	Percent Passing on Each Sieve								
		2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8
1	2"	100	80-100	50-85		20-40			0-5	
2(467)	1-1/2"		100	95-100		35-70		10-30	0-5	
3	1-1/2"		100	95-100		60-90	25-60		0-5	
4 (57)	1"			100	95-100		25-60		0-10	0-5
5(67)	3/4"				100	90-100		20-55	0-10	0-5
6(7)	1/2"					100	90-100	40-70	0-15	0-5
7	3/8"						100	70-95	0-25	
8	3/8"						100	95-100	20-65	0-10

1. Corresponding ASTM C 33 gradation shown in parentheses.

Loss by Decantation per TxDOT Test Method Tex-406-A. 1.0% Maximum. In the case of aggregate made primarily from crushing of stone. If the material finer than the 200 sieve is definitely established to be the dust

of fracture essentially free from clay or shale as established by Part III of TxDOT Test Method Tex-406-A, the percent may be increased to 1.5.

Aggregates which fail to meet the requirements of these specifications may be rejected by the OWNER. Such rejection shall incur no cost to the OWNER. Coarse aggregate sources, from which materials with properties not meeting these specifications are delivered, may be rejected as further supply sources to the project by the OWNER. Such rejection shall incur no cost to the OWNER.

407.1.B. Portland Cement

Portland cement shall be in accordance with Item 405.2 for Portland Cement Treatment. Only one brand of cement shall be used in any one (1) structure, except by written permission of the 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.

407.1.C. Admixtures

Unless otherwise provided in the plans or special provisions, approved types of chemical admixtures to minimize segregation, to improve workability or to reduce the amount of mixing water may be used in the rate of dosage specified by the OWNER and in accordance with the manufacturer's recommendations.

407.1.C.1. Chemical Admixtures: Chemical admixtures shall conform to ASTM C494 Chemical Admixtures for Concrete, Types "A", "D," "F" and "G" for concrete dosages in accordance with manufacturers' recommendations as specified by the OWNER.

Water-reducing admixtures conforming to ASTM C494, Types "A" and "F", shall be used to improve quality of concrete by obtaining specified strength at tower cement content and to increase slump without increasing water-cement ratio and may also be utilized in improving properties of concrete containing aggregates that are harsh or poorly graded.

Water-reducing, set retarding admixtures, conforming to ASTM C494, Type "D" and "G", may be used during hot weather concrete placement, so as to keep concrete workable during the entire placing period, in order that succeeding placements may be made without development of cold joints or discontinuities in the structural unit.

Air Entraining Admixture shall be used where specified or directed to improve workability and increase resistance to freeze and thawing, and scaling. The admixture 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 percent to six (6) percent.

407.1.C.2. Mineral Admixtures: Fly ash shall conform to the requirements of ASTM C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete, with the exception that the "Loss on Ignition" requirements shall be a maximum of 3-percent. Fly ash shall be sampled and tested at a frequency schedule in accordance with the requirements of ASTM C311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete. All sources of fly ash for use in Portland cement concrete shall conform to the requirements of Texas Department of Transportation (TxDOT) Material Specification DMS-8900 Fly Ash.

407.1.C.3. Fiber: At the OWNER'S option, fibrous reinforcement in concrete may be used unless otherwise shown on the plans or in the contract documents. Fibrous reinforcement shall not be used as a replacement for any reinforcement required for structural purposes. Add steel or polypropylene fibers only when called for on the plans or approved by the Engineer.

407.1.C.3.a. Polypropylene Fiber: Ratio shall be 1.5 pounds of fiber per cubic yard of concrete. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.

Physical Properties:

1. Material: Polypropylene.
2. Length: 3/4 inch.
3. Specific Gravity: 0.91.
4. Absorption: None.
5. Tensile Strength: 70-110 Ksi.
6. Modulus of Elasticity: 500 Ksi.
7. Melt Point: 140 degrees F (60 degrees C).
8. Flash Point: 932 degrees F (500 degrees C).
9. Density: 3.pounds/cubic yard.

407.1.C.3.b. Steel Fiber: Steel fiber shall comply with applicable provisions of ACI 544 and ASTM A820. Ratio shall be 50 to 200 pounds of fiber per cubic yard of concrete.

Physical Properties:

1. Material: Steel.
2. Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1.
3. Specific Gravity: 7.8.
4. Tensile Strength: 40-400 ksi.
5. Young's Modulus: 29,000 ksi.
6. Minimum Average Tensile Strength: 50,000 psi.
7. Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to an angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking.

Fibrous reinforcement or fiber-reinforced concrete may be rejected for failure to meet any of the requirements of this specification or ASTM C1116.

407.1.D. Water

Water for use in concrete shall be reasonably clean and free of oil, acid, alkali, organic matter or other deleterious substances. Water which is suitable for drinking or ordinary household uses may be accepted for use without being tested. Water used shall meet the requirements of ASTM C94

If the water is of questionable quality, it shall be tested in accordance with the standard Method of Test of Quality of Water to be used in concrete, AASHTO T26. Water for use with cement may be rejected for failure to meet any of the requirements of this specification and replaced at CONTRACTORS expense.

407.1.E. Formwork

Formwork shall be clean and in good condition, free from dents and rust, grease or other foreign material that tend to disfigure or discolor concrete in a gage and condition capable of supporting concrete and construction loads without significant distortion. Form Ties shall be metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Wire ties will not be allowed.

407.1.E.1. Lumber and Plywood: Materials shall be seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair the finished surface of concrete. Forms for bottoms of caps: At least 2-inch (nominal) lumber or 3/4-inch form plywood backed adequately to prevent misalignment and distortion. General use: Provide lumber of 1-inch nominal thickness or form plywood of approved thickness.

407.1.E.2. Rubbed Finish Exposed Concrete: Form or form-lining surfaces free of irregularities; plywood of 3/4-inch minimum thickness, preferably oiled at the mill.

407.1.E.3. Chamfer Strips: Materials shall be redwood, cypress or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.

407.1.E.4. Metal Forms: Clean and in good condition, free from dents and rust, grease or other foreign material that tend to disfigure or discolor concrete in a gage and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present a smooth surface and which line up properly.

407.1.F. Reinforcing

Concrete reinforcement is the metal (rods or fabric) imbedded in concrete in such a manner that the reinforcement and concrete act together in resisting forces.

407.1.E.1. Steel Reinforcement: Unless otherwise specified or designated on the plans, the metal for all bar reinforcement shall meet following:

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 A615, A767 or A775, grade 40 or grade 60.

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.

Reinforcement bars shall be bent cold to the shapes indicated on the plans. All bending of hard grade new billet steel shall be done in the shop. Bends shall be true to the shapes indicated, and irregularities shall be cause for rejection. Unless otherwise shown on the plans, bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar. Other bends shall be made according to the latest code of Standard Practice of the Reinforcing Steel Institute.

Reinforcement shall be stored above the ground surface upon skids, platforms or other supports, and shall be protected from mechanical injury and surface deterioration caused by exposure to the conditions producing rust. When placed in the work, the reinforcement shall be free from dirt, loose rust, scale, painting, oil or other foreign material.

Reinforcement may be rejected for failure to meet any of the requirements of this specification.

407.1.E.2. Steel Wire: At the OWNER's option the use of welded wire fabric may be used in lieu of deformed reinforcement bars unless otherwise shown on the plans or in the contract specifications. Welded wire fabric shall be delivered to the job site in sheets. Rolls of wire fabric shall not be permitted. The size of welded wire fabric shall be 12 x 12- W4 x W4. 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-185 or A884.

Reinforcement shall be stored above the ground surface upon skids, platforms or other supports, and shall be protected from mechanical injury and surface deterioration caused by exposure to the conditions producing rust. When placed in the work, the reinforcement shall be free from dirt, loose rust, scale, paint, oil or other foreign materials.

Reinforcement may be rejected for failure to meet any of the requirements of this specification.

407.1.E.3. Tie Wire: Tie wire shall be per ASTM A82. Use 16½ gauge minimum for tie wire, unless otherwise indicated.

407.1.E.4. Reinforcement Bar Chairs: Reinforcement bar chairs or supports shall be of adequate strength (if specified) to support the reinforcement bars and shall not bend or break under the weight of the reinforcement bars or CONTRACTOR'S personnel walking on the reinforcing bars.

Bar chairs may be made of metal (free of rust), precast mortar or concrete blocks or plastic. Pre-cast mortar or concrete blocks must be approved by the OWNER; and the CONTRACTOR shall supply test data showing the strength of the mortar or concrete blocks. For approval of plastic chairs, representative samples of the plastic shall show no visible indications of deterioration after immersion in a 5-percent solution of sodium hydroxide for 120-hours.

407.1.E.5. Dowel Bars: Dowel and tie bars shall be either straight or bent, smooth or deformed, as shown on the plans and shall conform to the requirements of Item for Steel Reinforcement. The dowel bars shall be coated with either hot asphalt or an alternate coating, as designated on the plans, to the extent shown on the plans.

Load Transmission Devices for Expansion and Contraction Joints, when indicated, shall meet the requirements specified herein:

Smooth steel bar dowels, used when indicated, shall be of the size and type indicated and shall be open-hearth, basic oxygen or electric-furnace steel conforming to the properties specified for grade 60 in ASTM A-615. The free end of dowel bars shall be smooth and free of shearing burrs.

When indicated, one end of each dowel bar shall be encased in an approved cap. The dowel caps and dowel bars shall be held securely in place by bar ties as indicated on the drawings. Mechanical methods of implanting dowel bars in the plastic concrete may be used when approved by the Engineer or designated representative. Where required, dowel bars shall be coated with a plastic material meeting the requirements indicated. Where red lead and oil bar coating is indicated, the red lead may be of any standard commercial grade and the oil shall be clean and no lighter than Standard No. 30 SAE grade. Approved thinner and dryer may be added to the red lead, but the material upon application shall be of such consistency that will provide a uniform and heavy coating on the bar. Where asphalt bar coating is indicated, the material may be any standard grade of oil asphalt and shall be applied hot. Cutback asphalt will not be permitted for bar coating.

Caps for slip dowel bars shall be of the length shown on the plans and shall have an internal diameter sufficient to permit the cap to freely slip over the bar. In no case shall the internal diameter exceed the bar diameter by more than 1/8"-in., and one end of the cap shall be rightly closed. The cap shall be installed to allow the bar to move not less than 1-1/4"-in. in either direction.

407.1.G. Joints

Joint filler is the material placed in concrete pavement and concrete structures to allow for the expansion and contraction of the concrete. Visible joint material shall have the color gray. Pre-molded Expansion Joint Filler shall conform to the requirements of ASTM Designation D-994 or other as approved by City Engineer.

Grout shall be non-shrink and shall conform to ASTM C 1107, Packaged, Dry, Hydraulic Cement Grout (Non-shrink), Grade C. Grout shall be packaged with mixed ingredients requiring the addition of water only.

407.1.G.1. Preformed Asphalt Board: Preformed asphalt board formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly impregnated with a suitable asphaltic binder and meeting the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM D 1751.

407.1.G.2. Preformed Non-bituminous Fiber Material: Preformed non-bituminous fiber material shall meet the requirements of the Standard Specifications for the Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM D 1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

407.1.G.3. Boards: Boards obtained from Redwood timber, of sound heartwood, free from sapwood, knots, clustered birdseye, checks and splits. Occasional sound or hollow birdseye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler.

407.1.G.4. Backer Rod: Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement and shall be used with joint sealer.

407.1.G.5. Joint Sealer: This material shall be a one-part low modulus silicone especially designed to cure at ambient temperatures by reacting with moisture in the air. The sealant material shall have the following properties:

Table 407.1.G.5.a. Joint Sealer Supplied Properties

Description	Property
Color	Gray
Flow, MIL-2-8802D Sec. 4.8.4	0.2 Max.
Working Time	10 min.
Tack-Free Time at 77 F±2 F Min. MIL-2-8802D Sec.4.8.7	60
Cure time, at 77 F	7-14 Days
Full Adhesion Time	14-21 Days
As Cured-after 7 days at 77 F (25 C) and 40% RH	90-100
No. 200	97-100

Table 407.1.G.5.b. Joint Sealer Cured Properties

Description	Property
Elongation	1200% Min.
Durometer Hardness, Shore A, ASTM D 2240	15 Min.
Joint movement capability	+100/50 Percent
Tensile Strength, elongation	100% Max.
Peal strength	25-psi (172-kPa)

Properties are As Cured-after 7 days at 77 F (25 C) and 40% RH

The joint sealer shall adhere to the sides of the concrete joint or crack and shall be an effective seal against infiltration of water and incompressible. A backer rod shall be required which will be compatible with the sealant. No bond or reaction shall occur between the rod and sealant. The sealant shall adhere to the sides of the concrete joint. It shall not crack or break when exposed to temperatures below 32°F (0°C).

Asphalt, Redwood board or other materials used shall extend the full depth of the concrete and shall be perpendicular to the exposed face. All joints shall be shaped to conform to the contour of the finished section in which they are installed. All material shall be a minimum of ½ inch thick or as indicated. Wood materials shall be anchored to the adjacent concrete to permanently hold them in place. Joint sealer shall be installed in accordance with the manufacturer's recommendations.

The material used for sidewalk expansion joints, shall conform to Item for Boards above, unless otherwise indicated.

The material used for curb and gutter expansion joints filler shall conform to any of the above, except when placed adjacent to concrete pavement, the joint material shall match the pavement joint material.

407.1.H. Concrete Properties

Concrete shall be composed of cementitious materials, fine aggregate, coarse aggregate, mineral filler and/or admixture if used and water, mixed in the proportions designated by the approved Mix Design and in the manner set forth in this specification. On the basis of job and laboratory investigations of the proposed materials, the Contractor will fix proportions by weight of water, coarse aggregate, fine aggregate, cementitious materials, admixture and mineral filler where required, in order to produce concrete of the specified strength and workability for the actual delivery time and site conditions to be encountered.

Concrete shall be proportioned- as detailed in the approved mix design. 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.

It shall be the responsibility of the Contractor to furnish the mix design, using a Coarse Aggregate Factor acceptable to the City, for the class of concrete specified. The mix shall be designed by a certified testing laboratory to conform with the requirements contained herein and in accordance with ASTM C1077. The Contractor shall perform, at his own expense, the work required to substantiate the design, and testing of concrete strength. Complete concrete design data shall be submitted to the Engineer for approval.

407.1.H.1. Concrete Classes: The concrete shall be uniform and workable and the minimum cement content, maximum water content, for the various classes of mixes shall conform to the following table 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:

Table 407.1.H.1.a. Concrete Classes

Class of Concrete¹	Min. Cementitious (lb/CY)	28 Day Min. Compressive Strength² (psi)	28 Day Min. Beam Strength² (psi)	Max. Water/ Cementitious Ratio	Max. Coarse Aggregate Size⁴
A ⁵	470	3000	500	0.58	1 ½"
C	564	3600	600	0.53	1 ½"
P1 ⁵	517	4000	N/A	0.49	1 ½"
P2	564	4500	N/A	0.45	1 ½"
M	As Directed by OWNER				

1. All exposed horizontal concrete shall have entrained - air.
2. Minimum Strength Required by OWNER [Compressive or Flexural]
3. ASTM C78 (Third-Point); Reduce by 10% when Type II Cement is Used
4. Smaller nominal maximum size aggregate may be used if strength requirement is satisfied
5. Sidewalks, separate curb and gutter, and 4-inch thick median pavement
6. Machine Finished
7. Hand Finished

407.1.H.2. Slump: Slump requirements for pavement and related concrete shall be as specified in Table 407.1.H.2.a. Slump Requirements. No concrete shall be permitted with slump in excess of the maximums shown. Any concrete mix failing to meet the above consistency requirements, although meeting the slump requirements, shall be considered unsatisfactory, and the mix shall be changed to correct such unsatisfactory conditions.

Table 407.1.H.2.a. Slump Requirements

Concrete Designation	Recommended Slump (in.)	Maximum Acceptable Placement Slump (in.)
Drilled shafts	5-7	8
Thin walled section (9 in. or less)	4	6-1/2
Approach slabs, concrete overlays, caps, columns, piers, wall sections (over 9 in.)	3	5
Bridge slabs	4	5-1/2
Prestressed concrete members	4	6-1/2
Concrete traffic barrier, concrete bridge railing	4	6-1/2
Dense concrete overlay	3/4	2
Latex-modified conc. for bridge deck overlays	3	7-1/2
Concrete placed underwater	6	8-1/2
Concrete pavement (slip-formed)	1-1/2	3
Concrete pavement (formed)	4	6-1/2
Riprap, curb, gutter, slip-formed, and extruded concrete	As approved	As approved

407.1.I. Submittals

The proposed methods, materials, installations, and other details in the submittals shall be modified as required to obtain the Engineer’s approval before beginning of construction. Prior to beginning construction, for each class of concrete to be used, the Contractor shall submit to the Engineer for approval the following items:

1. A concrete mix design that has been prepared by a certified testing laboratory to conform to the requirements contained in this Section. The submittal shall address all mixing and handling requirements as specified in this section.
2. A forming plan showing the forms to be used, the types of ties and bracing to be used, any construction joints that are proposed, pour rates, and other critical data. The form design is the complete responsibility of the Contractor, and the Contractor shall be required to obtain professional engineering assistance at his sole expense where appropriate for proper design.
3. A reinforcing schedule showing the size, type, grade, lengths, installation details, proposed supports, ties, and any other pertinent information related to the proposed reinforcing and its installation.

407.2 EQUIPMENT

All equipment necessary for the construction of this item shall be on the project and shall be approved by the OWNER as to condition before the CONTRACTOR shall be permitted to begin construction operations on which the equipment is to be used.

407.2.A. Forms

The side forms shall be metal, of approved cross section and bracing, of a height not less than the prescribed edge thickness of the concrete section and a minimum of 10-ft. in length for each individual form. Forms shall be

of ample strength and shall be provided with adequate devices for secure setting so that when in place they shall withstand the impact and vibration of equipment imposed thereupon without appreciable springing or settlement. In no case shall the base width be less than 8-in. for a form 8-in. or more in height. The forms shall be free from warps, bends or kinks and shall show no variation from the true plane for face or top. Each 10-ft. length of forms shall be provided with at least 3 pins for securely staking in position. Sufficient forms shall be provided for satisfactory prosecution of the work. 10-ft. metal form sections shall be used in forming curves with a 250-ft., and larger radius. For curves with a radius of less than 250-ft., acceptable flexible metal forms, or wood forms, may be used upon approval by the OWNER.

Slip form paving equipment shall be provided with traveling side forms of sufficient dimensions, shape and strength so as to support the concrete laterally for a sufficient length of time during placement to produce pavement of the required cross section. The equipment shall spread, consolidate, screed and float-finish the freshly placed concrete in such a manner as to provide a dense and homogeneous pavement.

407.2.B. Vibratory Equipment

All concrete placed as Machine Finish class concrete shall be consolidated by approved mechanical vibrators attached to the machine, operated ahead of the transverse finishing screen, and designed to vibrate the concrete internally. Unless otherwise shown on the plans, vibrators of the surface-pan type may also be used for full-depth placement provided that internal vibrators fixed to the machine are also used for vibrating the concrete internally. Vibratory members shall extend across the pavement practically to, but shall not come in contact with, the side forms. Mechanically-operated vibrators shall be mounted in such manner as not to interfere with the transverse or longitudinal joints.

The internal-type vibrators shall be spaced at not more than 24-in. and shall be equipped with synchronized vibratory units. Separate Vibratory units shall be spaced at sufficiently close intervals to provide uniform vibration and consolidation to the entire width of the pavement. The frequency in air of the internal spud-type Vibratory units shall be not less than 8,000-cycles-per-minute and not less than 5,000-cycles-per-minute for tube types. The method of operation shall be as directed by the OWNER. The CONTRACTOR shall have a satisfactory tachometer available for checking the vibratory elements.

The pavement vibrators shall not be used to level or spread the concrete but shall be used only for purposes of consolidation. The vibrators shall not be operated where the surface of the concrete, as spread, is below the elevation of the finished surface of the pavement, except for the first lift of concrete where the double strike-off method of placement is employed. The vibrators shall not be operated for more than 15-seconds while the machine upon which they are installed is still.

The pan-type vibrator units shall apply the vibrating impulses directly to the surface of the concrete. The operating frequency shall not be less than 3,500-cycles- nor more than 4,200-cycles-per-minute in air. The CONTRACTOR shall have a satisfactory tachometer available for checking the speed of the vibratory elements. Approved hand manipulated mechanical vibrators shall be furnished in the number required for provision of proper consolidation of the concrete along the forms, at joints and in areas not covered by mechanically controlled vibrators. These vibrators shall be sufficiently rigid to insure control of the operating position of the vibrating head.

407.2.C. Miscellaneous Equipment

The CONTRACTOR shall furnish a broom of the push broom type not less than 18-in. in width with stiff bristles for the final surface finish of concrete base or as the OWNER directs.

The CONTRACTOR shall furnish a sufficient number of bridges equipped to ride on the forms and span the pavement for finishing operations and for the installation and finishing of joints. The CONTRACTOR shall furnish, operate and maintain at least two standard 10-ft. (3m) steel straightedges and all necessary finishing and edging tools as may be required to complete the pavement in accordance with the plans and specifications.

407.2.C.1. Transverse Finishing Machine: The transverse finishing machine may be used for Machine Finish class concrete placement for pavement provided that internal vibrators fixed to the machine are also used for vibrating the concrete internally. The requirements for fixed internal vibrators given in part Item for

Vibratory Equipment, shall apply. The transverse finishing machine shall be provided with two screeds accurately adjusted to the crown of the pavement, shall be power driven, and mounted in a substantial frame equipped to ride on the forms. The machine shall be so designed and operated as to strike off and consolidate the concrete internally with internal-type vibrators as required in part Item for Vibratory Equipment.

Finishing machines shall be maintained in a tight and good operating condition, accurately adjusted to the required crown or profile and free from deflection, wobble, or vibration tending to affect the surface finish. Machines failing to meet these requirements shall be rejected by the OWNER, and the CONTRACTOR shall provide approved equipment.

407.2.C.2. Vibrating Screed: The mechanically vibrated screed shall be provided with a template adjusted to the crown of the concrete section. The template shall be power vibrated, adjustable in height and mounted to ride on the forms. The mechanical vibration of one of the screeds on the transverse finishing machine specified in Item for Transverse Finishing Machine shall be acceptable.

407.2.C.3. Hauling Equipment: Batch hauling equipment for the transportation of measured materials from the batching plant to the mixer shall be equipped with tight covers, which shall be used to prevent excessive evaporation of moisture or any loss of material.

If a central mixer is used, concrete may be transported to the point of delivery in truck agitators or non-agitating trucks.

If a truck mounted paving mixer is used, it may be used to transport the concrete after mixing is complete.

If non-agitator trucks are used they shall conform to the following requirements:

The bed of non-agitating hauling equipment shall be a smooth, mortar-tight, metal container. The hauling equipment shall be capable of delivering the concrete to the work site in a thoroughly mixed and uniform mass and capable of discharging the concrete at a satisfactory controlled rate without segregation. If in the opinion of the Engineer any appreciable segregation or accumulation of excess water and/or mortar occurs on the surface of the concrete, this may be cause for rejection and this method of transporting the concrete to the point of delivery shall be suspended as directed by the Engineer.

407.3 CONSTRUCTION METHODS

407.3.A. Mix Design

The Contractor shall perform at the Contractor's own expense and be responsible for the design of the concrete mix. The mix design shall be prepared and sealed by a person qualified and experienced in such work. Establish proportions on the basis either of laboratory trial batches or of field experience with the materials to be employed.

When ice is used to lower the concrete temperature during hot weather, the addition of ice shall not exceed 50 percent of the total mix water weight.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When field conditions are such that additional moisture is needed for the final concrete surface finishing operation, the required water shall be applied to the surface by fog spray only; and shall be held to a minimum amount. The concrete shall be workable, cohesive, possess satisfactory finishing qualities and be of the stiffest consistency that can be placed and vibrated into a homogeneous mass. Excessive bleeding shall be avoided.

If the strength or consistency required for the class of concrete being produced is not secured with the minimum cement specified or without exceeding the maximum water/cement ratio, the CONTRACTOR may use, or the OWNER may require, an approved cement dispersing agent {water reducer}; or the CONTRACTOR shall furnish additional aggregates, or aggregates with different characteristics, or the CONTRACTOR may use additional cement in order to produce the required results. The additional cement may be permitted as a temporary

measure, until aggregates are changed and designs checked with the different aggregates or cement dispersing agent.

The CONTRACTOR is solely responsible for the quality of the concrete produced. The OWNER reserves the right to independently verify the quality of the concrete through inspection of the batch plant, testing of the various materials used in the concrete and by casting and testing concrete cylinders or beams on the concrete actually incorporated in the pavement.

At least 10-days prior to the start of concrete paving operations, the CONTRACTOR shall submit to the OWNER a design of the concrete mix it proposes to use together with samples, if requested, of all materials to be incorporated into the mix and a full description of the source of supply of each material component.

The design of the concrete mix shall produce a quality concrete complying with these specifications and meet the requirements of ACI 318 (1992) - PART 3 Construction Requirements, CHAPTER 5, Concrete Quality, except as amended by these provisions. The concrete mix design shall include the following information:

1. Design Requirements and Design Summary
2. Material source
3. Dry weight of cement/cu. yd. and type
4. Dry weight of fly ash/cu. yd. and type, if used
5. Saturated surface dry weight of fine and coarse aggregates/cu. yd.
6. Design water/cu. yd.
7. Quantities, type, and name of admixtures with manufacturer's data sheets
8. Current strength tests or strength tests in accordance with ACI 318
9. Current Sieve Analysis and -200 Decantation of fine and coarse aggregates and date of tests
10. Fineness modulus of fine aggregate
11. Specific Gravity and Absorption Values of fine and coarse aggregates
12. L.A. Abrasion of coarse aggregates

All material samples submitted to the OWNER shall be sufficiently large to permit laboratory batching for the construction of test specimens to check the adequacy of the design. When the OWNER has approved the design mix, there shall be no change or deviation from the proportions thereof or sources of supply except as hereinafter provided. No concrete may be placed on the job site until the mix design has been approved by the OWNER in writing to the CONTRACTOR.

407.3.A.1. Testing: The Contractor shall prepare a minimum of four concrete test cylinders of each mix design, cure and test two each at the age of 7 and 28 days. From these preliminary tests the water-cement ratio required to produce concrete of the specified strength will be selected by the Contractor for approval by the Engineer or designated representative. The Contractor may at any time present in writing a suggested mix design and if the Engineer or designated representative concurs with the suggested design, the Contractor shall conduct trial batches necessary to determine its acceptability under these specification requirements.

The Contractor shall furnish and operate the mixer approved for use on this project unless the concrete is to be furnished from a transit mix (ready-mix) plant. For mixing the concrete to be used in making the preliminary test specimens, a minimum 1 cubic yard batch shall be mixed or a batch of sufficient size to afford proper mixing, whichever is the greater. In lieu of the above mixer and procedure, the Contractor may furnish a portable mixer of sufficient rated capacity to mix a minimum 3-sack batch; in which case, the batch mixed for the preliminary test not to be less than the rated capacity of the mixer furnished. A coating batch will be mixed prior to mixing for test cylinders.

Test beams or cylinders shall be required for each fifty (50) cubic yards or portion thereof, placed each day. The Engineer shall take test cylinders for compressive strength values on a random basis. The comparative results shall consist of the average of 2 cylinders each at 7 and 28 days for regular concrete, high early strength concrete and high range water reducing admixture concrete.

After the mix proportions and water-cement ratio required to produce concrete of the specified strength have been determined, placing of the concrete may be started. The strength of the concrete in the completed pavement will be determined by a minimum of four compressive strength test specimens made, cured with a minimum of two each tested at 7 and 28 days as provided in TxDOT Bulletin C-11. Modifications of the mix design may be requested by the Contractor on basis of conformity of the strength of these test specimens with the requirements and intent of this specification.

Changes in the water-cement ratio and the mix design, including an increase in cement factor if necessary, will be made when the average 7 day and/or 28 day compressive strength of the concrete, as indicated by the last 10 compressive strength values obtained from tests of cylinders made from concrete of the same water-cement ratio, departs from the desired minimum average strength by more than 4 percent.

Additional tests may be taken as determined by the concrete placement conditions or for adequately determining the strength of concrete where the early opening of the pavement to traffic is dependent upon concrete strength tests. No extra compensation will be allowed for materials and work involved in fulfilling these requirements.

407.3.A.2. 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.

407.3.A.3. 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 rate of delivery of the mixed concrete shall be such that the interval between loads shall not exceed 10-minutes. The concrete shall be delivered to the site of the work and discharged from the mixer before the drum has been revolved 300 revolutions, after the introduction of the mixing water with the dry materials.

The entire quantity of mixing water shall be accurately measured and controlled. Each batch shall be mixed to the consistency as described in the approved mix design. 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.

407.3.A.3. 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.

407.3.B. Placing Concrete

The Contractor shall give the Engineer at least twenty-four (24) hours advance notice that he intends to pour concrete in any unit of the structure. Prior to starting work the Contractor shall inform the Engineer 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 Engineer. 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.

407.3.B.1. Subgrade Preparation: When manipulation or treatment of subgrade is required on the plans, the work shall be performed in proper sequence with the preparation of the subgrade for pavement. Subgrade shall be prepared as indicated in Items 402, 403, 404, and 405. Density tests must be taken no more than 72-hours prior to placement of concrete. After the specified moisture and density are achieved, the CONTRACTOR shall maintain the subgrade moisture and density in accordance with Item for Subgrade Preparation until the pavement is placed. In the event that rain or other conditions may have adversely affected the condition of the subgrade or base, additional tests may be required as directed by the OWNER.

407.3.B.2. Forms: Facing of $\frac{3}{4}$ " grade B plywood 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 (ACI318-71)". 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 Engineer shall be used.

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 types 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 re-tempered sand cement mortar mixed in proportion of one to three, and the concrete shall be left smooth and even. Forms shall remain in place until the concrete has taken its final set. At the time the forms are removed, earth shall be banked against the sides of the slab and immediately and thoroughly wetted.

When forms settle over 1/8-in. under finishing operations, paving operations shall be stopped, the forms reset to line and grade and the pavement then brought to the required section and thickness.

Forms shall be thoroughly cleaned after each use and well-oiled before reuse.

407.3.B.3. Placing Reinforcing: Reinforcing steel, welded wire mesh, tie bars, dowels, etc., shall be placed as shown on the plans. All reinforcing shall be clean, free from rust in the form of loose or objectionable scale, and of the type, size and dimensions shown on the plans. Reinforcing bars shall be securely wired together at the alternate intersections and all splices and shall be securely wired to each intersection dowel and load-transmission unit intersected. All bars shall be installed in their required position as shown on the plans. The storing of reinforcing or structural steel on completed roadway slabs generally shall be avoided and, where permitted, such storage shall be limited to quantities and distribution that shall not induce excessive stresses.

Dowel bars shall be accurately installed in joint assemblies as indicated on the drawings, each parallel to the pavement surface and to the center line of the pavement and shall be rigidly secured in the required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete.

All reinforcing bars and bar mats shall be installed in the slab at the required depth below the finished surface and supported by and securely attached to bar chairs installed on prescribed longitudinal and transverse centers as shown by sectional and detailed drawings on the plans. After the reinforcing steel is securely installed above the subgrade, as specifically required by plans and as herein prescribed, there shall be no loading imposed upon (or walking upon) the bar mats or individual bars before or during the placing or finishing of the concrete.

When welded wire fabric is selected, the Contractor shall pour the lower half of the slab; place the welded wire fabric and then place the remaining concrete. Tie bars shall be installed in the required position by the method and device indicated. Bar coating indicated and of material specified, shall be completed and the bars and coating shall be free of dirt or other foreign matter at the time of installation in the concrete. Dowel bars shall be accurately installed in joint assemblies as indicated on the drawings, each parallel to the pavement surface and to the center line of the pavement and shall be rigidly secured in the required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete.

407.3.B.4. Joints: Expansion joints or dummy joints which may require an assembly of parts supported by special devices shall be completely assembled and rigidly supported in the correct position well in advance of the placing of concrete.

407.3.B.4.a. Joint Dimensions: The width of the joint shall be shown on the plans, creating the joint sealant reservoir. The depth of the joint shall be shown on the plans. Dimensions of the sealant reservoir shall be in accordance with manufacturer's recommendations. Normal width/depth ratios are 1 to 1, not to exceed 1 to 1½. After curing, the joint sealant shall be 1/8-in. to 1/4-in. below the pavement surface at the center of the joint. Expansion joints shall be installed perpendicularly to the surface and to the centerline of the pavement at the locations shown on the plans.

When no transverse joints are indicated, joints shall not exceed 40 feet. Such stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position. Where concrete base is overlaid by asphaltic concrete, the joints to be prepared as specified herein, but joint sealing will not be required unless indicated.

407.3.B.4.b. Joint Materials: Board joint material with less than 25-percent of moisture at the time of installation shall be thoroughly wetted on the job. Green lumber of much higher moisture content is desirable and acceptable. The joint filler shall be appropriately drilled to admit the dowel bars when required. The bottom edge of the filler shall extend to or slightly below the bottom of the slab. The top edge shall be held approximately 1/2-in. below the finished surface of the pavement in order to allow the finishing operations to be continuous.

Where the joint filler is of a pre-molded asphaltic type, the top edge shall be protected, while the concrete is being placed and finished, by a metal cap of at least 10 gauge material having flanges not less than 1½-in. in depth. The channel cap may remain in place during the joint finishing operations to serve as a guide for tooling the edges of the joint. After the removal of the side forms, the ends of the joints at the edges of the slab shall be carefully opened for the entire depth of the slab.

Routine pavement joints shall be filled to a depth of 1½-in. Materials shall generally be handled and applied according to the manufacturer's recommendations, with additional requirements as stated herein.

Dowel bars, where required on the plans, shall be installed through the predrilled joint filler and rigidly supported in true horizontal and vertical positions by an assembly of bar chairs and dowel holders welded to

transverse bars extending across the slab and placed on each side of the joint. The chair assembly shall be similar and equal to that shown on the plans and shall be approved by the OWNER prior to extensive fabrication.

407.3.B.4.c. Contraction Joints: Contraction or dummy joints shall be installed at the locations and at the intervals shown on the plans in accordance with this section and Item for Sawing. The joints shall be constructed by sawing to a 1/4-in. width and to a depth of 1/4 of the pavement thickness, or deeper if so indicated on the plans. Unless otherwise specified on the plans, joints shall be sawed into the completed pavement surface as soon as sawing can be accomplished without damage to the pavement and before 24 hours after the concrete has been placed, so that some raveling of the green concrete is observed in order for the sawing process to prevent uncontrolled shrinkage cracking. If sharp edge joints are being obtained, the sawing process shall be sped up to the point where some raveling is observed. Damage by blade action to the slab surface and to the concrete immediately adjacent to the joint shall be minimized. Any portion of the curing membrane which has been disturbed by sawing operations shall be restored by spraying the areas with additional curing compound. The sawed groove shall immediately be thoroughly cleaned for the full depth and width of the joint and filled. The type of equipment and method for performing this work shall be approved by the OWNER.

407.3.B.4.d. Construction Joints: Construction joints formed at the close of each day's work or when the placing of concrete has been stopped for 30-minutes or longer shall be constructed by use of metal or wooden bulkheads cut true to the section of the finished pavement and cleaned and oiled.

Asphalt, Redwood board or other materials used shall extend the full depth of the concrete and shall be perpendicular to the exposed face. All joints shall be shaped to conform to the contour of the finished section in which they are installed. All material shall be a minimum of 1/2 inch thick or as indicated in contract documents. Wood materials shall be anchored to the adjacent concrete to permanently hold them in place. Joint sealer shall be installed in accordance with the manufacturer's recommendations.

Wooden bulkheads shall have a thickness of not less than 1 1/2-in. Longitudinal bars shall be held securely in place in a plane perpendicular to the surface and at right angles to the centerline of the pavement. Edges shall be rounded to 1/4-in. radius. Any surplus concrete on the subgrade shall be removed upon the resumption of the work. In no case shall an emergency construction joint be placed within 8-ft. following a regular installation of expansion or contraction joint. If the emergency construction joint should fall within this limitation, the concrete shall be removed back to the previously installed joint.

Longitudinal construction joints shall be of the type shown on the plans. Longitudinal joints shall be constructed accurately to required lines in order to coincide with traffic lane lines. No width between longitudinal construction joints shall exceed 24-ft., unless specifically authorized or directed by the OWNER in writing.

407.3.B.4.e. Expansion Joints: Transverse expansion joints shall be formed perpendicular to the centerline and surface of pavement and shall be constructed in accordance with the sequence of operations indicated on the drawings. After the transverse finishing machine and before the longitudinal finishing machine have passed over the joint, the Contractor shall test the joint filler for correctness of position and make any required adjustment in the position of the filler and shall install the joint seal space form as indicated on the drawings. After removal of the joint seal form as indicated on the drawings, the joint seal space above the joint filler shall be thoroughly sandblasted or machine routed to remove all projecting concrete, laitance, dirt or foreign matter. The concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint. On completion of curing of the pavement, the joint sealing filler of the type specified shall be placed as indicated. The faces of the joint seal space shall be clean and surface dry at the time joint sealing filler is placed. On completion of the joint seal, the pavement adjacent to the joint shall be left free of joint sealing material. The joint seal space shall be exactly above and not narrower than the joint filler with no concrete over-hangings.

407.3.B.5. Pouring: The Contractor shall give the Engineer 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.

Unless otherwise shown on the plans, the concrete shall be placed using either forms or slipform paver. The concrete shall be rapidly deposited on the subgrade in successive batches and shall be distributed to the required depth and for the entire width of the pavement by shoveling or other approved methods. Any concrete not placed as herein prescribed within the time limits specified in Table 407.3.B.5.a. Concrete Temperature-Time Requirements will be rejected.

Table 407.3.B.5.a. Concrete Temperature-Time Requirements

Concrete Temp (at point of placement)	Max Time - (min) (no retarding agent)	Max Time - (min) (no retarding agent)¹
Non-Agitated Concrete All Temps	30	45
Agitated Concrete		
Above 90°F	45	75
Above 75°F thru 90°F	60	90
75°F and Below	90	120

1. Normal dosage of retarder.

Where 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 (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, paving, piers, walls, floors, slabs columns or superstructures in one continuous operation. If required by specific jobsite conditions, openings in the forms shall be provided for the removal of laitance and other foreign material. At the end of the day, or in case of unavoidable interruption or delay of more than 30-minutes, a transverse construction joint shall be placed.

Concrete shall not be placed before the time of sunrise and shall not be placed later than shall permit the finishing of the pavement during sufficient natural light.

Any concrete not placed as herein prescribed within 30 minutes after mixing shall be rejected and disposed of as directed except as provided otherwise herein. If in the opinion of the Engineer or designated representative, the temperature, wind and/or humidity conditions are such that the quality of concrete will not be adversely affected, the specified placing time may be extended by a maximum of 45 minutes.

407.3.B.5.b. Compaction: All concrete shall be well compacted and the mortar flushed to the surface of the forms by 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.

Special care shall be taken in placing and spading the concrete against the forms and at all joints and assemblies so as to prevent honeycombing. Excessive voids and honeycombing in the edge of the pavement, revealed by the removal of the side forms, may be cause for rejection of the section of slab in which the defect occurs.

The use of rakes will not be permitted. Workers will not be permitted to walk in the concrete with any earth or foreign material on their boots or shoes.

407.3.B.5.c. Weather Conditions: Except by specific written authorization of the OWNER, no concrete shall be placed when the air temperature is less than 40°F and falling but may be placed when the air temperature is above 35°F and rising. The temperature shall be taken in the shade away from artificial heat. When and if such permission is granted, the CONTRACTOR shall furnish sufficient protective material and devices (canvas and frame work or other type of housing) to enclose and protect the fresh concrete in such a way as to maintain the temperature of the air surrounding the fresh concrete at not less than 50°F for a period of at least 5-days. Sufficient heating apparatus such as stoves, salamanders, or steam equipment and fuel to furnish all required heat shall be supplied. It is to be distinctly understood that the CONTRACTOR is responsible for the quality and strength of the concrete placed under any weather conditions. No concrete shall be placed on a frozen subgrade. The Contractor shall be responsible for the quality and strength of concrete under cold weather conditions and any concrete damaged by freezing shall be removed and replaced at the Contractor's expense.

Concrete shall not be placed when it's temperature is greater than 95°F. During hot weather placement additional steps shall be taken to insure proper curing, including, but not limited to, the use of ice in the batch process, white pigmented curing compound, dampening of forms, steel, and subgrade beneath concrete. Additionally, placement of wet burlap on the surface of concrete, fogging or wet curing may be used and maintained for a minimum of 7 days.

407.3.B.6. Finishing: 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.

Finishing shall be done on all exposed surfaces up to 1-ft below finished grade.

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, betting, 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 workable, it shall be tested for irregularities with a 10-ft. metal straightedge placed parallel to the centerline of the pavement so as to bridge depressions and to touch all high spots. Ordinates measured from the face of the straightedge to the surface of the pavement shall at no place exceed 1/16 inch-per-foot from the nearest point of contact. In no case shall the maximum ordinate to a 10-ft. straightedge be greater than 1/8-in. Any surface not within the tolerance limits shall be reworked and refinished.

The edges of slabs and all joints requiring edging shall be carefully tooled with an edger of the radius required by the plans at the time the concrete begins to take its "set" and becomes non-workable. All such work shall be left smooth and true to lines.

407.3.B.6.a. Texturing: After completion of the straightedge operation, as soon as construction operations permit, texture shall be applied with 1/8 inch wide metal tines with clear spacing between the tines being not less than 1/4 inch nor more than 1/2 inch. If approved by the Engineer or designated representative, other equipment and methods may be used, provided that a surface texture meeting the specified requirements is obtained. The texture shall be applied transversely.

It is the intent that the average depth resulting from the number of tests directed by the Engineer or designated representative shall not be less than 0.060 inch with a minimum texture depth of 0.050 inch for any one test when tested in accordance with TxDOT Test Method Tex-436-A. Should the texture depth fall below that intended, the finishing procedures shall be revised to produce the desired texture.

The Contractor shall have available at all times hand rakes with tines for the purpose of providing textures in the event of equipment breakdown. The Contractor also shall have available a conventional garden spray type can, containing a commercially available monomolecular film compound. This shall be applied in the case of equipment breakdown or other emergencies to prevent the pavement from drying too rapidly. The use of this product will give the Contractor additional time to provide adequate texturing.

After completion of texturing and about the time the concrete becomes hard, the edge of the slab and joints shall be carefully finished with an edger and the pavement shall be left smooth and true to line.

407.3.B.6.b. Stamping: All concrete including curbs, curb with gutter, sidewalks, alleys, driveways and other structures shall be marked by means of a substantial stamp or die so designed to make an impression in the finish of the concrete. The stamp or die shall designate the firm name or CONTRACTOR and the month and year in which the work was done. The design of the stamp or die shall be approved by the Engineer.

407.3.B.6.c. Hand Finishing: Hand finishing shall be permitted only in intersections and areas inaccessible to a finishing machine. The addition of one-sack of cement per cubic-yard shall be required for all hand finish concrete.

When the hand method of striking off and consolidating is permitted, the concrete, as soon as placed, shall be approximately leveled and then struck off and screeded to such elevation above grade that, when consolidated and finished, the surface of the pavement shall be at the grade elevation shown on the plans. The entire surface shall then be tamped and the concrete consolidated so as to insure maximum compaction and a minimum of voids. For the strike off and consolidation, both a strike template and tamping template shall be provided on the work. In operation the strike template shall be moved forward with a combined longitudinal and transverse motion and so manipulated that neither end of the template is raised from the forms during the striking off process. A slight excess of material shall be kept in front of the cutting edge at all times. The straightedge and joint finishing shall be as hereinabove prescribed.

407.3.C. Curing Concrete

All concrete pavements shall be cured by protecting it against loss of moisture for a period of not less than 72 hours from the beginning of the curing operations. Immediately after finishing operations have been completed, the entire surface of the newly laid concrete shall be covered and cured in accordance with the requirements specified for whichever of the following methods the Contractor may elect. The curing method as herein specified does not preclude the use of any of the other commonly used methods of curing, and the OWNER may approve another method of curing if so requested by the CONTRACTOR. If any selected method of curing does not afford the desired results, the OWNER shall have the right to order that another method of curing be instituted.

The curing of concrete pavement shall be thorough and continuous throughout the entire curing period. Failure to provide proper curing as herein prescribed shall be considered as sufficient cause for immediate suspension of the paving operations.

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.

All concrete shall be cured and sealed with a continuous acrylic membrane-forming compound meeting the requirements of ASTM C-309. Products shall be Sealco 309 by Gifford-Hill; Horn Clear Seal by W.R. Grace and Company, or an approved equal.

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

407.3.D. Opening to Traffic

All traffic shall be excluded from the pavement for a period of not less than 14-days or until field cured test specimens indicate concrete meets at least 75% of design strength, or as otherwise approved by the OWNER. In all cases the pavement shall be cleaned and joints shall be filled and trimmed before being opened to traffic.

When it is necessary to provide for traffic across the pavement, the CONTRACTOR shall, at its own expense, construct suitable and substantial crossings over the concrete which shall be adequate for the traffic using same.

Opening pavement to traffic shall not relieve the CONTRACTOR of responsibility for the work and shall not in any way affect the time charge on the entire project. The number of days stated in the contract shall govern for the completion of the entire work covered by the contract.

407.3.E. Testing and Evaluation

All testing shall be in accordance with applicable ASTM Standards and concrete testing technician must be ACI certified or equivalent.

During the progress of the work, the CONTRACTOR shall cast test cylinders, in accordance with ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field, to maintain a check on the compressive strengths of the concrete being placed. In accordance with ASTM C31 and ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete, four test cylinders shall be taken from a representative portion of the concrete being placed for every 150-cubic yards of concrete pavement placed, but in no case shall less than 2 sets of cylinders be taken from any one day's placement.

After the cylinders have been cast, they shall remain on the job site and then transported, moist cured, and tested by the OWNER in accordance with ASTM C31 and ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. In each set, one of the cylinders shall be tested at 7-days, two cylinders shall be tested at 28-days, and one cylinder shall be held or tested at 56-days, if necessary.

407.3.E.1. Deficient Pavement: The adjustment in unit prices provided for in this item will apply only when measurement for payment is by the square yard. It is the intent of this specification that the pavement be constructed in strict conformity with the thickness, strength and typical sections indicated on the drawings. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.

The pavement will be core drilled after any grinding operations have been completed for surface corrections prior to final acceptance. Locations of core tests may be selected by the Engineer or designated representative; however, spacing interval for core tests, as specified herein, shall be maintained. The

thickness of the pavement will be determined by measurement of the cores in accordance with TxDOT Test Method Tex-424-A.

One core will be taken at the location selected by the Engineer or designated representative or at random in each unit. If the measurement deficiency of the core is less 0.2-in from the plan thickness, full payment will be made. When the measurement of the core is deficient more than 0.2 inch but less than 0.75 inch from the plan thickness, 2 additional cores (at directed locations) will be taken from the unit and the average of the 3 cores determined. The 2 additional cores from any 1,000-foot unit will be taken at intervals of not less than 300 feet. The 2 additional cores from any 1,000 square yard unit will be taken at locations such that the pavement in the unit will be well represented. If the average measurement of these 3 cores is not deficient more than 0.2 inches from the plan thickness, full payment will be made. If the average thickness of the 3 cores is deficient by more than 0.2 inch but not more than 0.75 inch from the indicated thickness, an adjusted unit price as provided below will be paid for the areas represented by these cores.

After any grinding or milling operations have been completed to meet the surface-testing requirement of this specification, if average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than 0.75 inch, payment will be made at an adjusted price as specified in the following table:

Table 407.3.E.1.a. Concrete Pavement Thickness Deficiency

Thickness Deficiency (in)	Contract Price Allowed (%)
0.00 to 0.20	100
0.21 to 0.30	80
0.31 to 0.40	72
0.41 to 0.50	68
0.51 to 0.75	57

Any area of pavement found deficient in thickness by more than 0.75 inch but not more than 1 inch or 1/8 of the indicated thickness, whichever is greater, shall be evaluated by the Engineer. If, in the judgment of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced at the Contractor's entire expense, with concrete of the thickness indicated on the drawings.

If the average compressive strength based on concrete test cylinders at 28 days is less than the specified minimum strength of the concrete, then payment will be made at an adjusted price as specified in the following table. The Ratio shall be that of the Average Strength from Test Cylinders to Specified Minimum Compressive Strength both at 28 Days.

Table 407.3.E.1.b. Concrete Pavement Strength Deficiency

Ratio of Average Strength	Contract Price Allowed (%)
0.95-1.00	100
0.90-0.95	85
0.85-0.90	70
0.80-0.85	60
Less than 0.80	0 or Remove and Replace

When, in the opinion of the Engineer or designated representative, the compressive strength test results appear unrepresentative, additional testing of field cores may be authorized. To be considered acceptable for consideration the field cores shall be acquired, properly handled and tested in accordance with ASTM C 42/C 42M, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" within 45 days of the original concrete placement date. The retesting will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original test results were erroneous by more than 15% in the opinion of the Engineer or designated representative, the original test results will be discarded. In the instance of erroneous original test results the subsequent first set of retests will be at the expense of the Owner.

When, in the opinion of the Engineer or designated representative, the concrete compressive strength is deemed unacceptable for the intended use of the pavement, the concrete shall be removed and replaced to the limits indicated by test results.

407.3.E.2. Pavement Cracks: Random drying shrinkage cracks or stress cracks of widths greater than 0.025-inches in recently placed reinforced Portland cement concrete pavement placed on stabilized subbase or slabs on grade are subject to being removed and replaced at the discretion of the OWNER.

Random drying shrinkage cracks or stress cracks of any nature in recently placed non-reinforced Portland cement concrete pavement placed on non-stabilized subbase or slabs on grade are subject to being removed and replaced at the discretion of the OWNER. Recently placed concrete pavement or slabs on grade are those for which the one-year maintenance bond has not expired. Routing, by any means, and sealing random cracks will not be permitted.

When Portland cement concrete pavement or slabs on grade must be removed and replaced, the area of removal must extend from the nearest contraction or dummy joint or construction joint a minimum distance of 10-feet, measured parallel to the longitudinal axis of the pavement, and include that portion of the concrete pavement or slab on grade containing the random crack. A sawed dummy joint will be required to be sawed across the opposing, non-damaged, slab in line with the saw cut made for the removal of the damaged slab. The area of removal and replacement of slabs containing longitudinal random cracks will be determined by the OWNER or its representative. Randomly cracked Portland cement concrete sidewalks will require removal and replacement of only the five-foot long section or sections containing random cracks.

407.4 MEASUREMENT AND PAYMENT

When specifically included on the bid form as a pay item, concrete placed under this Section shall be measured complete in place by physically measuring the completed concrete structure after removal of forms and all required finishing has been completed. Length and width (or depth) shall be measured, and the constructed volume of the placed concrete shall be computed in square yards (SY). When not specifically included on the bid form as a pay item, there shall be no direct measurement of installed concrete, and all installed concrete not included in a specific bid item shall be paid as a subsidiary item to other bid items in the contract.

Concrete Pavement, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Concrete Pavement" which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, hauling and handling all concrete ingredients, including all freight and royalty involved; for placing and adjusting forms, including supporting material or preparing track grade; for mixing, placing, finishing, sawing, cleaning and sealing joints and curing all concrete; for furnishing and installing all reinforcing steel; for furnishing all materials for sealing joints and placing longitudinal, expansion and weakened plane joints, including all steel dowel caps and load transmission devices required and wire and devices for placing, holding and supporting steel bars, load transmission devices and joint filler material in proper position, for coating steel bars, all other materials and methods, equipment, tools, testing, labor, and incidentals necessary to complete the work.

408 SIDEWALKS, DRIVEWAYS, RAMPS, AND VALLEY GUTTERS

This item includes sidewalk, concrete driveway approaches, barrier free access ramps, and valley gutter construction within public right-of-way. All sidewalks, drive approaches, barrier free access ramps, and valley gutters shall conform to the standard plans and details appended to these Standard Specifications.

408.1 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 407, "Concrete Pavement".
- B. Flexible Base Material shall conform to the requirements of Item 403, "Flexible Base".

408.1.A. Reinforcing: Driveway approaches and walk reinforcing, when required, shall be No. 3 bars on 24-in. centers or No. 4 on 30-in. centers. No. 6 gauge, 6-in. x 6-in. wire fabric conforming to Item 407.1.F. Reinforcing may be used only as approved by the OWNER.

Sidewalk reinforcing (except in driveway approach) may be No.3 bars on 24-in. centers or No. 10, 6-in. x 6-in.

All excavation, construction of fills or embankments and grading within the, public right-of-way shall conform to the appropriate section(s) of the standard specifications.

408.2 CONSTRUCTION METHODS

Construction of concrete valley gutters, sidewalks, barrier free access ramps, and concrete driveway approaches shall conform to the following requirements. Concrete shall be Class A as specified under Item 407, "Concrete Pavement", 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 details in the approved plans or Standard Details appended to these specifications. Grades, alignment, and tolerances shall be as 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 concrete driveway approaches. The reinforcing steel shall be placed in position as shown on the details in the approved plans. Care shall be exercised to keep all steel in its proper location during concrete placement.

Concrete surface 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. After the surface has become firm, the surface shall be given a single floating with a wood float to provide a uniform surface.

The CONTRACTOR shall do all necessary filling, leveling and fine grading required to bring the subgrade to the exact grades specified and compacted to at least 90-percent of maximum density as determined by ASTM 0698 Test Methods, from -2 to +4 of optimum.

408.2.A. Valley Gutters

Concrete Valley Gutters shall be constructed in accordance with details in the approved plans or 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.

408.2.B. Sidewalks, Driveways, and Ramps

Sidewalks, barrier free access ramps, and Concrete Driveway Approach shall conform to the details in the approved plans or 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 concrete driveway approach. Reinforcing shall conform to the details in the approved plans or Standard Details appended to these

specifications. Expansion joints shall be installed at the intersection of drives and walks as indicated on Item 407, 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 407, 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 concrete driveway approach apron. Curing compound shall be applied to the surface immediately after finishing is completed.

408.2.B.1. Sidewalks: Concrete sidewalks shall have a minimum thickness of 4-in., except sidewalks constructed in driveway approach sections shall have a minimum thickness equal to that of driveway approach or as called for by plans and specifications within the limits of the driveway approach. Standard slope for walks shall be 1/4-in. per-ft. in the direction of the curb or perpendicular to sidewalk direction, with a tolerance of 1/8-in. per-ft. When sidewalk is against the curb, expansion joints and tooled grooves shall match those in the curb.

408.2.B.2. Ramps: Ramps shall comply with provisions of Texas Accessibility Standards including location, slope, width, shapes, texture and coloring. At the locations shown on the plans or at locations designated by the OWNER, the separate curb, integral curb, or curb and gutter shall be laid down to a uniform width of not less than the specified height of the curb from the back of the curb line for access to future driveways. The return radii and partial curb return shall be built from the face of the curb to the back of the curb lay-down.

408.2.B.2. Driveways: Where a driveway approach or ramp is to be constructed at a location where there exists a separate curb and gutter, said curb and gutter shall be removed for the full width of the gutter to the nearest joint or to a sawed point at the point of radius. On concrete pavement with monolithic curb, the breakout line shall be 12-in. from the face of the curb line and shall be parallel to it and form a right angle with the concrete surface. The breakout line shall be a sawed groove in accordance with the requirements of Item for Sawing. Alternately, the OWNER may approve use of equipment designed to cut concrete curbs. All faces and edges exposed as a result of cutting shall be smoothed.

408.3 MEASUREMENT AND PAYMENT

All Concrete Valley Gutters, Sidewalks, and Concrete Driveway Approach will be measured per square yard (SY) complete in place.

All barrier free access ramps will be measured per Each (EA) complete in place.

Price of Concrete Valley Gutter, Sidewalks, ramps, and Concrete Driveway Approach if included in the bid, shall be measured as specified above, which price shall be full compensation for all work herein specified, including the furnishing of all materials, equipment, tools, labor, and incidentals necessary to complete the work.

409 CONCRETE CURB AND GUTTER

This item shall consist of Portland Cement concrete curb or curb and gutter with reinforcing steel as required, constructed on an approved subgrade and base in accordance with this specification and in conformity with the lines, grades, section and details indicated or as established by the Engineer.

409.1 MATERIALS

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

- A. Concrete and reinforcing shall conform to the requirements of Item 407, "Concrete Pavement".
- B. Flexible Base Material shall conform to the requirements of Item 403, "Flexible Base".
- C. Reinforcing steel shall conform to Item 407, "Concrete Pavement". All bars shall be wired at their intersections and at all laps or splices. All bars at splices shall be lapped a minimum of 20-diameters of the bar or 12-in., whichever is greater.
- D. Expansion joint materials shall conform to Item 407, "Concrete Pavement".

409.2 CONSTRUCTION METHODS

This section is intended to comply with section 402, 403, and 407. If anything in this section appears to contradict the above sections then the CONTRACTOR shall bring it to the attention of the OWNER for further guidance. Subgrade for curb and gutter shall be excavated and prepared to required depth and width including a minimum of 12 inches behind the curb, unless a greater width is indicated, to construct the work to grades and dimensions indicated. If dry, the subgrade shall be sprinkled with water lightly before concrete is deposited thereon.

The reinforcing steel shall be placed in position as shown on the typical section. Care shall be taken to keep all steel in its proper location.

409.2.A. Joints: Expansion joint material, ½-in thickness, shall be provided at intervals not to exceed 40 feet and at intersection returns and other rigid structures, or matching abutting sidewalk joints and pavement joints, or as otherwise specified by the OWNER. The expansion joints in concrete pavement shall coincide with the expansion joints in the curb and gutter and sidewalk. Joints shall extend the full width and depth of the concrete.

Longitudinal dowels, across the expansion joints in the curb and gutter, shall be required. There shall be three No. 4, round, smooth bars for dowels at each expansion joint. Dowels shall be spaced in accordance with standard reinforcement steel specifications. The dowel shall be a minimum of 24-in. in length. One-half of the dowel shall be coated with asphalt and terminated with an expansion cap. The cap shall provide a minimum of 1-in free expansion. Dowels shall be supported by an approved method to provide a true horizontal and longitudinal alignment.

Weakened plane joints or tooled joints shall be made ¾ inch deep at 10-foot intervals or matching abutting sidewalk joints and pavement joints. All joint headers shall be braced perpendicular and at right angles to the curb.

Two round smooth dowel bars, ½ inch in diameter and 24 inches in length, shall be installed at each expansion joint. Sixteen inches of one end of each dowel shall be thoroughly coated with hot oil, asphalt or red lead, so that it will not bond to the concrete. The dowels shall be installed with a dowel sleeve on the coated end as indicated or equivalent as directed by the Engineer.

409.2.A. Forms: All forms shall be of well-seasoned wood or steel, straight, free of warp and framed, braced or staked in a substantial and approved manner so as to insure perfect alignment and grade. The length of the forms shall be not less than 10 feet. Flexible or curved forms shall be used for curves of 100-foot radius or less. Wood forms for straight sections shall be not less than 2 inches in thickness. Forms shall be clean, straight, free from warp and oiled with a light form oil. All forms shall be securely staked to line and grade and maintained in a true position during the depositing of concrete.

409.2.B. Workmanship: Concrete shall be placed in the forms, rodded and tamped to exclude all air and honeycomb. Not more than 1 hour after the concrete has been placed, a thin coating not more than ½ inch nor less than ¼ inch thick of finish mortar, composed of 1 part Portland Cement to 2 parts fine aggregate, shall be worked into the exposed faces of the curb and gutter by means of a "mule." After the concrete has become sufficiently set, the exposed edges shall be rounded by the use of an edging tool to the radii indicated. The entire exposed surface of the curb and gutter shall be floated to a uniform smooth surface, then finished with a camel hair brush to a gritty texture. The forms shall remain in place a minimum of 24 hours unless approved otherwise by the Engineer. After removal of the forms, any minor honeycombed surfaces shall be plastered with a mortar mix as described above. Excessively honeycombed curb and gutter, as determined by the Engineer, shall be completely removed and replaced when directed.

409.2.A. Finishing: After the concrete has been struck off and while it is still plastic, the exposed surfaces may be plastered with 1/4-in. mortar topping. The mortar topping shall be applied with a steel "mule," or a finishing tool or method which produces results equivalent to that obtained with the mule. All exposed surfaces shall then be floated or troweled and lightly brushed as required by the OWNER to produce a smooth and uniform finish. Excess working of the surfaces shall be avoided. Excess water, laitance and inert materials shall be removed from the surfaces.

The top of all the work and the face of all curbs shall be checked for irregularities as soon as the surface is finished, using a 10-ft. straightedge, and the maximum distance from the straightedge to the concrete shall not exceed 1/4-in. All variations greater than specified shall be immediately corrected. All honeycombed areas disclosed by removal of forms shall be immediately chipped out and patched with Portland cement mortar.

After a minimum of 3 days curing and before placing the final course base, the curb shall be backfilled to the full height of the concrete, tamped and sloped as directed by the Engineer. The top 4 inches of backfill shall be of clean topsoil, free of stones and debris.

409.3 MEASUREMENT AND PAYMENT

Accepted work as prescribed by this item will be measured by the linear foot (LF) of concrete curb and gutter, complete in place. The work, when direct payment is provided for in the Bid, performed as prescribed by this item will be paid for at the unit price bid per linear foot for "Concrete Curb and Gutter" and / or "Concrete Curb," which price shall be full compensation for all work for excavation, preparing the subgrade, for furnishing and placing all base material, reinforcing steel, dowels, expansion joint material, backfilling and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

410 MEDIANS

This item shall consist of concrete medians and headers in accordance with these specifications and in conformance with the lines and grades established by the OWNER and details shown on the plans.

410.1 MATERIALS

All material requirements for constructing concrete medians shall conform to the requirements of Item for Concrete Curb and Gutter. Where a monolithic concrete median is indicated, concrete and reinforcement shall match the adjacent pavement. Concrete material requirements shall be the same as those for Item for Concrete Paving.

410.2 CONSTRUCTION METHODS

Excavation and fine grading shall be done according to Item for Unclassified Street Excavation, and shall be subsidiary to the item. Forms and concrete placement shall conform to the requirements of Item for Concrete Curb and Gutter and shall be of a depth equal to the depth of the required section. Forms shall be securely staked to line and grade and maintained in a true position during the depositing of concrete.

The surface shall be finished with a float and lightly brushed to obtain a uniform finish. Tooled joints shall be placed longitudinally and transversely at intervals not to exceed 6-ft. center to center, as shown on the plans, or as directed by the OWNER. Joints in the median shall coincide with joints in curb and gutter. Expansion joint material shall be placed between the median and the back of curb and around all obstructions protruding through the concrete median.

Concrete header shall be constructed at the location(s) shown on the plans and shall be constructed as shown on the plans in accordance with Item for Concrete Pavement.

410.3 MEASUREMENT AND PAYMENT

Concrete median shall be measured by the square-yard (SY) complete in place.

Concrete header shall be paid per each (EA) complete in place.

The work performed and materials furnished as prescribed by this item, measured as provided for in this item, shall be paid for at the contract unit price bid for "concrete median," and "concrete header," which price shall be full compensation for constructing concrete median, concrete header, necessary excavation, and for preparing the subgrade; furnishing and placing all materials, reinforcing steel, including sand cushion, reinforcement and expansion materials; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

411 PAVEMENT REPAIR

No interference with traffic flow on the thoroughfares and collectors shall be permitted during the hours of 6:30 a.m. to 9:30 a.m. and 3:30 p.m. to 6:30 p.m., Monday through Friday, unless directed otherwise by the OWNER. A traffic lane shall be considered satisfactorily open if it is paved with hot-mix or cold mix asphalt paving, or paved with another suitable material approved by the OWNER, or covered.

If the cut is to be covered, the CONTRACTOR shall use steel plates of sufficient strength and thickness to support all the traffic. A transition of hot-mix or cold-mix asphalt conforming to the requirements of Item for Asphalt Pavement shall be constructed from the top of the steel plate to the existing pavement to create a smooth riding surface. Exceptions to these specifications must be approved by the OWNER.

411.1 REPAIR DIMENSIONS

Exact pavement removal locations must be approved by the OWNER prior to construction. If multiple repairs are closer than 10-ft. apart from edge of one repair to the edge of a second repair, a continuous section shall be replaced.

411.1.A. Concrete Repairs

Sidewalks shall be removed and replaced to the nearest existing joint. No sidewalk or driveway section to be replaced shall be smaller than 30-in. in either length or width unless otherwise approved by the OWNER.

A gutter of at least 12-in. may remain, provided that the curb and gutter is not damaged by the construction activity. Damaged curbs shall be replaced at the expense of the CONTRACTOR.

In a concrete paved street or alley, no horizontal dimension of any cut along the street path shall be less than 3-ft. or no less than 1-ft. from the edge of the trench on each end, whichever is greater. Where saw-cut locations coincide with or fall within 3-ft. of the present location of dummy joints, cold joint, construction joints, expansion joints, or edge, removal shall be to the existing joint or edge. If the trench edge or point repair is located greater than 1-ft. from a lane line on the side of the line closest to the curb, pavement shall be removed and replaced from the curb to the lane line. If the edge of a trench or point repair is located less than 1-ft. from a lane line on the side of the line closest to the curb, pavement shall be removed and replaced from the curb to the 2nd lane line beyond the trench edge or point repair.

411.1.B. Asphalt Repairs

In an asphalt paved street or alley, no horizontal dimension of any cut along the street path shall be less than 4-ft. or no less than 2-ft. from the edge of the trench on each end, whichever is greater.

If the edge of a trench or point repair is located less than or equal to ½ lane width but greater than 2-ft. from a lane line, the lane-width of pavement shall be removed and replaced. If the edge of a trench or point repair is located less than 2-ft. from a lane line, the pavement shall be removed and replaced to ½ lane width on each

side. In the lane along the curb, if the trench edge or point repair plus 2-ft. toward the lane line is less than ½ lane width, pavement shall be removed and replaced from the curb to ½ lane width.

411.2 SAWING

This item shall apply in the removal of bituminous or concrete pavement, curb, gutter, sidewalk or driveways. This item shall also govern for the sawing of weakened plane joints (contraction joints). Sawing shall be in accordance with the requirements of this item unless otherwise shown on the plans or in the special provisions. The removal and replacement of portions of permanent pavement (Portland cement concrete or hot-mix asphalt), drives, slabs, sidewalks, etc. shall require a full-depth cut to be sawed by the use of an approved power driven concrete saw in accordance with this specification or as directed by the OWNER.

Sawing shall be considered subsidiary to the items requiring sawing if no pay item exists in the Contract.

411.2.A. Equipment

The saw shall be power driven, shall be manufactured especially for the purpose of sawing pavement, shall be suitable for the work to be performed including dust control and shall be maintained in good operating condition.

Saw blades shall make a clean, smooth cut, producing a groove 1/8-in. to 1/4-in. wide and to the full depth required by these specifications or as shown on the plans. The saw, with its control devices, shall be mounted on a sturdy frame supported on rubber-tired wheels.

411.2.B. Construction Methods

Dust and residues from sawing shall be prevented from entering the atmosphere or storm drain. The edge of pavements, curb, gutter, sidewalk and/or driveways shall be neatly sawed. Saw cuts shall be made perpendicularly to the surface to full pavement depth or as directed by the OWNER. The edges of pavement and appurtenances damaged subsequent to sawing shall again be saw cut to neat straight lines for the purpose of removing the damaged areas. Such saw cuts shall be parallel to the original saw cut. Concrete sidewalk or driveway to be removed shall be neatly sawed in straight lines either parallel to the curb or at right angles to the alignment of the sidewalk.

For repairs due to trench excavations the existing pavement shall be precut, sawed or scored so as to result in an even, 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 material shall then be replaced in three (3) inch layers tamped in place. Replaced base material shall comply with Item for Flexible Base, and in no case be less than 8 inches thick. 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. Removal of excess surfacing beyond the nominal limits of the ditch shall be kept to a minimum, and such areas shall be outlined with straight saw-cuts and included in areas to be repaired as described above. Base material shall be compacted to ninety-five (95) percent of maximum density as determined by TxDOT Test Method TX-113/114. The replaced surface course shall consist with Item for Hot Mix Asphaltic Concrete.

In all paved streets the trench shall be finished in a workmanlike manner consistent 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.

411.3 MEASUREMENT AND PAYMENT

If provided, the pavement repair shall be measured by the square-yard (SY) complete in place.

If not provided in the contract documents, Pavement Repair shall be considered subsidiary to the items requiring repair if no pay item exists in the Contract.

The work performed and materials furnished as prescribed by this item, measured as provided for in this item, shall be paid for at the contract unit price bid for "pavement repair," which price shall be full compensation for constructing pavement, necessary removal and excavation, saw cutting, and for preparing the subgrade; furnishing and placing all materials, reinforcing steel, including sand cushion, reinforcement and expansion materials; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

412 ROCK RIPRAP

This item shall include the construction of all Rock Riprap, and all of the materials, labor, and other incidentals required to complete the work at location specified by the Engineer.

412.1 MATERIALS

All Rock Riprap materials and construction shall conform to the Contract Documents.

- A. Geotextile Fabric – 6 OZ non-woven needle punch geotextile or as approved by Engineer.
- B. Clean native rock, size as indicated in the Contract Documents - as approved by Engineer.
- C. Grout – As indicated in item 405 and 407 with the use of only fine aggregates.

412.2 CONSTRUCTION METHODS

All Rock Riprap construction shall conform to the Contract Documents. Geotextile shall be placed in such manner that edge of geotextile is 12-in. from edge of rock riprap. Geotextile is not required if riprap is grouted. When geotextile is required, rock size shall be 6" min as measured on shortest axis.

412.3 MEASUREMENT AND PAYMENT

All Rock Riprap shall be measured by the square-yard (SY) complete in place.

Rock Riprap, if included in the bid, shall be measured as specified above and paid as described above, which price shall be full compensation for all work herein specified, including the furnishing of all materials, equipment, tools and labor and incidentals necessary to complete the work.

413 HIKE AND BIKE TRAIL

This item shall govern the furnishing and installation of hike and bike trails of the type and depth specified on a prepared surface to the typical sections and to the lines and grades indicated.

413.1 MATERIALS

Subgrade Preparation shall conform to Section for "Subgrade Preparation," except that compaction requirements may be evaluated by either proof rolling or density testing, as established by the Owner. Any material necessary to establish the required grade shall conform to Item for Borrow.

Flexible Base shall conform to Item for "Flexible Base." Concrete shall conform to Item for "Concrete Pavement." Concrete Curb shall conform Item for "Concrete Curb and Gutter."

Hot Mix Asphaltic Concrete shall conform to Item for "Hot Mix Asphaltic." All Hot Mix used for Hike and Bike Trails shall be Type D with a minimum thickness of 1.5".

Reinforcing steel and fiber reinforcing shall conform to Item for "Concrete Pavement."

413.1.A. Granite Gravel

The material shall be Texas decomposed unwashed granite aggregate and clay fines meeting the requirements hereinafter specified and shall be screened to the required particle size. The material shall be from approved sources.

Testing of granite gravel materials shall be in accordance with the following TxDOT standard laboratory test procedures:

- | | |
|--|-----------|
| 1) Preparation for Soil Constants and Sieve Analysis | Tex-101-E |
| 2) Liquid Limit | Tex-104-E |
| 3) Plastic Limit | Tex-105-E |
| 4) Plasticity Index | Tex-106-E |
| 5) Sieve Analysis | Tex-110-E |

Granite gravel material will be stockpiled and tested by the testing agency designated by the Owner and reviewed by the Owner prior to being hauled to the project site.

The material shall be well graded and when properly tested, shall meet the following requirements:

Table 413.1.A.1. Granite Gravel Gradation Requirements

Sieve Size	Percent Passing
5/8"	100
No. 40	40-45
No. 200	15-25
Properties	
Liquid Limit	35 Max.
Plasticity Index	12-18

413.1.B. Submittals

Prior to beginning construction, the Contractor shall submit to the Engineer for approval the following items:

1. Concrete: Concrete submittals shall be in accordance with Section 300 "Concrete."
2. Hot Mix Asphaltic Concrete: Hot Mix Asphaltic Concrete submittals shall be in accordance with Section 410 "Hot Mix Asphaltic Concrete."
3. Flexible Base: Flexible Base submittals shall be in accordance with Section 240 "Flexible Base."
4. Fiber Reinforcing: Fiber type, supplier, and product properties. Submit fiber documentation for compliance with this specification and ASTM C-1116.
5. Granite Gravel: Prior to construction, a sealed laboratory report shall be provided to verify compliance with the material requirements for granite gravel.

413.2 CONSTRUCTION METHODS

Granite gravel shall be compacted to not less than 92 percent of optimum density, as determined by TxDOT test method Tex-114, in accordance with ASTM D2167 Nuclear Test Method. Field density determinations shall be made in accordance with approved methods. Tests shall be performed at intervals not exceeding 500 feet at random points on the Hike and Bike Trail cross section.

When granite gravel is utilized as the finished surface for a Hike and Bike Trail, both sides shall be protected throughout the length of the trail by a concrete ribbon curb six inches in width, and shall match the depth of the granite gravel material. Alternatively, tightly fitted or mortared cut limestone blocks may be used, provided that no gaps larger than 1/4 of an inch are present between blocks. In addition, any areas with steep topography, or

that may be subject to erosion potential, shall be required to have a concrete surface a minimum of four inches in depth.

412.3 MEASUREMENT AND PAYMENT

Hike and Bike Trail will be measured by the square yard (SY) of gravel area, complete in place regardless of depth required.

Concrete curbs, as prescribed by this item will be measured by the linear foot (LF), complete in place.

“Hike and Bike Trail,” if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for “Hike and Bike Trail” which price shall be full compensation for all work herein specified, including the furnishing of all materials, compacting, excavation, embankment, equipment, tools, labor, water for sprinkling, proof rolling and incidentals necessary to complete the work. Payment for “Concrete,” “Concrete Curb and Gutter,” “Class B Borrow,” “Reinforcing Steel,” “Flexible Base,” “Hot Mix,” and “Subgrade Preparation” necessary constructing “Hike and Bike Trail” in accordance with this specification, shall be subsidiary to payment for “Hike and Bike Trail.”

414 PAVEMENT MARKINGS

This item shall govern for the type, quality and application of paint or appropriate coatings for pavement surfaces. Such applications include liquid coatings and galvanizing. Items to receive applications may include, but are not limited to, bridges, barriers, concrete pavement, and asphalt pavement.

414.1 DESCRIPTION

Painting, coating and other protective treatments shall include, unless otherwise provided in the contract, the preparation of the surfaces; the application, protection and drying of the paint, coating(s) or treatments; the protection of all traffic upon, underneath, or near the structure, material or pavement; the protection of all parts of the structure, material or pavement against disfigurement by any and all painting operations; and the supplying of all tools, tackle, scaffolding, labor, workmanship, paint, coating and/or other materials necessary for the completion of the entire work in accordance with the plans and these specifications.

The intent of the design herein specified is to procure the paints, coatings or treatments on surfaces so that the durability and protective value of these designs shall be realized in service. Accordingly, the best quality materials and workmanship are implied throughout. Surface conditions and application requirements are specified with the intent to obtain full adhesion of paint, coatings or treatments to clean, dry, firm surfaces. This shall require careful attention to preparation of surface, to the prevention of contamination and marring of the coating during and after drying, and to uniform, skilled application.

Fire Lanes shall be installed in accordance with the International Fire Code (IFC), as well as the requirements set forth in the construction documents or referenced in the local governing authority’s regulations and/or ordinances.

414.1.A. Safety

Some paints are harmful to the health. All paints shall be handled according to the information contained on the paint safety data sheet. The CONTRACTOR shall be responsible for safety during all cleaning and painting operations.

Unless shown otherwise on the plans, the CONTRACTOR shall be responsible for necessary precautions to contain refuse, dust and paint overspray generated during cleaning and painting operations. Containment shall be such that all falling material is contained and collected for disposal. Non-containment of airborne particles is permissible provided they are not visible over 100-feet from the actual cleaning or painting operation. A skimmer shall be used when cleaning and painting is over bodies of water. Disposal of collected refuse shall be in accordance with Federal, State and Local rules and regulations.

If spray application is used, workers shall be adequately protected with respirators, and provisions shall be made to prevent infliction of harm upon all other humans and/or animals that might be exposed to the fumes or might eat food upon which the fumes have deposited. This warning shall absolve the OWNER from blame in the event of harm to persons or property from the named cause, and full responsibility for any such harm shall rest upon the CONTRACTOR.

414.2 MATERIALS

All materials used in the painting and marking herein specified shall conform to the material and composition requirements of the applicable TxDOT Material Specification Item 666, Item 667, Item 672, Item 677, and Item 678.

414.2.A. Striping

Pavement Striping shall comply with:

- DMS-8200 Traffic Paint - Type II Marking Materials,
- DMS-8220 Hot Applied Thermoplastic - Type II Marking Materials,
- DMS-8240, Prefabricated Pavement Markings – Permanent,
- DMS-8241, Prefabricated Pavement Markings – Removable,
- DMS-8242, Temporary Flexible-Reflective Roadway Marker Tabs,
- DMS-8290 Glass Traffic Beads

Including any official TxDOT amendment or modification of these specifications, where reference to TxDOT or its representatives shall mean the OWNER. The CONTRACTOR shall certify to the OWNER that paint or coatings provided meet TxDOT material requirements.

414.2.B. Raised Pavement Markers

Raised Pavement Markers shall comply with TxDOT Item 672 and Specifications:

- DMS-4100, Jiggle Bar Tile,
- DMS-4200, Pavement Markers (Reflectorized),
- DMS-4300, Traffic Buttons,
- DMS-4210, Pavement Markers (Plowable Reflectorized),
- DMS-6100, Epoxies and Adhesives,
- DMS-6130, Bituminous Adhesive for Pavement Markers

The inspector will sample in accordance with Tex-729-I.

414.2.C. Testing

All paint and paint materials shall be sampled and tested prior to use. All tests shall be conducted in accordance with the methods specified by ASTM or methods set forth in Federal Standard FEDSTD-141 C/GEN Paint, Varnish, Lacquer, and Related Materials: Methods of Inspection, Sampling, and Testing. In the absence of any such methods, other suitable methods may be designated and utilized by the OWNER.

Raw materials and finished products that fail to meet any requirements of these specifications shall be subject to rejection. Final acceptance or rejection shall be based on results of tests on samples of raw materials and finishes as soon as practicable after their arrival at the shipping destination. Approval of materials, as a result of preliminary testing prior to manufacture into finished coatings, shall not be binding upon final approval or rejection. The judgment of the OWNER shall be final in all questions relative to conformance with the provisions of these specifications.

414.3 EQUIPMENT

Use equipment that is maintained in satisfactory condition, meets or exceeds the requirements of the National Board of Fire Underwriters and the RRC for this application, uses an automatic bead dispenser attached to the pavement marking equipment, and can provide continuous mixing and agitation of the pavement marking material. Provide a hand-held thermometer capable of measuring the temperature of the marking material when applying Type I material.

414.4 CONSTRUCTION METHODS

Throughout paint application, including shop and field painting, no paint shall be applied over a surface that evidences a loose or scaly condition. Every effort shall be made by means of the most effective and practical methods to remove all loose mill scale, rust, dirt, oil and grease, as well as all other foreign surfaces which would be deleterious to the procurement of the firm paint coating. Markings shall be applied only when the pavement surface is dry and clean, which may be accomplished with machinery specialized to prepare pavement in front of the marking operation. The CONTRACTOR shall comply with all environmental condition restrictions recommended by the manufacturer of pavement paints or other markings. Glass beads or other refractive material and application rates shall be as identified on the plans.

Temporary markings shall be thoroughly removed to the satisfaction of the OWNER using an approved method prior to the application of permanent markings.

When the CONTRACTOR is responsible for marking pavements, as identified in the plans, cleaning and marking shall conform to these specifications and the Texas Manual on Uniform Traffic Control Devices. Place markings before opening to traffic unless short term or work zone markings are allowed.

On roadways already open to traffic, place markings with minimal interference to the operations of that roadway. Use traffic control as shown on the plans or as approved. Protect all markings placed under open-traffic conditions from traffic damage and disfigurement.

414.4.A. Surface Preparation

Unless otherwise shown on the plans, prepare surfaces in accordance with this section. When existing pavement markings are present, remove loose and flaking material. Ensure that the bond surfaces are free of dirt, curing compound, grease, oil, moisture, loose or unsound pavement markings, and any other material that would adversely affect the adhesive bond. Approved pavement surface preparation methods are sweeping, air blasting, flail milling, and blast cleaning unless otherwise specified on the plans.

414.4.A.1. New Pavement Surfaces: Air-blast or broom the pavement surface to remove loose material, unless otherwise shown on the plans. A sealer for Type I markings is not required unless otherwise shown on the plans.

Furnish raised pavement markers for each class from the same manufacturer. Place raised pavement markers on the new asphaltic concrete surface or surface treatment only after the new surface has aged at least 14 days. Surface shall be prepared in accordance with TxDOT Item 678.

414.4.A.2. Old Pavement Surfaces: For old surfaces and all concrete surfaces, clean in accordance with TxDOT Item 678, "Pavement Surface Preparation for Markings," to remove curing membrane, dirt, grease, loose and flaking existing construction markings, and other forms of contamination.

414.4.A.3. Sealer for Type I Markings: For old surfaces and all concrete surfaces, apply a pavement sealer before placing Type I markings on locations that do not have existing markings, unless otherwise approved. The pavement sealer may be either a Type II marking or an acrylic or epoxy sealer unless otherwise shown on the plans. Follow the manufacturer's directions for application of acrylic or epoxy sealers. When the sealer becomes dirty after placement, clean by washing as directed. Place the sealer in the same configuration and color (unless clear) as the Type I markings unless otherwise shown on the plans.

Apply markings on pavement that is completely dry and passes the following tests:

414.4.A.4. Type I Marking Test: Place a sample of Type I marking material on a piece of tarpaper placed on the pavement. Allow the material to cool to ambient temperature, and then inspect the underside of the tarpaper in contact with the pavement. Pavement will be considered dry if there is no condensation on the tarpaper.

414.4.A.5. Type II Marking Test: Place a 1-sf piece of clear plastic on the pavement, and weight down the edges. The pavement is considered dry if, when inspected after 15 min., no condensation has occurred on the underside of the plastic.

414.4.B. Application

Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed, and have guide locations verified. Use material for guides that will not leave a permanent mark on the roadway. Apply markings that meet the requirements of Tex-828-B, using information as shown on plans. Alignment must not deviate than 1 in. per 200 ft. of roadway or more than 2 in. max. Markings shall be clean and reflectorized.

414.4.B.1. Weather Conditions: Apply markings during good weather unless otherwise directed. If markings are placed at Contractor option when inclement weather is impending and the markings are damaged by subsequent precipitation, the Contractor is responsible for all costs associated with replacing the markings if required. As a general rule if the material manufacturer does not establish temperature requirements, do not place material if the pavement temperature is below 60°F or above 120°F.

414.4.B.1.a. Type I Markings: Place the Type I marking after the sealer cures, and within the temperature limits recommended by the material manufacturer. If during a spray application, operations cease for 5 min. or longer, flush the spray head by spraying marking material into a pan or similar container until the material being applied is at the recommended temperature. Apply on clean, dry pavements passing the moisture test described above, and with a surface temperature above 50°F when measured in accordance with Tex-829-B.

414.4.B.1.b. Type II Markings: Apply on surfaces with a minimum surface temperature of 50°F and within temperature limits recommended by the material manufacturer.

414.4.B.2. Application: Apply markings and install markers as shown on plans. Do not make permanent marks on the roadway for the guides.

414.4.B.2.a. Type I Markings: Apply TY-I markings with a minimum thickness of 0.1-in. for new markings and retracing water based markings and 0.06-in. for retracing on thermoplastic pavement markings, or 0.09-in. for all other Type I markings. The maximum thickness for Type I markings should not exceed 0.18-in. as measured in accordance with Tex-854-B using the tape method.

414.4.B.2.b. Type II Markings: Apply TY-II markings at least 20 gal. per mile on concrete and asphalt surfaces for a solid 4-in. line. Adjust application rates proportionally for other widths. When Type II markings are used as a sealer for Type I markings, apply at least 15 gal. per mile using Type II drop-on beads.

414.4.B.2.c. Beads: Bead Application for Type I and Type II markings shall be provided with a uniform distribution of beads across the surface of the stripe, with 40% to 60% bead embedment.

414.4.B.2.d. Raised Markers: Epoxy adhesive and bituminous adhesive will be used for jiggle bar tile and reflectorized pavement markers. For traffic buttons on hydraulic cement concrete pavements and for plowable reflectorized pavement markers use only epoxy adhesive. For traffic buttons on bituminous pavements use only bituminous adhesive.

Apply adhesives in sufficient quantity to ensure that 100% of the bonding area of raised pavement markers is in contact with the adhesive. Do not heat bituminous adhesive above 400°F. Agitate bituminous adhesive to ensure even heat distribution. Place raised pavement markers immediately after the adhesive is applied and ensure proper bonding. Do not use adhesives or any other material that impairs the functional retro-reflectivity of the raised pavement markers.

414.4.C. Testing

All markings and replacement markings must meet the requirements of Tex-828-B for at least 30 calendar days after installation. Markings should not lift, shift, smear, spread, flow, or tear by traffic action. Markings that fail these requirements within 30-days shall be removed and replaced according to this Item at CONTRACTOR's expense.

414.5 MEASUREMENT AND PAYMENT

Linear pavement markings shall be measured per Linear Foot (LF) of installed marking as measured along the centerline of stripe. Other markings and raised pavement markers shall be measured either per Each (EA) or per Lump Sum (LS).

Payment shall be made per unit described above and shall include any type, color specified and the shape, width, size, and thickness, all types of paint (TY-I, TY-II, Beads, Sealer), surface preparation, testing, and furnishing and placing all materials, tools, labor, for removing existing markers and markings; furnishing and installing raised pavement markers; and equipment, materials, labor, tools, and incidentals to complete the work.

415 TRAFFIC CONTROL

This item shall consist of furnishing, installing and removing all temporary traffic control devices necessary to meet the requirements of the latest version of the Texas Manual on Uniform Traffic Control Devices (TMUTCD), and the requirements set in the traffic control plan.

415.1 INSTALLATION

Temporary traffic control devices shall be installed as required before the beginning of any construction adjacent to active traffic lanes. Temporary traffic controls shall be modified as required at the beginning of each construction phase to comply with the construction phasing and actual traffic patterns to be accommodated. If at any time during the project, the temporary traffic controls are not installed or maintained in a manner consistent with the Contract Documents and the TMUTCD, the Engineer shall have the authority to order all work stopped until the temporary traffic controls are brought into full compliance. No additional contract time or extra pay shall be allowed for such shutdown periods.

Temporary striping shall be as denoted on the plans and shall conform to TxDOT Item 662 for Type II work-zone pavement markings.

415.2 MEASUREMENT AND PAYMENT

Temporary traffic control devices will be measured by Lump Sum (LS), Per Month (Mo), or Per Each (EA), which shall include all maintenance, revisions, removal, and relocations.

Payment for all items and tasks described in this Specification Item shall include the cost of materials, labor and all incidental and subsidiary materials and work necessary to complete installation and meet all requirements as indicated.

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501 INTRODUCTION

This Item shall govern the control measures necessary to define methods and limits of drainage improvements, demolition, installation, and other structures. All items specified herein are intended to comply with the City of Marble Falls Drainage Criteria Manual and the Non-Point Source Pollution (NPS) Manual and Ordinance. CONTRACTOR shall notify Engineer if it is noticed discrepancies between this Item and other City manuals and ordinances. CONTRACTOR shall be prohibited with continuation of work while knowing of such discrepancies.

The OWNER reserves the right to have required temporary erosion sedimentation and water pollution prevention and control work performed by others should the CONTRACTOR fail to perform required temporary erosion, sedimentation, and water pollution prevention and control work in a timely fashion or should the CONTRACTOR fail to prevent and control soil erosion, damage control, safety, and water and air pollution which may degrade quality of air and water. All costs including engineering and right-of-way costs for the work required shall be borne by the CONTRACTOR. The CONTRACTOR shall reimburse the OWNER for all such costs within 30-days after receipt of the reimbursement request from the OWNER. Failure to submit payment for such reimbursement costs in the time prescribed above may result in the OWNER withholding the reimbursement due from the monthly progress payments to the CONTRACTOR until reimbursement to the OWNER is made.

502 DESCRIPTION

This item shall consist of furnishing all pipe and/or materials for constructing pipe mains, sewers, laterals, stubs, inlet leads, service connections and culverts, including all applicable work such as excavating, bedding, jointing, backfilling, materials, tests, etc. The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer and shall include all joints or connections to new or existing mains, pipes, sewers, manholes, inlets, structures, etc. as may be required to complete the work in accordance with specifications and standard published practices of the trade associations for the material specified and to the lines and grades indicated. This item shall consist of pumping, bailing, drainage and Trench Safety Systems for trench walls when indicated. Unless otherwise provided, this item shall consist of the plugging of the ends of abandoned piped utilities cut and left in place and the restoration of existing utilities damaged in the process of excavation, cutting and restoration of pavement.

The OWNER shall at all times have free access to the manufacturer's plant while production in progress, and may at any time refuse to accept pipe made when the plant is failing to follow the stipulations of the specifications in regard to workmanship, or failing in provisions to insure a uniform product coming within the permissible variations of the specifications. The OWNER may reject pipe if adequate means and methods are not provided so as to insure the manufacture of a product of uniform high quality.

All specifications under the Item for Drainage shall be for specified for gravity flows only. This section does not address pressurized drainage structures.

502.1 DAMAGE PRECLUSION

CONTRACTOR TO REPORT UTILITY LINE DAMAGE: CONTRACTOR shall protect and cause no damage to existing structures or other utilities as specified in Item under Existing Structures Location. If any utility, structure, line, service, or appurtenance to a utility is damaged, the CONTRACTOR shall notify the owner of that utility, structure, line, service, or appurtenance to a utility, immediately. *[NOTE: If there are specific local, state, or federal laws or regulations regarding damage notifications, the CONTRACTOR shall comply with those applicable laws or regulations in addition to following the requirements of this specification.]*

503 EXISTING STRUCTURES LOCATION AND PROTECTION

CONTRACTOR shall determine the location of existing structures, utilities and appurtenances shall proceed according to the specifications herein. BIDDERS must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location and sizes of pipe or conduits of various kinds in place.

Where the exact depth of any utility or obstruction is not shown on a plan, excavation shall be made prior to reaching the obstruction in order to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary. Extra compensation shall not be paid for such delays. Refer to Item for Demolition for additional information on existing structures location and protection, or replacing and relocation.

504 DRAINAGE PIPES

This item shall govern reinforced concrete culvert, storm drain, pipe and precast reinforced concrete box sections. Pipe shall be cured in accordance with the applicable ASTM Designations for each type of pipe as referred to below.

504.1 MATERIALS

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the Engineer at the pipe manufacturing plant and at the project site prior to and during installation.

Unless otherwise noted in construction drawings, all pipe material for pipes 15-in in diameter or larger shall be Reinforced Concrete Pipe Class III or Class IV as indicated on the drawings. For pipes less 15-in in diameter refer to sections below.

504.1.A. PVC Pipe

The thermoplastic material shall be rigid PVC plastic and shall meet or exceed the requirements of ASTM Specification D1784-81 for a minimum cell classification of 12454B or 12454C. The fittings shall be of PVC plastic having a cell classification of 12454B, 12454C or 13343C as defined in ASTM D1784-81. Approved product is A-2000 from manufacturer Contech. Contractor may provide an "or equal" material subject to inspection and OWNER approval.

504.1.A.1. Fabrication: Pipe manufacture shall conform to ASTM F949-90 for pipe and fittings with a minimum pipe stiffness of 50-psi, in accordance with ASTM D2412. There shall be no evidence of splitting, cracking or breaking when pipe is tested with ASTM D2412 at 60% flattening. Pipe dimensions shall meet requirements of F949-90 when measured in accordance with ASTM D2122.

504.1.A.2. Joints: Gasketed pipe joints shall show no leakage when tested in accordance with ASTM D3212. Joints shall be elastomeric seals meeting the requirements of ASTM F477. Joints shall be an integral bell-gasketed joint. When the joint is assembled, it shall prevent misalignment of adjacent pipes and form either a soil tight joint (2-psi hydrostatic test per AASHTO Standard Specification for Highway Bridges, Section 26.4.2.4) or a watertight joint (10.8-psi test per ASTM 03212 Standard Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals) as required.

504.1.B. Corrugated Metal Pipe

Contractor may provide an "or equal" material subject to inspection and OWNER approval.

Unless otherwise specified on the plans or herein, corrugated metal pipe may be galvanized steel, aluminized steel, aluminum or pre-coated galvanized steel conforming to the following:

Galvanized Steel	AASHTO M218
Aluminized Steel	AASHTO M274
Aluminum	AASHTO M197
Pre-coated Galvanized Steel	AASHTO M246

Where reference is made to gauge of metal, the reference is to U.S. Standard Gauge for uncoated sheets.

Sampling and Testing of metal sheets and coils used for corrugated metal pipe shall be in accordance with Test Method Tex-708-I. Damaged pipe shall be repaired in accordance with manufacturer's recommendations as authorized by the Engineer.

504.1.B.1. Fabrication: Corrugated metal pipe of all types may be fabricated with annular corrugations, lap joint construction with riveted seams or may be fabricated with helical lock seams. Steel corrugated pipe may also be fabricated with resistance spot welded seams or helical continuous welded seams. All corrugated pipe shall be circular or arch as specified on the plans, capable of H-20 loading.

- a. Steel Pipe. Galvanized or aluminized steel pipe shall conform to the requirements of AASHTO M36.
- b. Aluminum Pipe. Aluminum pipe shall conform to the requirements of AASHTO M196.
- c. Pre-coated Galvanized Steel Pipe. Pre-coated galvanized steel pipe shall conform to the requirements of AASHTO M245. Unless otherwise noted on the plans, both inside and outside coating shall be a minimum thickness of 10 mils.

504.1.B.2. Coupling Bands: Except as otherwise required herein, coupling bands and other hardware for galvanized or aluminized steel pipe shall conform to the requirements of AASHTO M36 for steel pipe and AASHTO M196 for aluminum pipe. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of side material during the life of the installation.

Coupling bands shall be not more than three nominal sheet thicknesses lighter than the thickness of the pipe to be connected and in no case lighter than 0.052 inch for steel or 0.048 for aluminum. Coupling bands shall be made of the same base metal and coating as the pipe. Coupling bands shall lap equally on each of the pipes being connected to form a tightly closed joint after installation.

Coupling bands with annular corrugations shall be used only with pipe with annular corrugations, or helical pipe in which the ends have been rerolled to form annular corrugations. The corrugations in the band shall have the same dimensions as the corrugations in the pipe end, or may be of a special design to engage only the first or second corrugation from the end of each pipe. The band may also include a U-shaped channel to accommodate upturned flanges on the pipe.

Helical pipe without annular end corrugations will be permitted only when it is necessary to join a new pipe to an existing pipe having helical end corrugations. Pipe furnished with helical end corrugations shall be field joined with either helically corrugated bands or with bands with projections (dimples).

Coupling bands with projections (dimples) may be used with pipe having either annular or helical corrugations. The bands shall be formed with the projections in annular rows with one projection for each corrugation of helical pipe. Bands 10½ or 12 inches wide shall have two (2) annular rows of projections and bands 16¼ or 22 inches wide shall have four (4) annular rows of projections.

The coupling band width shall not be less than recommended by the manufacturers. The bands shall be connected in a manner approved by the Engineer with suitable galvanized devices such as angles, integrally or separately formed and attached flanges, bolted with galvanized bolts and nuts; bars and straps; wedge lock and straps or lugs. Other types of coupling systems designated in AASHTO M36 may be used, when authorized by the Engineer.

The minimum diameter of bolts for coupling bands shall be 3/8 of an inch for pipe diameters 18 inches and less and ½ inch for pipe diameters 21 inches and greater. Bands 12 inches wide or less will have a minimum of two (2) bolts, and bands greater than 12 inches wide shall have a minimum of three (3) bolts, all galvanized.

504.1.C. Reinforced Concrete Pipe

Approved manufacturer is Hanson Pipe & Precast. Contractor may provide an "or equal" material subject to inspection and OWNER. All reinforced concrete pipe (RCP) shall be Class II or IV with rubber gasketed joints unless otherwise specified in the construction documents.

Circular reinforced concrete pipe shall conform to ASTM C76 (C76M) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe of the class as designed on the plans subject to the following modifications:

1. All pipes shall be machine-made by a process which shall provide for uniform placement of zero slump concrete in the form and compaction by mechanical devices which shall assure a dense concrete in the finished product.
2. Sizes larger than 60-in. diameter shall be manufactured using two lines of circular reinforcement.
3. Where Class III pipe of sizes larger than 60-in. diameter are specified, the manufacturer may at its option furnish pipe manufactured with either Wall "B" or Wall "C" minimum thicknesses and the applicable minimum steel area as listed for circular cages in Table II of ASTM C76 (C76M), provided tests strength requirements for Class III pipe are satisfactorily met.

Variations in diameter, size, shape, wall thickness, reinforcement, placement of reinforcement, laying length and the permissible underrun of length shall be in accordance with the applicable ASTM specification for each type of pipe as referred to previously.

504.1.C.1. Joints: Where rubber gasket pipe joints are to be used, the design of joints and permissible variations in dimensions shall be in accordance with ASTM C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets, Sections 5 and 6.

Pipe to be placed along curves shall consist of whatever pipe joint lengths or beveled end joints of pipe or combination thereof that are required to place the pipe on the designated centerline curve with no more than one-half of the tongue length of the pipe exposed from its normal fully closed joint position. The amount of bevel, "drop" or shortening of the pipe joint length by the bevel shall not exceed 3.5-in. for pipes less than 30-in. in diameter, and 5-in. for pipes over 30-in. in diameter.

Contractor shall have the option of using joints with preformed flexible joint sealants or with rubber gaskets. Preformed flexible joint sealants for storm drain joints shall comply with ASTM C990, and rubber gaskets for storm drain joints shall comply with ASTM C 1619. Mortar shall not be used to seal pre-fabricated joints. Pipe manufacturer shall be responsible for submitting to the Owner a detailed design of the joint upon request. The pipe manufacturer shall be responsible for submitting to the Owner a complete list of joint sizes showing the minimum size of material to be used with each size joint, along with complete instructions on recommended installation procedures. Quality control testing at the manufacturing plant shall be in accordance with Texas Department of Transportation (TxDOT) Departmental Materials Specifications (DMS) 7310, "Reinforced Concrete Pipe And Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification." The pipe manufacturer shall be verified as compliant with TxDOT DMS 7310 at time of pipe delivery to the jobsite.

504.1.C.1.a. Mortar: Where used, the Mortar shall be composed of 1 part Type I Portland Cement and 2 parts clean, sharp mortar sand suitably graded for the purpose and conforming in other respects to the provisions for fine aggregate of Item for Concrete for Structures. Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight of the total dry mix.

504.1.C.1.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:

Table 504.1.C.1.b.(1) Gasket Chemical Composition

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 Max.

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 H2S solution shall show no visible deterioration.

The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:

Table 504.1.C.1.b.(2) Gasket Physical Properties

Property	Test Method	Typical Analysis	
		Minimum	Maximum
Specific Gravity at 77°F	ASTM D 71	1.2	1.35
Ductility at 77°F (cm) Minimum	Tex-503-C	5.0	
Softening point at 77°F	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	

504.1.C.1.c. Bends: 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.

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.

504.1.C.2. Testing: The acceptability of the pipe in all diameters, strengths and classes shall be determined by such material tests performed as required in ASTM C76 (C76M), C506 or C507; by the results of the three-edge bearing test for the load to produce a 0.01-in. crack and ultimate load and by absorption tests on selected samples from the wall of the pipe in accordance with ASTM C497 (C497M) Concrete Pipe, Manhole Sections, or Tile; and by inspection of the finished pipe to determine its conformance with the design prescribed in these specifications and its freedom from defects. Testing rates shall be as follows, except that in no case fewer than two specimens shall be furnished:

- a. If subjected to three-edge-bearing tests for the 0.01-in. crack only, testing shall be performed on 0.8-percent of the number of pipe sections of each size included in the order. Pipes that have been tested only to the formation of a 0.01-in. crack and that meet the 0.01-in. test load requirements shall be accepted for use.
- b. If subjected to three-edge-bearing tests for both the 0.01-in. (0.25mm) crack and the ultimate load, testing shall be performed on 0.2-percent of the number of pipe sections of each size included in the order.

As an alternate to the three-edge-bearing test, concrete pipe 60-in. in diameter and over may be accepted, at the option of the manufacturer, on the basis of material tests and inspection of the completed product. Acceptability of pipe on this basis shall be determined by the results of material tests as required in ASTM C76, C506 or C507; by crushing tests on cores taken from the barrel of the completed and cured pipe; by absorption tests on samples from the wall of the pipe; and by inspection of the finished pipe, including amount and placement of reinforcement, to determine its conformance with the design prescribed in these specifications and its freedom from defects.

The manufacturer shall furnish facilities and personnel for taking the cores from the pipe barrel and for determining the compressive strength of the samples. When the cores cut from a section of pipe successfully meet the strength requirement, the core-holes shall be plugged and sealed by the manufacturer in a manner such that the pipe section shall meet all of the test requirements of ASTM C76, C506 or C507. Pipe sections, so sealed, shall be accepted for use. Tested pipe accepted for use shall be marked "TEST" or otherwise appropriately identified. Should any of the test specimens fail to meet the test requirements, two consecutive joints in the same mix series shall be tested and results shall be a basis of accepting or rejecting the pipe of the series.

All rejected pipe shall be plainly marked by the Engineer and shall be replaced by the CONTRACTOR with pipe that meets the requirements of these specifications. Such rejected pipe shall be removed immediately from the site of the work.

504.1.C.3. Pipe Markings: Markings shall be indented on the pipe section or painted thereon with waterproof paint. The following information shall be clearly marked on each section of pipe:

- a. the class of pipe,
- b. the date of manufacture,
- c. the name or trademark of the manufacturer,
- d. where elliptical reinforcement is used, one end of each section or joint of pipe shall be clearly marked during the process of manufacture or immediately thereafter on the inside and the outside of opposite walls to show the location of the "top" or "bottom" of the pipe as it should be installed.
- e. "Top" and "bottom" shall be required on pipe, unless pipe has such an external shape that the correct position of the top and bottom is obvious.

504.1.D. HDPE Pipe

Approved product is from manufacturer ADS. Contractor may provide an “or equal” material subject to inspection and OWNER approval. The high density polyethylene pipe (HDPE) shall meet or exceed the requirements of ASTM D 3350.

504.1.E. Precast Reinforced Concrete Box

Precast reinforced concrete box sections shall conform to ASTM C789 (C789M) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers, or ASTM C850 (C850M) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers With Less Than 2 Feet of Cover Subject to Highway Loadings. Two-piece box culverts, if approved by the OWNER, must meet or exceed the load requirements of ASTM C789 and ASTM C850. Materials and construction methods, unless otherwise specified, shall conform to the requirements of Item for Precast and Cast-In-Place Concrete.

All joints at Concrete Box Culvert sections shall include a flexible water-tight joint sealant. In addition, the inside perimeter of each joint shall be filled with mortar to provide a smooth surface with no voids. The mortar shall contain an acrylic bonding agent and be mixed and applied according to the bonding agent manufacturer’s specifications, subject to the Engineer’s approval.

Unless otherwise shown on the drawings, when installing box culverts, the Contractor shall have the option of making joints with preformed flexible joint sealants or with rubber gaskets. Preformed flexible joint sealants for box culvert joints shall comply with ASTM C990, and rubber gaskets for box culvert joints shall comply with ASTM C1677. Box culvert joint shall be designed to prevent the flow of solids through the joint.

504.1.E.1. Defects and Repair: Fine cracks or checks on the surface of the member which do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Cracks, which extend into the plane of the reinforcing steel, but are acceptable otherwise, shall be repaired in an approved manner.

Small damaged or honeycombed areas, which are purely surface in nature, may be repaired. Excessive damage, honeycomb or cracking will be subject to structural review. Repairs shall be sound, properly finished and cured in conformance with the pertinent specifications.

When fine cracks or hair-checks on the surface indicate poor curing practices, further production of precast boxes shall be discontinued until corrections are made and proper curing provided.

504.1.E.2. Submittals: Submittals shall be required for all Concrete Box Culverts and proposed epoxy sealant prior to ordering. Concrete Box Culvert submittals shall include structural loading calculations and reinforcing schedule sealed by a Professional Engineer.

504.2 CONSTRUCTION METHODS

The construction methods for storm drain shall be done per Item for Drainage Installation.

504.3 MEASUREMENT AND PAYMENT

Drainage Pipe will be measured by the linear foot (LF) along the centerline of the pipe for the various sizes and classes of pipe in place, in accordance with these specifications, complete and accepted by the Engineer, including excavation and backfill, unless they are included in the bid as a pay item.

Payment for pipe, measured as prescribed above, will be made at the unit price bid, when provisions are made directly for payment, per linear foot for the various sizes of pipe, of the materials and class indicated. Mitigation of unstable material, if encountered, trench excavation, and backfill (for all depths) are considered subsidiary to this item unless specifically included as a separate pay item.

Payment shall be full compensation, in accordance with the pay items set in the bid, for excavation, furnishing, hauling and placing pipe including lugs and all incidental and subsidiary materials and work; preparing, shaping, dewatering and shoring of trenches; hauling, placing and preparing bedding; for connecting to new or existing systems or structures; for hauling, moving, placing and compacting backfill materials and all other incidentals necessary to complete the pipe installation as indicated.

505 DRAINAGE APPURTENANCES

This item shall consist of furnishing all materials for constructing pipe mains, laterals, stubs, inlet leads, service connections and culverts, including all applicable work such as excavating, bedding, jointing, backfilling, materials, tests, etc. The appurtenances shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer and shall include all joints or connections to new or existing mains, pipes, manholes, inlets, structures, etc. as may be required to complete the work in accordance with specifications and standard published practices of the trade associations for the material specified and to the lines and grades indicated. This item shall consist of pumping, bailing, drainage and Trench Safety Systems for trench walls when indicated. Unless otherwise provided, this item shall consist of the cutting and restoration of pavement and base courses, the furnishing and placing of select bedding, backfilling and cement or lime stabilized backfill, the hauling and disposition of surplus materials, bridging of trenching and other provisions for maintenance of traffic or access as indicated.

Unless otherwise specified on the plans, all storm sewer structures such as junctions, transitions, manholes, cleanouts, wyes, elbows, tees, stoppers and such other miscellaneous structures or appurtenances which may be shown on the plans shall be made of the same base metal and coating (metallic or otherwise) as the pipe on which it is connected.

505.1 INLETS

All Inlets shall be cast concrete sections will be manufactured in a plant especially designed for that purpose. All units will conform to the design shown on the drawings, and all work shall be done under strict plant controlled supervision. Concrete inlets may be pre-cast or cast in place if design is provided for in the drawings.

505.1.A. Materials

The concrete shall conform to Item for Concrete Structures.

Design loads shall consist of dead load, live load, impact, and in addition, loads due to water table, and any other loads which may be imposed upon the structure. Design loading shall be for HS-20 vehicular loading.

Unless otherwise specified, all concrete shall have an average compressive strength at 28-days equal or greater than 3000-psi.

All forms used in placing concrete shall be of metal and sufficiently designed and braced to maintain their alignment under pressures of the concrete during placing.

CONTRACTOR shall submit manufacturer material specifications to OWNER prior to beginning construction. The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of frames, grates, rings, covers, height adjustment insert and nuts and bolts required for completion of the work.

505.1.A.1. Aggregates: All aggregates fine and coarse other than lightweight aggregate shall conform to specifications outlined by ASTM C-33-64. Lightweight aggregates fine and coarse shall conform to the specifications outlined by ASTM C-330-64T. Aggregates shall be free of deleterious substances causing reactivity with oxidized hydrogen sulfide. Both types of aggregate shall be graded in a manner so as to produce a homogeneous concrete mix. All materials are to be accurately weighed at a central batching facility for mixing.

505.1.A.2. Cement: All cement shall be Portland Cement conforming to ASTM C150, Type I or Type III. Cement content shall be sufficient to produce minimum strength of 4,500 psi, or other design strengths required.

505.1.A.3. Reinforcing: All reinforcing steel shall be Grade 60, including welded wire mesh, shall be of the size and in the location as shown on the plans. All reinforcing shall be sufficiently tied to withstand any displacement during the pouring operation. All bars shall be intermediate or hard grade billet steel conforming to ASTM A615. Bars other than ½ inch round, or smaller, shall be deformed in accordance with ASTM A305.

505.1.A.4. Grates: Grates shall have an open area of at least 50% and be rated for HS-20 loading.

505.1.A.4.a. Welded Steel Grates: When approved welded steel grates and frames shall conform to the number; size, dimensions and details indicated on the Drawings and shall be welded into an assembly in accordance with those details. Steel shall conform to the requirements of ASTM A-36/A-36M, "Specification for Structural Steel".

505.1.A.4.b. Castings: Castings, whether Carbon-Steel, Gray Cast Iron or Ductile Iron shall conform to the shape and dimensions indicated on the Drawings and shall be clean substantial castings, free from sand or blowholes or other defects. Surfaces of the castings shall be free from burnt on sand and shall be reasonably smooth. Runners, risers, fins and other cast on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. Pairs of machined castings shall be match marked to facilitate subsequent identification at installation with the exception of water and wastewater manhole and valve castings. These manhole and valve castings shall be fabricated with such draft, tolerances, bolt hole spacing, etc., that all rings and covers of a particular type or class are interchangeable and match-marking will not be required.

Steel castings shall conform to ASTM A 27/27M, "Specifications for Steel Castings, Carbon, for General Application". Grade 70-36 (480-250) shall be furnished unless otherwise specified on the Drawings.

Cast iron castings shall conform to ASTM A 48, "Specification for Gray Iron Castings", Class 30.

Ductile Iron castings shall conform to ASTM A 536, "Specification for Ductile Iron Castings". Grade 60-40-18 (415-275-125) shall be used unless otherwise indicated on the Drawings.

505.1.A.5. Frames, Grates, Rings, Covers: Frames, and cover shall be East Jordan Iron Works, Inc. V-1600-5 or approved equal.

505.1.B. Construction Methods

The Contractor shall prepare the excavation for the correct elevation after grading has been properly executed. The Precast Concrete Inlet shall be set according to the drawings. Backfill material should be free flowing and placed in lifts of approximately 2 feet around the manhole inlet so as not to shift the Precast section. Compaction of each lift shall be approved by the Engineer. The lifts will continue until lines and grades as shown on the drawings have been achieved.

All concrete shall be handled from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until (the approved unit operation) is completed. Concrete shall be placed in layer not over 2 feet deep. Each layer shall be compacted by mechanical internal or external vibrating equipment. Duration of the vibration cycle shall be limited to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

The subgrade shall be moistened to a minimum depth of 2-in. before placing concrete.

The cured unit shall not be removed from the forms until sufficient strength is obtained for the unit to withstand any structural strain that may be subjected during the form stripping operation. After the stripping of forms further curing by means of water spraying or a Membrane Curing Compound may be used and shall be of a clear or white type, conforming to ASTM C309-58.

All welding shall conform to the requirements of the ANSI/AWS Structural Welding Code D1.1. Welded frames, grates, rings and covers shall be given 1 coat of a commercial grade red lead oil paint and 2 coats of commercial grade aluminum paint. All coats shall be a minimum of 1.5 mils, dry.

505.1.C. Measurement and Payment

Measurement and Payment will be made per each (EA) for each Precast Concrete Inlet installed. Excavation and backfill shall be included in the Unit Price Bid for the Precast Concrete Inlet.

Payment for the Precast Concrete Inlet, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the Precast Concrete Inlet and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary for completion of the Work.

505.2 JUNCTIONS AND MANHOLES

The requirements of this section shall govern for all concrete manholes, Interceptor Structures, junction boxes, whether precast or formed and poured in place.

Design loads shall consist of dead load, live load, impact, and in addition, loads due to water table, and any other loads which may be imposed upon the structure. Design loading shall be for HS-20 vehicular loading.

505.2.A. Materials

Appurtenances under this item shall conform to the sizes, lines, and elevations shown in the construction plans.

All precast concrete sections will be manufactured in a plant especially designed for that purpose. All units will conform to the design shown on the drawings, and all work shall be done under strict plant controlled supervision.

This item, whether precast or formed and poured in place, shall be constructed with materials as described below:

505.2.A.1. Approved Product: The Contractor shall submit shop drawings for the Engineer's approval.

505.2.A.2. Forms: All forms used in placing concrete shall have smooth surfaces and sufficiently designed and braced to maintain their alignment under pressures of the concrete during placing.

505.2.A.3. Cement: All cement shall be Portland Cement conforming to ASTM C150, Type I or Type III. Cement content shall be sufficient to produce minimum strength of 4,500 psi, or other design strengths required.

505.2.A.4. Concrete: All Concrete shall conform to Item for Structures and shall be Class "A" with grade 8 aggregate. All forms shall be smooth and reasonably free of knots, bulges, and holes.

505.2.A.5. Reinforcing: All reinforcing steel shall be Grade 60, including welded wire mesh, shall be of the size and in the location as shown on the plans. All reinforcing shall be sufficiently tied to withstand any displacement during the pouring operation. All bars shall be intermediate or hard grade billet steel conforming to ASTM A615. Bars other than ½ inch round, or smaller, shall be deformed in accordance with ASTM A305.

505.2.A.6. Pipe Runners: All Pipe runners shall be furnished as shown in the plans and in accordance with the following:

- a. ASTM A 53, Type E or S, Grade B
- b. ASTM A 500, Grade B; or
- c. API 5L, Grade X42

505.2.A.7. Frames, Grates, Rings, Covers: Frames, and cover shall be East Jordan Iron Works, Inc. V-1600-5 or approved equal.

505.2.A.8. Manhole Cover Riser Rings: Height-adjustment inserts for wastewater manhole rings, which are used for raising standard manhole covers, shall be used as required. No separate pay item.

505.2.A.9. Nuts and Bolts: Nuts and bolts shall be hex head 5/8" x 2.5" #11 National Coarse Thread, Type 316 stainless steel. For bolted manhole covers, a thin film of an approved "Anti-freeze" compound, approved by the Engineer or designated representative, shall be applied to all bolts.

505.2.B. Construction Methods

The Contractor shall prepare the excavation for the correct elevation after grading has been properly executed. The Precast Concrete for this item shall be set according to the drawings. Backfill material should be free flowing and placed in lifts of approximately 2 feet around the manhole so as not to shift the Precast section. Compaction of each lift shall be approved by the Engineer. The lifts will continue until lines and grades as shown on the drawings have been achieved.

All concrete shall be handled from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until (the approved unit operation) is completed. Concrete shall be placed in layer not over 2 feet deep. Each layer shall be compacted by mechanical internal or external vibrating equipment. Duration of the vibration cycle shall be limited to the time necessary to produce satisfactory consolidation without causing objectionable segregation. The subgrade shall be moistened to a minimum depth of 2-in. before placing concrete.

The cured unit shall not be removed from the forms until sufficient strength is obtained for the unit to withstand any structural strain that may be subjected during the form stripping operation. After the stripping of forms further curing by means of water spraying or a Membrane Curing Compound may be used and shall be of a clear or white type, conforming to ASTM C309-58.

All welding shall conform to the requirements of the ANSI/AWS Structural Welding Code D1.1. Welded frames, grates, rings and covers shall be given 1 coat of a commercial grade red lead oil paint and 2 coats of commercial grade aluminum paint. All coats shall be a minimum of 1.5 mils, dry.

505.2.C. Measurement and Payment

Measurement and Payment will be made per each (EA) for each manhole or junction installed. Excavation and backfill, along with any required frames, rings, and grates shall be included in the Unit Price Bid

Payment for the Junctions and Manholes, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the Junctions or Manholes and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary for completion of the work.

505.3 TRENCH DRAINS

This item shall govern construction of trench drains, complete in place, and the materials used therein, including excavation, installation, backfilling and surface restoration. It shall also include furnishing all covers and appurtenances, as well as any other incidentals necessary to complete the work.

505.3.A. Materials

Approved Manufacturer – ACO Polymer Products, Inc. or Approved Equal.

505.3.B. Measurement and Payment

Measurement and Payment will be made per each (EA) for each trench drain system installed. Excavation and backfill, along with any requirements needed and shall be included in the Unit Price Bid.

The work performed and material furnished as prescribed by this item and measured as provided above will be paid for at the unit price per each. The price shall include full compensation for furnishing, preparing, hauling and installing all required materials, labor, tools, equipment and incidentals necessary to complete work.

505.4 OUTFALL STRUCTURES

This Item shall govern for the furnishing and installation of Culvert Outfalls, headwalls, wing walls and splash pans (aprons), in accordance with these specifications and as shown on the plans. Culvert Outfalls include: concrete headwalls and wing walls, concrete riprap, rock riprap, box culverts, safety end treatments and all materials, labor and other incidentals required to complete the work at the location specified by the Engineer.

505.4.A. Materials

Headwalls and wing walls shall conform to TxDOT Item 466. Splash pans shall conform to TxDOT Item 432 for concrete riprap. Details, concrete specifications, concrete reinforcement requirements shown on the plans, and structural concrete requirements per these specifications, shall take precedence over requirements listed in the applicable TxDOT Items.

505.4.B. Construction Methods

The Contractor shall prepare the excavation for the correct elevation after grading has been properly executed. The Precast Concrete for this item shall be set according to the drawings.

All concrete shall be handled from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until (the approved unit operation) is completed. Concrete shall be placed in layer not over 2 feet deep. Each layer shall be compacted by mechanical internal or external vibrating equipment. Duration of the vibration cycle shall be limited to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

The subgrade shall be moistened to a minimum depth of 2-in. before placing concrete.

The cured unit shall not be removed from the forms until sufficient strength is obtained for the unit to withstand any structural strain that may be subjected during the form stripping operation. After the stripping of forms further curing by means of water spraying or a Membrane Curing Compound may be used and shall be of a clear or white type, conforming to ASTM C309-58.

505.4.C. Measurement and Payment

Measurement and Payment will be made per each (EA) outfall item or structure. Excavation and backfill, along with any required frames, rings, and grates shall be included in the Unit Price Bid

Payment for the Junctions and Manholes, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the outfall structure and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing

bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary for completion of the work.

505.5 LEVEL SPREADER

This item shall include the construction of all Level Spreader, and all of the materials, labor, and other incidentals required to complete the work at location specified by the Engineer.

505.5.A. Materials

Approved Manufacturer – ACO Polymer Products, Inc. or Approved Equal.

1. **Geotextile:** If required, fabric must meet the following minimum criteria:
 - a. Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 300-lbs.
 - b. Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 120-lbs.
 - c. Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 600-psi.
 - d. Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 40 (max).
2. **Stone:** Stone shall be well graded with size range from 3-inches to 5-inches in diameter where stream velocities are less than 2 fps. 5-inches to 8-inches in diameter aggregate shall be used where anticipated stream velocities are more than 2 fps.

505.5.B. Measurement and Payment

Measurement and Payment will be made per linear foot (LF) of level spreader installed. Excavation and backfill, along with any requirements needed and shall be included in the Unit Price Bid.

Level Spreader, if included in the bid, shall be measured as specified above and paid as described above, which price shall be full compensation for all work herein specified, including the furnishing of all materials, equipment, tools and labor and incidentals necessary to complete the work.

506 DRAINAGE INSTALLATION

This item shall govern and control the furnishing and placing of culvert pipe and/or conduits or drainage lines including pipe fittings, connecting drain lines to curb inlets, all joints, all connections to new or existing pipe or headwalls, manholes, catch basins etc., to the lines and grades shown on the plans. All pipe and fittings shall be of the types, shapes, classes, sizes and dimensions as shown thereon; and as may be required to complete the work as shown on the plans.

506.1 PIPE INSTALLATION

The CONTRACTOR shall furnish, at its own expense, and place in position as directed by the Engineer all necessary batter boards, string lines, plummets, graduated poles, etc., required in establishing and maintaining the lines and grades. The batter boards and all location stakes must be protected from possible damage or change of location.

Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the Engineer and shall become the property of the Contractor to dispose of on site or at a permitted fill site, without injury to any individual. Such surplus material shall be removed from the work site promptly following the completion of the portion of the utility involved.

506.1.A. Materials

Reinforced concrete pipe and jointing materials shall conform to the requirements of Item for Drainage Pipes and Drainage Appurtenances. Unless otherwise specified in the contract, water required for construction and furnished from the OWNER's distribution system shall be paid and accounted for as prescribed by the OWNER. The CONTRACTOR shall make and bear the cost of all necessary arrangements and means for hauling the water. Water shall be furnished free of charge from the OWNER'S main, if available. Construction water, if delivered through a fire hydrant meter, shall be protected by a reduced pressure zone assembly provided at the CONTRACTOR's expense.

506.1.A.1. Jointing: Jointing material shall be per Item 504 Drainage Pipes.

506.1.A.2. Pipe Bedding Stone: Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C-33 for stone quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 or Table 506.1.A.2.a. Pipe Bedding Stone Gradation:

Table 506.1.A.2.a. Pipe Bedding Stone Gradation:

Sieve Size	Percent Retained by Weight
1½"	0
1"	0-10
½"	40-85
No. 4	90-100
No. 8	95-100

506.1.A.3. Flexible Base: Flexible Base shall be per Item 403 Flexible Base.

506.1.A.4. Bedding Sand: Sand for use as pipe bedding shall be clean, granular and homogeneous material composed mainly of mineral matter, free of mud, silt, clay lumps or clods, vegetation or debris. 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.

The resistivity shall not be less than 3000 ohms-cm as determined by TxDOT Test Method Tex-129-E. Size gradation of sand for bedding shall be per Table 506.1.A.4.a. Pipe Bedding Sand Gradation:

Table 506.1.A.4.a. Pipe Bedding Sand Gradation:

Sieve Size	Percent Retained by Weight
¼"	0
No. 60	75-100
No. 100	95-100

506.1.A.5. Pea Gravel: Pea gravel bedding shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C 33. Size gradation shall be per Table 506.1.A.5.a. Pipe Bedding Pea Gravel Gradation:

Table 506.1.A.5.a. Pipe Bedding Pea Gravel Gradation:

Sieve Size	Percent Retained by Weight
¾"	0
½"	0-25
¼"	90-100

506.1.A.6. Select Backfill: This material shall consist of borrow or suitable material excavated from the trench. It shall be free of stones or rocks over 6 inches and shall have a plasticity index of less than 20. The moisture content at the time of compaction shall be within 2 percent of optimum as determined by TxDOT Test Method Tex-114-E. Sandy loam borrow will not be allowed unless shown on the Drawings or authorized by the E/A.

All suitable materials from excavation operations not required for backfilling the trench may be placed in embankments, if applicable. All unsuitable materials that cannot be made suitable shall be considered surplus excavated materials. The Contractor may, if approved by the engineer, modify unsuitable materials to make them suitable for use. Modification may include drying, removal or crushing of over-size material, and lime or cement treatment.

506.1.A.7. Flowable Backfill: Flowable backfill shall consist of a mixture of native soils or manufactured materials, cement and/or fly ash, and water which produces a material with unconfined compressive strength of between 300-psi and 450-psi after 28-days. Any materials used shall be primarily granular, with a plasticity index <12 and with 100% passing a ¾-in. sieve. The flowable mixture shall be mixed in a pug mill, concrete mixer, or transit mixer and shall have a minimum slump of 5-in. The flowable mixture must be allowed to set prior to the placement of any overlying material.

506.1.A.8. Geotextile Filter Fabric for Pipe Bedding: Geotextile filter fabric for pipe bedding material shall be Hanes Geo Components - TerraTex NO4.5 (AOS US Standard Sieve 70) geotextile fabric or approved equal.

506.1.A.9. Bulkheads: The submittal requirements for this item shall include the type (wood, plastic, rubber, etc.) and application (pipe characteristics and location) of bulkheads. Plywood shall be construction grade, ¾ inch thick and need not be new or treated. End caps may be plastic, vitrified clay pipe, rubber or concrete.

506.1.B. Construction Methods

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.

The **pipe zone** is defined as including the pipe bedding, backfill to one-half the pipe diameter (to the spring line) and the initial backfill to 12 inches above the top of the pipe.

506.1.B.1. Excavation: Trench excavation shall be to the lines and grades shown on the plans or Contract Documents or as required by the specifications for the line work to be installed therein. Excavation for structures shall be sufficient to accommodate forms, where required. Over depth excavation shall be avoided. All excavation, regardless of the materials encountered, shall be unclassified so far as payment is concerned.

Unless otherwise indicated, all underground piped utilities shall be constructed in an open cut in accordance with applicable State Statutes with a trench width and depth described below. Required vertical sides shall be sheeted and braced as indicated to maintain the sides of the required vertical excavation throughout the

construction period. Adequacy of the design of sheeting and bracing shall be the responsibility of the design professional. Contractor shall be responsible for installation as indicated. After the pipe has been laid and the backfill placed and compacted to 12 inches above the top of the pipe, any sheeting, shoring or bracing required may be removed with special care to insure that the pipe is not disturbed. As each piece of sheeting is removed, the space left by its removal must be thoroughly filled and compacted with suitable material and provisions made to prevent the sides of the trench from caving until the backfill has been completed. Any sheeting left in place will not be paid for and shall be considered subsidiary to the pipe item bid.

506.1.B.1.a. Excavation Methods: 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 Engineer 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 laid 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, inspected, repaired if necessary, and the earth backfill completed to a depth of two (2) feet unless ordered by the 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 Engineer shall be installed.

Excavate by open cut with trenching machine or backhoe. Do not use excavated material composed of large chunks or clods for backfill, but dispose of such material and provide other suitable material for backfill without additional expense. During excavation, pile material suitable for backfilling in an orderly manner far enough from the bank of the trench to avoid overloading, slides or cave-ins. Remove from site all excavated materials not required or suitable for backfill. Loading and transportation of waste material shall be included in contract price and no additional payment will be made. Grade as necessary to prevent surface water from flowing into trenches, or other excavations.

506.1.B.1.b. 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.

506.1.B.1.c. 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.

When rainfall runoff is occurring or is forecast by the U.S. Weather Service, the Contractor shall not perform or attempt any excavation or other earth moving work in or near the flood plain of any stream or watercourse or on slopes subject to erosion or runoff, unless given specific approval by the Engineer. When such conditions delay the work, an extension of time for working day contracts will be allowed in accordance with other sections of the Construction Documents.

506.1.B.2. Trench Excavation: Cut banks of pipe trench as nearly vertical as practical in the pipe zone without violating the requirements for the trench safety system. Remove stones as necessary to avoid point-bearing. Over excavate wet or unstable soil from the trench bottom to permit construction of a more stable bed for pipe.

Dig the trench the proper width as shown. If the trench width below the top of pipe is wider than specified in this section or shown on the plans, then the Contractor shall install higher class of pipe and/or improved bedding as determined by the Engineer. No additional payment will be made.

Accurately grade the trench bottom to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except where necessary to excavate for bell holes and for proper sealing of pipe joints. Dig bell holes and depressions for joints after the trench bottom has been graded. Make bell holes and depressions for joints no deeper, longer or wider than needed to make the joint properly.

If any excavation is carried beyond the lines and grades required or authorized, the Contractor shall, at his own expense, fill such space with concrete or other suitable material as directed by the Engineer. No additional payment will be made.

The excavation of trench shall not advance more than 100-feet ahead of the completed pipe work except where specifically authorized by the Engineer, or as indicated on the construction drawings.

506.1.B.2.a. Trench Width: Trenches for Storm Sewers up to 42 inches shall have a width of 1-foot on each side beyond the outside surfaces of the pipe. Pipes more than 42 inches shall have a trench width not to exceed 18-inches on each side beyond the outside surfaces of the pipe. Unless noted otherwise, the minimum depth below the pipe shall be 3-inches.

If trench width within the pipe zone exceeds this maximum, the entire pipe zone shall be refilled with approved backfill material, thoroughly compacted to a minimum of 95% of maximum density as determined by TxDOT Test Method Tex-114-E and then re-excavated to the proper grade and dimensions. Excavation along curves and bends shall be so oriented that the trench and pipe are approximately centered on the centerline of the curve; using short links of pipe and/or bend fittings if necessary.

506.1.B.2.b. Depth of Cover: All pipe and in-line appurtenances shall be laid to the grades indicated. The depth of cover shall be measured from the established finish grade, natural ground surface, subgrade for staged construction, street or other permanent surface to the top or uppermost projection of the pipe.

Storm Drainage piping installed in undisturbed ground and shall be laid with at least 24-in. of cover to natural grade or 18-in. minimum to bottom of subgrade.

506.1.B.2.c. Sheet piling and Bracing: Install, in trenches and other excavations with vertical sides, sheet piling and bracing necessary to support the sides. Sheet piling and bracing shall be so installed as to place no undue or damaging strain on uncompleted work. Any damage resulting from settlement or lack of bracing shall be repaired by the Contractor at his own expense.

The sides of all trenches shall be securely held by bracing and sheet piling which may be removed in units when the level of backfilling has reached the elevation necessary to properly protect the work and adjacent property.

When sheet piling or shoring cannot be safely removed, it shall be left in place. Timber left in place shall be cut off at least 2 feet below the surface.

506.1.B.3. Conflicting Utilities: The Contractor shall conduct his work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of all existing utilities. If at any time the Contractor damages the utilities in place through his operations, the Contractor shall immediately notify the owner of the utility to make the necessary repairs. When active wastewater sewer lines are cut in the trenching operations, temporary flumes shall be provided across the trench, while open and the lines shall be restored when the backfilling has progressed to the original bedding lines of the sewer so cut.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours or to make other adjustments to utility lines in order that the Contractor may proceed with his work with a minimum of delay and expense. The Contractor shall

cooperate with all utility owners concerned in effecting any utility adjustments necessary and shall not hold the City liable for any expense due to delay or additional work because of conflicts arising from existing utilities.

The Contractor shall do all trenching in accordance with the provisions and the directions of the Engineer to the amount of trench left unfilled at any time. All excavation and backfilling shall be accomplished as indicated and in compliance with requirements of OSHA.

Wherever existing utility branch connections, sewers, drains, conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impractical, a deviation from line and grade will be ordered by the Engineer and the change shall be made in the manner directed. 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.

When the Contractor installs a pipe that crosses under a utility or storm sewer structure and the top of the pipe is within 12 inches of the bottom of the structure, the pipe shall be backfilled as shown in the Drawings. When the Contractor installs a pipe that crosses under a utility or storm sewer structure that is not shown in the Drawings, the pipe shall be backfilled as directed by the Engineer. Payment for backfilling pipe at utility or storm sewer structures not shown in the Drawings shall be by Change Order.

506.1.B.4. Bedding: Bedding shall be 6" thick min. measured from any point of natural ground including rock projections to any point on the conduit. (e.g. pipe bell or fitting). Bedding shall be compacted and brought to grade prior to laying pipe. Mounds or blocking pipe to achieve grade is prohibited. Place bedding material evenly and carefully in layers no thicker than 6 inches. Compact with mechanical vibratory tampers, to 95 percent of maximum density, as determined by TxDOT Test Method TX-113/114.

In areas where the excavation in the embedment zone encounters material other than rock (as determined by the Engineer), filter fabric shall be placed prior to bedding placement and extend up the trench an adequate distance to completely wrap the embedment zone with a 6" overlap seam along the top center of the embedment.

506.1.B.4.a. Ground Water Bedding: 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 Engineer will direct the Contractor when and where to place washed gravel.

506.1.B.5. Embedment: Embedment shall be placed in equal lifts along the side of the pipe to prevent lateral displacement and shovel sliced back under the pipe haunch uniformly along both sides.

In the pipe zone, place bedding material evenly and carefully around and over pipe in layers no thicker than 6 inches. Compact with mechanical vibratory tampers to 95 percent of maximum density, as determined by TxDOT Test Method TX-113/114, until there is a cover of not less than 1 foot over utility lines. Take special care not to damage pipe wrapping or coating. In no case should compaction equipment be allowed to contact pipe.

In areas, where the excavation in the pipe zone encounters material other than rock (as determined by the Engineer), filter fabric shall completely wrap the pipe zone with a 6" overlap seam along the top center of the embedment.

In rock excavations, after placement of embedment and prior to backfilling, filter fabric shall be placed over the embedment. Filter fabric width shall be slightly wider than the trench width at the elevation of placement. Longitudinal splices shall be lapped at least 1' and taped.

506.1.B.6. Backfill: Backfill shall be either Select Backfill or Common Backfill. Select Backfill only shall be placed in Streets and Drives. In all other areas either Select Backfill or Common Backfill may be used. Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the Engineer and shall become the property of the Contractor to dispose of on site or at a permitted fill site, without injury to any individual. Such surplus material shall be removed from the work site promptly following the completion of the portion of the utility involved.

506.1.B.6.a. Select Backfill: Beneath streets or other areas to be paved, Select Backfill shall be used for the total depth immediately below the base material and above the select bedding material. Select Backfill shall be of generally granular type material such as base material, road gravel, sand or sandy gravel, free of trash and spongy or otherwise objectionable material (approved by the Engineer) and shall have a Plasticity Index of not more than twenty (20). 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 contain rock, and no more than ten (10) percent shall be as large as six (6) inches. Not more than twenty-five (25) percent shall be clay or clay lumps.

Above the pipe zone, select backfill soil material shall be deposited in 8-inch layers. Each layer shall be compacted to 95 percent of maximum density as determined by TxDOT Test Method TX-113/114. Density tests shall be performed at a rate of one test per lift per 300-ft of trench. During testing the entire length of the lift shall be exposed (i.e. no benching or slope cut for testing multiple lifts). Place compacted fill material to bottom of the pavement section. At the contractor's option, flowable fill may be used in lieu of density testing requirements for select backfill at the contractor's expense. A design submittal must be approved by the Engineer if the contractor elects to use flowable fill.

506.1.B.6.b. Common Backfill: In areas outside of streets and drives, trench backfill above select bedding material may be accomplished with the use of excavated material if the material is suitable for compaction and contains only an occasional rock no more than five (5) inches in its greatest dimension.

- (1) Above the pipe zone, deposit common backfill in 8-inch loose lifts. Compact each layer to 90 percent of maximum density as determined by TxDOT Test Method TX-113/114.
- (2) All forms, lumber, trash and debris shall be removed from manholes and other structures. Backfill shall be placed symmetrically on all sides in layers no thicker than 8 inches. Each layer shall be compacted to 90 percent of maximum density as determined by TxDOT Test Method TX-113/114. Density tests shall be performed at a rate of one test per lift per 500-ft of trench.

506.1.B.7. Pavement Repair: Existing pavement shall be precut, sawed or scored so as to result in an even, 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 material shall then be replaced in three (3) inch layers tamped in place. Replaced base material shall comply with Item for Flexible Base, and in no case be less than 8 inches thick. 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. Removal of excess surfacing beyond the nominal limits of the ditch shall be kept to a minimum, and such areas shall be outlined with straight saw-cuts and included in areas to be repaired as described above. Base material shall be compacted to ninety-five (95) percent of maximum density as determined by TxDOT Test Method TX-113/114. The replaced surface course shall be in conformance with Item for Hot Mix Asphaltic Concrete.

In all paved streets the trench shall be finished in a workmanlike manner consistent 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.

506.1.B.8. Connections: Where installation of proposed drainage facilities joins existing drainage facilities, the Contractor shall be required to locate, expose, and prepare the ends of existing drainage facilities in an acceptable manner to allow connection of the proposed facilities to provide an overall functioning system

with no breaks, leaks or unacceptably rough joints. If necessary, the Contractor shall remove existing pipe bulkheads, replace existing pipe stubs, and / or cut connections into existing manholes as required to make an acceptable connection. The Contractor shall be required to remove any temporary bulkheads, blockages, inlet protection or inlet plugs that were previously put in place to serve temporarily until the proposed facilities in the current project were to be completed.

506.1.B.8.a. Bends: 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.

506.1.B.8.b. Bulkheads: After installation of the utility requiring temporary bulkheads, an end cap or a section of plywood, having dimensions at least 6 inches in excess of the outside pipe diameter shall be attached to the exposed bell or spigot and backfilled immediately after installation. Care shall be exercised to prevent the backfill material from entering the pipe. Bulkheads used with staged construction shall be sound, reasonably free of knots and warps and have a 3 inch minimum nominal thickness.

506.1.B.8.c. Storm Drain Joints: Storm drain joints sealed with preformed flexible joint sealants shall be provided and installed in compliance with ASTM C990. Storm drain joints sealed with rubber gaskets shall comply with ASTM C443 Install joint sealants in accordance with the pipe and joint sealant manufacturers' recommendations. Place the joint sealer so that no dirt or other deleterious materials come in contact with the joint sealing material. Pull or push home the pipe with enough force to properly seal the joint with the final joint opening (gap) on the inside of the installed pipe being less than or equal to the pipe manufacturer's recommended dimensions. Protrusion of joint material greater than 1/8" into the interior of the pipe will not be accepted. Excess joint material will be removed to within 1/8" of pipe surface. Observe joint sealant manufacturer's recommendations for installation temperature of the joint sealant. Apply joint sealant to pipe joint immediately before placing pipe in trench, and then connect pipe to previously laid pipe.

If inspection (video or other means) reveal C-990 joints that show signs of backfill infiltration, or where joints or conduits exhibit excessive joint gap or are otherwise defective, then the contractor has the following options:

- (1) Conduits less than 36-inches in any dimension: pour a concrete collar around the joint or wrap joint with a wrap meeting requirements of ASTM C-877 or approved equal.
- (2) Conduits greater than or equal to 36-inches in all dimensions: repair joints using joint repair techniques recommended by the manufacturer to achieve a completed system that meets all Contract requirements.

506.1.B.8.d. Pipe Collars: At all changes in pipe sizes in the conduit line, except at manholes, a pipe collar, as shown in detail on the plans, shall be provided. The locations at which such collars are to be provided are shown on the plan-profile sheets, and their costs are to be included in the price bid for furnishing and installing reinforced concrete pipe. No extra payment shall be made for the installation of concrete pipe collars as shown on the plan-profile sheets.

506.1.B.8.e. Shop and Field Fabricated Connections: Shop or field fabricated wyes, tees, crosses or bends shall be furnished and installed where indicated or required by the Engineer. Fittings for pipe, the largest size of which is less than 24-in. in diameter, shall be shop fabricated. Fittings for larger pipe, which is 24-in. in diameter and increasingly larger, may be field fabricated. Care shall be taken in the fabrication that the concrete walls of the pipe are broken back only enough to provide the required finishing opening. The

reinforcing mesh or bars in each pipe shall be joined by bending, twisting or spot welding, which shall provide a rigid connection. Concrete or mortar meeting the requirements of Item for Portland Cement Concrete Pavement or Item for Concrete Structures shall be wiped over the reinforcing wires connecting the two-pipe joints, compacted by light blows, shaped to the contour of the pipe barrels, lightly brushed for finish and cured under wet burlap.

506.1.C. Measurement and Payment

If and only if a specific pay item is included in the bid form for any of the pay items listed below, the installed items shall be measured as noted below and the Contractor shall be paid for each item as noted in the contract documents; otherwise, all items under this Section shall be considered subsidiary to the facility being installed in the trench referenced by this Section. In most cases this item shall be paid under Item for Drainage Pipes. When a bid item is included for the work under this section, trench shall be measured by the linear foot (LF) for the trench width and depth required for installation of the pipe in accordance with the elevations indicated graphically and appropriate detail as specified in the construction documents.

The work performed and materials furnished as prescribed by this Section and measured as provided under "Measurement" will be paid under the following item if and only if this item is included as a pay item on the bid form; otherwise, all work under this Section shall be subsidiary to the pay item for the facility to be installed in the trench referenced by this Section.

506.2 TRENCH SAFETY SYSTEMS

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.

506.2.A. Materials

The Contractor shall immediately notify the Engineer if, in the Contractor's opinion, additional trench safety protection is required in areas where not shown on the plans or not listed in the Unit Price Schedule. The Contractor shall be responsible for applying all such additional protection that may be required, and if, in the opinion of the Engineer, the additional protection is warranted, pay quantities shall be adjusted according to the terms of the contract, provided that such adjustments are allowed under the contract. Refer to Item 506.1 for additional information.

506.2.B. 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.

In accordance with the Laws of the State of Texas and the U.S. Occupational Safety and Health Administration regulations, all trenches over 5 feet in depth in either hard and compact or soft and unstable soil shall be sloped, shored, sheeted, braced or otherwise supported. Furthermore, all trenches less than 5 feet in depth shall also be

effectively protected when hazardous ground movement may be expected. Trench safety systems to be utilized for projects within the City shall be provided by the contractor prior to commencement of any excavation exceeding 5 feet in depth.

If design drawings require a trench to be deeper than 5-ft, but no separate pay item has been provided for Trench Safety Systems, then CONTRACTOR shall consider this item to be subsidiary to the utility installation.

In accordance with the U.S. Occupational Safety and Health Administration regulations, when employees are required to be in trenches 4 feet deep or more, adequate means of exit, such as a ladder or steps, must be provided and located so as to require no more than 25 feet of lateral travel.

If trench safety system details were not provided in the plans because trenches were anticipated to be less than 5 feet or more in depth or trenches less than 5 feet in depth are in an area where hazardous ground movement is expected, all construction shall cease, the trenched area shall be barricaded and the City Engineer notified immediately. Construction shall not resume until appropriate trench safety system details, as designed by a registered professional engineer in the State of Texas are submitted to and accepted by the City, and, a bid item for implementation of trench safety systems is added to the contract by change order.

506.2.C. Public Safety

All excavations shall be protected from access by the public at all times. Protection shall include warning tape, barricades, appurtenances, flagging operations, and any other items required to prevent access to any excavation regardless of the size or depth. In no case will excavations be left open during non-working hours unless protected by H-20 traffic rated steel plates installed and secured to prevent them from being dislodged by traffic.

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.

506.2.D. 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.

506.2.E. 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), judgments 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.

Refer to general provisions for additional information on Indemnification.

506.2.F. Measurement and Payment

If provided, Trench Safety shall be measured per linear foot (LF) along the centerline of the installed safety system, without adjustment for changes in width at manholes, junction boxes, or any other facilities.

Payment for Trench Safety Systems shall be made per unit as described above, up to and including the depths listed on the Unit Price Schedule for each item. Multiple pay items may be included for systems installed at differing depths as required. Such payment shall be full compensation for furnishing, hauling, installing, maintaining, removing, disposing of any materials used in the Trench Safety System, and all incidentals involved in the Trench Safety Systems.

506.3 JACKING AND BORING

This item shall govern furnishing and installing of encasement and carrier pipe by methods of jacking or boring as indicated on the Drawings and in conformity with this specification. This item shall also include, but not be limited to other construction activities such as traffic control measures, excavation, removal of all materials encountered in jacking or boring pipe operations, disposal of all material not required in the work, grouting, bulkhead installation, and other items required to complete the utility installation under this method.

506.3.A. Materials

Carrier pipe and encasement pipe shall conform to Specification, "Pipe Casing" under item 605 as appropriate, as well as "Concrete Encasement and Encasement Pipe" and "Drainage Pipe" and shall be size, type materials, thickness and class indicated on the Drawings, unless otherwise specified. Grout shall be supplied according to these specifications.

206.3.A.1. Submittals: The submittal requirements for this specification item shall include:

- a. Shop drawings identifying proposed jacking or boring method complete in assembled position
- b. Trench Safety Plan including pits, trenches and sheeting or bracing if necessary,
- c. Design for jacking or boring head,
- d. Installation of jacking or boring supports or backstop,
- e. Arrangement and position of jacks and pipe guides,
- f. Grouting plan, and
- g. Materials and method for tying restraints to both ends of the casing.

506.3.B. Construction Methods

The Contractor shall have sole responsibility for the safety of the jacking and boring operations and for persons engaged in the work. The Contractor's attention is directed to the Construction Industry Occupational Safety and Health Administration (OSHA) Standards (29 FR 1926/1920) as published in U.S. Department of Labor publication OSHA 2207, latest revision, with particular attention to Subpart S. The Contractor shall provide an appropriate Trench Safety Plan.

The Contractor is responsible for:

1. Adequacy of jacking and boring operations,
2. Installation of support systems as indicated on the Drawings,
3. Provision of encasement and carrier pipe, and
4. Execution of work involving the jacking operation, the wet or dry method of boring and the installation of encasement pipe simultaneously.

When the grade of the pipe at the jacking or boring end is below the ground surface, suitable pits or trenches shall be excavated to provide sufficient room to conduct the jacking or boring operations and for placement of end joints of the pipe. In order to provide a safe and stable work area, the excavated area shall be securely sheeted and braced to prevent earth caving in accordance with the Trench Safety Plan.

The location of the work pit and associated traffic control measures required for the jacking or boring operations shall conform to the requirements of the Texas Manual on Uniform Traffic Control Devices (TMUTCD) and when along state highway rights of way, shall be approved by TxDOT.

Where installation of pipe is required under railroad embankments, highways, streets, or other facilities by jacking or boring methods, construction shall be undertaken in such a manner that it will not interfere with operation of any railroad, street, highway, utility or other facility and shall not weaken or damage any embankment or structure. All appropriate permits shall be acquired prior to the initiation of the work.

During construction operations, and until the work pits are backfilled and fill material compacted, traffic barricades and warning lights to safeguard traffic and pedestrians shall be furnished and maintained by the Contractor. The Contractor shall submit the proposed pit location and traffic control plan for review by the Engineer or designated representative. The review by the Engineer or designated representative, however, will not relieve the Contractor from his responsibility to obtain specified results in a safe, workmanlike manner.

When grade of pipe at jacking or boring end is below ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking or boring operations and for joining pipe. Work shall be securely sheeted and braced as indicated on the Trench Safety Plan to prevent earth caving and to provide a safe and stable work area.

The pipe shall be jacked or bored from the low or downstream end, if possible. Minor lateral or vertical variation in the final position of pipe from line and grade established by Engineer or designated representative will be permitted at the discretion of Engineer or designated representative provided that such variation is regular and occurs only in one direction and that the final grade of the flow line conforms to the specified direction.

When conforming to details indicated on the drawings, but the bottom of the work pit is unstable or excessively wet or the installation of water and wastewater pipe will result in less than 30 inches of cover, the Contractor shall notify the Engineer or designated representative. The Engineer or designated representative may require the Contractor to install a concrete seal, cradle, cap or encasement or other appropriate action.

Approved neoprene end seals shall be installed at each end of the casing pipe to prevent water and debris from entering the casing pipe.

As soon as possible after the carrier pipe(s), and end-seals are completed, the work pits or trenches, which are excavated to facilitate these operations, shall be backfilled. The backfill in the street ROW shall be compacted to not less than 95 percent of the maximum density conforming to TxDOT Test Method Tex-114-E, "Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil". Field density measurements will be made in accordance with TxDOT Test Method Tex-115-E, "Field Method for Determination of In-Place Density of Soils and Base Materials".

206.3.B.1. Jacking: Heavy-duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating the jacks, an even pressure shall be applied to all jacks used so that the pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The complete jacking assembly shall be placed in order to line up with the direction and grade of the pipe. In general, the embankment material shall be excavated just ahead of the pipe, the material removed through the pipe and the pipe forced through embankment by jacking, into the space thus provided.

The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of no more than 2 inches may be provided for the upper half of the pipe. This clearance shall be tapered to zero at the point where excavation conforms to contour of pipe.

The distance that excavation shall extend beyond the end of the pipe depends on the character of material encountered, but it shall not exceed 2 feet in any case. This distance shall be decreased, when directed by the Engineer or designated representative, if the character of the material being excavated makes it desirable to keep the advance closer to the end of the pipe.

The Contractor may use a cutting edge of steel plate around head end of the pipe extending a short distance beyond the end of pipe with inside angles or lugs to keep cutting edge from slipping back onto the pipe.

When jacking of the pipe is begun, all operations shall be carried on without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at its entire expense.

206.3.B.2. Boring: The boring shall proceed from a work pit provided for the boring equipment and workmen. Excavation for the work pits and the installation of shoring shall be as outlined in the Trench Safety Plan. The location of the pit shall be approved by the Engineer or designated representative. The boring shall be done mechanically using either a pilot hole or the auger method.

In the pilot hole method an approximate 2-inch pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored.

When the auger method is used, a steel encasement pipe of the appropriate diameter equipped with a cutter head to mechanically perform the excavation shall be used. Augers shall be of sufficient diameter to convey the excavated material to the work pit.

Excavated material will be removed from the working pit and disposed of properly. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Water jetting will not be permitted.

In unstable soil formations, a gel-forming colloidal drilling fluid, that consists of at least 10 percent of high grade, carefully processed bentonite, may be used to consolidate the drill cuttings, seal the walls of the hole and furnish lubrication to facilitate removal of the cuttings from the bore.

506.3.C. Measurement and Payment

Jacking or boring pipe will be measured by the linear foot (LF) of pipe complete in place. Such measurement will be made between the ends of the pipe along the central axis as installed.

The work performed and materials furnished as prescribed by this item and measured as provided will be paid for at the unit bid price per linear foot for "Jacking or Boring Pipe", if provided for in the Unit Price Schedule of type, size and class of encasement and carrier pipe indicated on the Drawings. Unless provided for under a separate pay item, the price shall include full compensation for furnishing, preparing, hauling and installing required materials, encasement pipe, carrier pipe, restraints, end seals, for grouting and for labor, tools, equipment and incidentals necessary to complete work, including excavation, backfilling and disposal of surplus material.

506.4 INSPECTION

All storm drain conduits (pipe and box culvert) shall be inspected for conformance to the requirements of this specification. All deficiencies revealed by inspection shall be corrected. Video re-inspection meeting the requirements of this specification shall be provided at the Contractor's expense to show that deficiencies have been corrected satisfactorily. Further, the contractor shall provide video in complete segments (manhole to manhole) versus specific deficiency locations.

Projects are also subject to the following constraints:

- A. All inspectors utilized by the Contractor for video inspection shall be NASSCO-PACP certified for a minimum of 3 years.
- B. The Contractor will be required to inspect, assess, and record the condition of the storm drain pipe using National Association of Sewer Service Companies (NASSCOs) Pipeline Assessment Certification Program (PACP) coding standards.

Contractor shall provide all labor, equipment, material and supplies and perform all operations required to conduct internal closed-circuit television and video recording of all storm drain conduits. Video recording of each storm drain conduit section shall be conducted after the trench has been backfilled and prior to placement of permanent pavement repairs or permanent pavement reconstruction. The video recording shall be provided to the Owner for review. Contractor shall not place permanent pavement repairs or permanent pavement reconstruction over the storm drain conduit until Owner has reviewed the video and agrees that there are no defects in the storm drain conduit installation shown in the video submitted by the Contractor or shown in any video acquired by the Owner through other means. Placement of permanent pavement repair or permanent pavement reconstruction over the installed storm drain conduit before the Owner acknowledges no defects shall be at the Contractor's risk. Any defects revealed by the video inspection shall be corrected at the Contractor's expense and a new video submitted to the Owner for review prior to acceptance of the conduit.

All video work shall be conducted under the direct full-time supervision of a NASSCO-PACP certified operator.

506.4.A. Materials

The conduit inspection camera shall have the capability of panning plus/minus 275 degrees and rotating 360 degrees. The television camera shall be specifically designed and constructed for such use. The camera shall be operative in 100% humidity conditions. Camera shall have an accurate footage counter that displays on the monitor the exact distance of the camera (to the nearest tenth of a foot) from the centerline of the starting manhole or access point. Camera shall have height adjustment so that the camera lens is always centered within plus/minus 10% of the center axis of the conduit being videoed. Camera shall provide a minimum of 460 lines of horizontal resolution and 400 lines of vertical resolution. Camera shall be equipped with a remote iris to control the illumination range for an acceptable picture. Geometrical distortion of the image shall not exceed one percent (1%). The video image produced by each camera shall be calibrated using a Marconi Resolution Chart No. 1 or equivalent.

Lighting for the camera shall be sufficient to allow a clear picture of the entire periphery of the conduit without loss of contrast, flare out of picture or shadowing. A reflector in front of the camera may be required to enhance lighting in dark or large sized conduit. The video camera shall be capable of showing on the digital display the Owner's name, Project name, Contractor name, date, line size and material, conduit identification, and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing a picture quality satisfactory to the satisfaction of the Owner. The recording of the internal condition of the storm drain conduit shall be clear, accurate, focused and in color. If the recording fails to meet these requirements, the equipment shall be removed and replaced with equipment that is suitable. No payment will be made for an unsatisfactory recording.

506.4.B. Construction Methods

All video shall be documented using a data logger and reporting system that are PACP compliant and which use codes as established by the National Association of Sewer Service Companies (NASSCO)s - Pipeline Assessment and Certification Program (PACP).

Provide a full 360-degree view of conduit, all joints, and all connections. In no case shall the camera be pulled at a speed greater than 30 feet per minute.

If during video inspection, water is encountered inside the conduit, the conduit shall be dewatered by the Contractor. The storm drain section must be dry. Video recording conducted while the camera is floating is not acceptable unless approved by the Owner.

If during video inspection, debris is encountered that prohibits a proper inspection of the conduit, the Contractor shall remove the debris before proceeding.

Post-installation video shall not be completed until all work is completed on a section of storm drain conduit. The post-installation video work shall be completed to confirm that the storm drain conduits are free of defects. Provide a color video showing the completed work. Prepare and submit video logs providing location of storm drain conduit along with location of any defects. Manhole and inlet work shall be complete prior to post-installation video work.

Once videoed, the CDs/DVDs, and other memory storage devices, shall be labeled and become the property of the Owner. The Contractor shall have all video and necessary playback equipment readily accessible for review by the Owner while the project is under construction.

506.4.C. Measurement and Payment

If provided, Video Inspection shall be measured per linear foot (LF) along the centerline of the inspected pipe, without adjustment for changes in width at manholes, junction boxes, or any other facilities.

Payment for Video Inspection shall be made per unit as described above, up to and including all the depths and pipe sizes listed on the Unit Price Schedule for each drainage item. Such payment shall be full compensation for furnishing, hauling, installing, manpower, electrical, transportation, materials and equipment, and disposing of any materials used in the Video Inspection, and all incidentals involved in the Video Inspection.

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601 INTRODUCTION

This Item shall govern the control measures necessary to define methods and limits of water improvements, demolition, installation, and other water appurtenances. All items specified herein are intended to comply with the City of Marble Falls Standard Details, the Non-Point Source Pollution (NPS) Manual and Ordinance, and TCEQ requirements for water installation. CONTRACTOR shall notify Engineer if it is noticed discrepancies between this Item and other City/State manuals and ordinances. CONTRACTOR shall be prohibited with continuation of work while knowing of such discrepancies.

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 requirements herein.

The OWNER reserves the right to have required temporary erosion sedimentation and water pollution prevention and control work performed by others should the CONTRACTOR fail to perform required temporary erosion, sedimentation, and water pollution prevention and control work in a timely fashion or should the CONTRACTOR fail to prevent and control soil erosion, damage control, safety, and water and air pollution which may degrade quality of air and water. All costs including engineering and right-of-way costs for the work required shall be borne by the CONTRACTOR. The CONTRACTOR shall reimburse the OWNER for all such costs within 30-days after receipt of the reimbursement request from the OWNER. Failure to submit payment for such reimbursement costs in the time prescribed above may result in the OWNER withholding the reimbursement due from the monthly progress payments to the CONTRACTOR until reimbursement to the OWNER is made.

The contractor shall ensure that all requirements of the Texas Commission on Environmental Quality (TCEQ) are complied with. This shall include TCEQ Chapter 290, Subchapter D: Rules and Regulations for Public Water Systems §§290.38 - 290.47, and TCEQ Chapter 217, Design Criteria for Sewerage Systems.

As the project progresses, the Contractor shall be required to field verify that all proposed installations of water supply appurtenances will meet the clearances specified in TCEQ Chapter 290, §§290.44, and TCEQ Chapter 217, §§215.53 . If the proposed installations may result in inadequate clearances, the Contractor shall immediately stop work and immediately notify the Engineer by telephone and in writing. If the Engineer agrees with the Contractor's assessment, contract time shall be suspended until the conflict can be fully resolved.

The water system must maintain a minimum pressure of 35 psi at all points within the distribution network at flow rates consisting of a minimum of 1.5 gallons per minute for each connection. When fire flow is required, the system must maintain a minimum of 20 psi with combined fire flow demand and domestic usage.

602 DESCRIPTION

This item shall consist of furnishing all pipe and/or materials for constructing pipe mains, laterals, service lines, including all applicable work such as excavating, bedding, jointing, backfilling, materials, tests, etc. The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer and shall include all joints or connections to new or existing mains, pipes, valves, manholes, structures, etc. as may be required to complete the work in accordance with specifications and standard published practices of the trade associations for the material specified and to the lines and grades indicated. This item shall consist of pumping, bailing, drainage and Trench Safety Systems for trench walls when indicated. Unless otherwise provided, this item shall consist of the plugging of the ends of abandoned piped utilities cut and left in place and the restoration of existing utilities damaged in the process of excavation, cutting and restoration of pavement.

CONTRACTOR 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. Water lines

shall not be located closer than nine (9) feet from sewer lines or reuse distribution lines. 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 OWNER. Any work found not to be acceptable shall be removed and replaced at the Contractor's expense. The Contractor shall notify the OWNER prior to starting work and prior to covering any water lanes in place.

The OWNER shall at all times have free access to the manufacturer's plant while production in progress, and may at any time refuse to accept pipe made when the plant is failing to follow the stipulations of the specifications in regard to workmanship, or failing in provisions to insure a uniform product coming within the permissible variations of the specifications. The OWNER may reject pipe if adequate means and methods are not provided so as to insure the manufacture of a product of uniform high quality.

602.1 DAMAGE PRECLUSION

CONTRACTOR TO REPORT UTILITY LINE DAMAGE: CONTRACTOR shall protect and cause no damage to existing structures or other utilities as specified in Item under Existing Structures Location. If any utility, structure, line, service, or appurtenance to a utility is damaged, the CONTRACTOR shall notify the owner of that utility, structure, line, service, or appurtenance to a utility, immediately. *[NOTE: If there are specific local, state, or federal laws or regulations regarding damage notifications, the CONTRACTOR shall comply with those applicable laws or regulations in addition to following the requirements of this specification.]*

603 EXISTING STRUCTURES LOCATION AND PROTECTION

CONTRACTOR shall determine the location of existing structures, utilities and appurtenances shall proceed according to the specifications herein. BIDDERS must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location and sizes of pipe or conduits of various kinds in place. Where the exact depth of any utility or obstruction is not shown on a plan, excavation shall be made prior to reaching the obstruction in order to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary. Extra compensation shall not be paid for such delays. Refer to Item for Demolition for additional information on existing structures location and protection, or replacing and relocation.

604 WATER PIPES

This item shall consist of furnishing of all piping for constructing pipe mains, laterals, stubs, service connections, services leads, and fittings. All pipe and appurtenances shall be manufactured in the United States, unless otherwise specified in the construction documents. The pipe shall be of the sizes, types, classes and dimensions indicated herein or designated by the Engineer. Pipe shall be cured in accordance with the applicable ASTM Designations for each type of pipe as referred to below.

The contractor shall contact the municipality or water district, as appropriate, a minimum of 48 hours prior to making any connections or performing any work that may have an impact on that entity's facility to arrange inspection by the entity.

604.1 MATERIALS

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the Engineer at the pipe manufacturing plant and at the project site prior to and during installation. All pipe and appurtenances shall be manufactured in the United States, unless otherwise specified in the construction documents. The pipe shall be of the sizes, types, classes and dimensions indicated herein or designated by the Engineer.

The contractor shall ensure all requirements of the Texas Commission of Environmental Quality (TCEQ) are complied with. This shall include TECQ Chapter 217 and 290.

The materials listed below are also referenced in the following specifications:

1. *AWWA C905-97; Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.*
2. *ASTM D1784; Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.*
3. *ASTM D2122; Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings.*
4. *ASTM D3139; Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.*
5. *ASTM F477; Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.*

604.1.A. PVC Pipe

All polyvinyl chloride (PVC) water pipe shall be DR-18 of the rigid (UNPLASTICIZED) type and must bear the National Sanitation Foundation seal of approval for potable water pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Contractor may provide an “or equal” material subject to inspection and OWNER approval.

For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 Inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer’s requirements. The tape shall be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.

604.1.A.1. Pipes 0- 3 inches: (excludes SDR-21) PVC Pipe and fittings shall be Type I, Grade 1, Schedule 40, 200 psi. All fittings shall be of Schedule 40 or heavier plasticized polyvinyl chloride. Fittings may be solvent welded.

604.1.A.1.a. Physical Requirements: Pipe shall be extruded from 100 percent virgin unplasticized Type 1, Normal Impact Polyvinyl Chloride (PVC) to conform to the following minimum physical properties:

Table 604.1.A.1.a.(1) PVC Physical Requirements:

Physical Description	Quantity
Specific Gravity	1.36-1.40
Tensile Strength at 78°F (PSI)	7,500
Compression Strength (PSI)	9,400
Modulus of Elasticity	410,000
Coefficient of Linear Expansion	0.000067 K/C
Izod Impact at 78°F (ft.lbs./in.notch)	0.7-1.5
Burning Rate	Self-Extinguishing
Heat Distortion at 264 PSI	160°F

604.1.A.1.b. Visual Inspection: Pipe shall be homogenous throughout and free from visible cracks, holes or foreign materials. Pipe shall be free from blisters, wrinkles and dents. This inspection shall be made on each length of pipe.

604.1.A.1.c. Markings: All PVC pipe shall be continuously and permanently marked with the following information: manufacturer's name, pipe size, class or schedule, type of pipe and material. When used for potable water line, the pipe shall bear the seal of the National Sanitation Foundation for potable water pipe.

604.1.A.1.d. Inspection and Testing: Test certificates from a testing laboratory and/or guarantee by the manufacturer satisfactory to the Engineer shall be furnished for the pipe and fittings to be incorporated in the work. As required by the Engineer, certificates shall be submitted for other materials to be incorporated in the work. These certificates, stating that the materials meet the requirements of the specifications, will be required before permission is given to incorporate such materials in the work.

The cost of this inspection and testing will be paid for by the Contractor and shall be included in his price bid for such materials complete in place.

Any material brought on the ground for use in the work and deemed by the Engineer as unsuitable or not in conformity with the specifications shall be removed from the site of the work by the Contractor upon receipt of written notice from the Engineer to that effect.

604.1.A.1.e. Material Handling: The Contractor is cautioned to exercise care in handling, loading, unloading and storing PVC pipe and fittings. All PVC pipe and fittings will be stored under cover before using and will be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subject to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded until said section of pipe is cut out and rejoined with a coupling.

Pipe ends and fittings shall be covered or otherwise protected from foreign material entering the pipe and fittings until immediately prior to placing the pipe and fittings.

604.1.A.1.f. Threaded Connections: Where PVC to metal connections are required, the Contractor shall work the metal connections first. A non-hardening pipe dope such as Permatex #2, or equal, shall be used on all threaded PVC to metal joints and light wrench pressure is all that should be used. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded.

604.1.A.2. Pipes 4 - 12 inches: PVC Pipe shall be of the rigid (UNPLASTICIZED) type, and must bear the National Sanitation Foundation seal of approval for potable water pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe shall be pressure rated at 150 psi, DR-18 or thicker.

Pipe shall have push-on, rubber gasket joints of the bell and spigot type with thickened integral bells or of the double spigot type with thickened coupling sleeves 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. Solvent welding of PVC water pipe shall not be allowed.

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.

604.1.A.2.a. Physical Requirements: Except as modified or supplemented herein, PVC pipe shall meet the following standards: AWWA C-900, DR 18 for PVC Pressure Pipe, in 4, 6, 8, 10, and 12 inch nominal sizes, having Cast Iron Pipe size outside diameters. All pipe 4 inches and larger must be approved Underwriter's Laboratories for use in buried water supply and fire protection systems. All pipe and fittings shall

be made from clean, virgin, NSF approved, Class 12454B PVC. Clean reworked materials generated from the manufacturer's own production may be used within the current limits of the referenced AWWA C-900.

Fittings used with PVC Pressure Pipe shall be AWWA C-110 Full-Body Cast Iron Fittings.

Standard sizes, dimensions and tolerances for DR-18 pipe shall be per the following table:

Table 604.1.A.2.a.(1) PVC Physical Requirements:

Pipe Label	Outside Diameter		Wall Thickness	
Nominal Tube Size (in)	Outside Dia. (in)	Tolerance (in)	Wall Thickness	Tolerance (in)
4	4.80	±0.009	0.267	±0.032
6	6.90	±0.011	0.383	±0.046
8	9.05	±0.015	0.503	±0.060
10	11.10	±0.015	0.617	±0.740
12	13.20	±0.015	0.733	±0.088

604.1.A.2.b. Visual Inspection: Pipe shall be homogenous throughout and free from visible cracks, holes or foreign materials. Pipe shall be free from blisters, wrinkles and dents. This inspection shall be made on each length of pipe.

604.1.A.2.c. Markings: Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

- (1) Nominal pipe size and OD base (e.g., 4 CIPS).
- (2) The type of plastic material (e.g. PVC 12454B).
- (3) The standard Dimension Ratio and the pressure rating in psi for water at 73 F (e.g., DR 18, 150 psi).
- (4) The AWWA or ASTM designation with which the pipe complies (e.g., AWWA C 900).
- (5) The manufacturer's name or code and the National Sanitation Foundation (NSF) mark.

604.1.A.2.d. Material Handling: The Contractor is cautioned to exercise care in handling, loading, unloading and storing PVC pipe and fittings. All PVC pipe and fittings will be stored under cover before using and will be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subject to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded until said section of pipe is cut out and rejoined with a coupling.

Pipe ends and fittings shall be covered or otherwise protected from foreign material entering the pipe and fittings until immediately prior to placing the pipe and fittings.

604.1.A.2.e. Fittings: All fittings shall conform to AWWA C-110 Full-Body for all pipe sizes or AWWA C-153 Short-Body Ductile Iron Fittings for pipes 4-16 inches. All ductile iron fittings shall be Megalug Restraining Glands. 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.

604.1.A.3. Pipes 14 - 24 inches: Pipe shall be DR-18 AWWA C905 Polyvinyl Chloride (PVC) Water Transmission Pipe. This product specification covers 14-inch nominal diameter through 24-inch nominal diameter polyvinyl chloride (PVC) potable water transmission pipe with integral bell and spigot joints. The pipe shall be extruded from Class 12454-A or 12454-B PVC compound as defined in ASTM D-1784 and provide for a hydrostatic design basis (HDB) of 4,000 psi (27.58 MPa). If pipe is used as a pump line, subject to frequent

surges, the pipe shall be DR-14. All pipe furnished shall be in conformance with American Water Works Association (AWWA) Standard C905-97, or latest revision thereof.
All definitions are defined according to AWWA C905-97 Section 1.2 Definitions.

Dimension Ratio (DR) is defined as the ratio of the pipe outside diameter to the minimum wall thickness. The quotient is rounded to the nearest 0.5 when necessary.

The nominal pressure rating of transmission pipe is determined from formulas in Section 5: Transmission-Pipe Ratings of AWWA C905-97 using a safety factor of 2.0. There is no allowance for surge pressure in the pressure rating.

The documents listed below are referenced in this specification.

- a. AWWA C905-97; Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.
- b. ASTM D1784; Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
- c. ASTM D2122; Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
- d. ASTM D3139; Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- e. ASTM F477; Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

604.1.A.3.a. Physical Requirements: Except as noted otherwise on the plans, all C905 PVC pipe shall have a pressure rating of 235 PSI and a dimension ratio of 18 or have the highest pressure rating available for each size of pipe.

Pipe shall be furnished in standard laying lengths of 20 feet plus or minus 1 inch unless otherwise noted. Each pipe shall have an integral bell formed on the pipe end, and be designed to be at least as strong as the pipe wall. An elastomeric gasket shall be designed with a retainer ring, which locks the gasket into integral bell groove and shall be installed at the point of manufacture. The dimensions and design of the gasket joint provided for the PVC transmission pipe shall meet requirements provided in ASTM D3139 and ASTM D2122. The gasket shall be reinforced with a steel band and shall conform to ASTM F477.

604.1.A.3.b. Visual Inspection: Pipe shall be homogenous throughout and free from visible cracks, holes or foreign materials. Pipe shall be homogenous throughout. It shall be free from voids, cracks, inclusions, and other defects. It shall be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces shall be free from nicks and scratches. Joining surfaces of spigots and joints shall be free from gouges and imperfections that could cause leakage. This inspection shall be made on each length of pipe.

604.1.A.3.c. Markings: Each length of pipe furnished shall bear identification markings that will remain legible after normal handling, storage, and installation. Markings shall be applied in a manner that will not weaken or damage the pipe. Markings shall be applied at intervals of not more than 5 ft. on the pipe. The minimum required markings are given in the list below. Marking requirements shall be in conformance with Section 4.7 Marking Requirements of AWWA C905-97:

- (1) Nominal size and OD base (for example, 24 CI).
- (2) PVC.
- (3) Dimension Ratio (for example, DR 25)
- (4) AWWA pressure rating (for example, PR 165)
- (5) AWWA designation number for this standard (AWWA C905).
- (6) Manufacturer's name or trademark.
- (7) Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacture.

604.1.A.3.d. Inspection and Testing: Test certificates from a testing laboratory and/or guarantee by the manufacturer satisfactory to the Engineer shall be furnished for the pipe and fittings to be incorporated in the work. As required by the Engineer, certificates shall be submitted for other materials to be

incorporated in the work. These certificates, stating that the materials meet the requirements of the specifications, will be required before permission is given to incorporate such materials in the work.

The manufacturer shall take adequate measures during pipe production to assure compliance with AWWA C905-97 by performing quality-control tests and maintaining results of those tests as outlined in Section 4: Inspection and Testing of that standard. Submission of product shall constitute certification of compliance with AWWA C905-97 Section 4: Inspection and Testing.

The manufacturer shall pressure test all pipe, including the joint, that is marked with the designation number of AWWA C905-97 at 73.4 Deg. F. +/- 3.6 Deg. F. (23 Deg. C. +/- 2 Deg. C.). Each length of pipe shall be proof tested at twice the pressure rating listed in Table 3 Transmission-Pipe Pressure Rating of AWWA C905-97 Sec. 4.6 Pressure Strength and Hydrostatic Proof Testing.

The Owner may, at no cost to the manufacturer, subject random lengths of pipe to testing by an independent laboratory for compliance with this specification. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

604.1.A.3.e. Material Handling: The Contractor is cautioned to exercise care in handling, loading, unloading and storing PVC pipe and fittings. All PVC pipe and fittings will be stored under cover before using and will be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subject to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded.

Pipe ends and fittings shall be covered or otherwise protected from foreign material entering the pipe and fittings until immediately prior to placing the pipe and fittings.

Pipe shall be bundled in pallets for ease of handling and storage. Pipe bundles (Units) shall be packaged to provide structural support to insure that the weight of upper units shall not cause deformation to pipe in lower units. No pipes bundles shall be accepted which show evidence of ultraviolet radiation "sunburn" on exposed pipe as may be caused from extended unprotected storage conditions.

604.1.A.3.f. Warranty: The pipe is intended for use as an underground, direct bury pressure pipe for transport of potable water. The expected life of the pipe system, after installation, is 25 to 50 years. A one-year warranty shall be provided for all materials sold and delivered for use and incorporated into the water supplier's water distribution system. Such warranty shall take effect on the date that the pipe is received and accepted by an authorized representative of the water supplier's water System. User references and a claims history shall be provided for further investigation, prior to rendering a final decision on the acceptance of the product to be furnished.

604.1.B. Ductile Iron Pipe

Ductile-iron pressure pipe 4-in. through 64-in. shall conform to the American National Standard for Ductile-Iron Pipe Centrifugally Cast for Water or Other Liquids. Contractor may provide an "or equal" material subject to inspection and OWNER approval. Ductile Iron Pipe shall conform to AWWA C-151 for mechanical joint pipe unless otherwise specified in the construction plans. Alternatively, push-on joint pipe may be used if all pipe joints are restrained in accordance with the requirements provided in this section.

604.1.B.1. Physical Requirements: 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.

604.1.B.1.a. Flanges: 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. These flanges are the same in all respects as flanges shown in ANSI/AWWA C110/A21.10 for

fittings. 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 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.

604.1.B.1.b. Pipe Lining: Water pipe shall be cement lined and seal coated in accordance with AWWA C-104. Sewer pipe shall be lined with minimum 80 mil corrosion resistant lining. Approved products are PROTECTO 401 Epoxy Lining or SEWPERCOAT. Only one type and brand of pipe lining shall be used on a given project. External surfaces of pipe shall be wrapped in a minimum 8 mil polyethylene film conforming to AWWA C-105.

604.1.B.1.c. Fittings: Fittings shall conform to AWWA C-110 and shall be mechanical joint unless otherwise specified in the construction plans. All ductile iron fittings shall be Megalug Restraining Glands. Water fittings shall be cement lined and seal coated in accordance with AWWA C-104. Sewer force main fittings shall be internally lined with a minimum 80 mil non-corrosive lining material. Approved products are Protecto 401 Epoxy Lining or SewperCoat.

604.1.B.1.d. Joints: All gaskets shall conform to ANSI A21.11/AWWA 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.

Bolts for flanged or mechanical joints shall be stainless steel or corrosion resistant, low alloy, high strength steel bolts having UNC Class 2 rolled threads or alloyed ductile iron conforming to ASTM A536. Tee-head bolts, hex-head bolts and all nuts shall be marked for ready visual identification and conform to ANSI A21.11/AWWA C-111.

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.

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.

Either Tee-head or Hex head nuts and washers as required, shall be protected with bonded fluoro-polymer corrosion resistant coating if specifically required in the drawings. In the event that corrosion resistant bolts are not available and the use of carbon steel bolts is permitted, they must be coated as follows: Nuts and bolts shall be immersed in Koppers Super Tank Solution, inserted and tightened in the joint while still wet and all exposed parts touched up with a brush coat immediately after tightening. After an interval of at least 1 hour, the entire joint shall be coated with 1-inch minimum thickness of mortar or 2 coats of Koppers Bitumastic #50 or approved equal.

604.1.B.1.e. Polyethylene Wrap: All iron water pipe, fittings, and accessories shall be wrapped with 8-mil (minimum) low-density polyethylene film or 4-mil (minimum) cross-laminated high-density polyethylene conforming to AWWA C-105, with all edges and laps taped securely to provide a continuous wrap to prevent contact between the pipe and the surrounding backfill and bedding material. Repair rips, punctures or other damage to the polyethylene, including those caused in the placement of the bedding aggregate, with an acceptable adhesive tape.

604.1.B.2. Visual Inspection: Pipe shall be homogenous throughout and free from visible cracks, rust, holes or foreign materials. Pipe shall be homogenous throughout. It shall be free from voids, cracks, inclusions, and other defects. It shall be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces shall be free from nicks and scratches. Joining surfaces shall be free from gouges and imperfections that could cause leakage. This inspection shall be made on each length of pipe.

604.1.B.3. Markings: Each length of pipe 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. The manufacturer's name or trademark code and seal of approval (NSF mark) of the National Sanitation Foundation is also required.

604.1.B.4. Inspection and Testing: Test certificates from a testing laboratory and/or guarantee by the manufacturer satisfactory to the Engineer shall be furnished for the pipe and fittings to be incorporated in the work. As required by the Engineer, certificates shall be submitted for other materials to be incorporated in the work. These certificates, stating that the materials meet the requirements of the specifications, will be required before permission is given to incorporate such materials in the work.

604.1.C. PE Pipe

The polyethylene (PE) tubing pressure-rated for water pipes ¾" through 2" shall meet or exceed the requirements of ASTM D-2737. All polyethylene plastic tubing shall be high density, high molecular weight plastic tubing meeting ASTM D-2737, pressure rated at 200 psi working pressure and must bear the National Sanitation Foundation seal of approval for potable water service and meet AWWA C-901. Contractor may provide an "or equal" material subject to inspection and OWNER approval.

604.1.C.1. Physical Requirements: When tested for Environmental Stress Cracking, the PE tubing shall not show any loss of pressure in the 6 specimens tested for 3 hours in accordance with the requirements of ASTM D-2737 using the test pressure of 400 psi at 73.4°F. The minimum burst pressure shall be 630 psi at 73.4°F determined in accordance with ASTM D-1599, latest revision. The time of testing of each specimen shall be between 60 and 70 seconds.

The tubing shall not fail, balloon, burst or weep as defined in ASTM D 1598, latest revision, when tested in accordance with the Sustained Pressure Test Method of ASTM D 2737 but under the following test conditions:

Table 604.1.C.1.a. PE Pressure Test Conditions:

Temperature	Time (hrs)	Pressure (psi)
73.4°F	1,000	400
100°F	1,000	330

PE tubing shall be standard copper tube size outside diameter, with Standard Dimension Ratio (SDR) of 9. Standard sizes, dimensions and tolerances shall be as follows:

Table 604.1.C.1.b. Tube Size:

Pipe Label	Outside Diameter		Wall Thickness	
	Outside Dia. (in)	Tolerance (in)	Wall Thickness	Tolerance (in)
¾	0.875	±0.004	0.097	±0.010
1	1.125	±0.005	0.125	±0.012
1 ¼	1.375	±0.005	0.153	±0.015
1 ½	1.625	±0.006	0.181	±0.018
2	2.125	±0.006	0.236	±0.024

604.1.C.2. Visual Inspection: Pipe shall be homogenous throughout and free from visible cracks, holes or foreign materials. Pipe shall be free from blisters, wrinkles and dents. This inspection shall be made on each length of pipe.

604.1.C.3. Markings: Each length of pipe and fitting shall be marked as required by Permanent marking on the tubing shall include the following at intervals of not more than 5 feet:

- a. Nominal tubing size.
- b. The type of plastic material, i.e., PE 3408.
- c. The Standard Dimension Ratio (SDR) and the pressure rating in psi for water at 73.4 F (e.g., SDR-9, 200 psi).
- d. ASTM D 2737 designation.
- e. The manufacturer's name or trademark code and seal of approval (NSF mark) of the National Sanitation Foundation.

604.1.C.4. Inspection and Testing: Test certificates from a testing laboratory and/or guarantee by the manufacturer.

604.1.D. Copper Tubing

All copper service tubing shall be annealed seamless Type K water tube meeting ASTM B88 and rated at 150 psi working pressure.

604.1.D.1. Physical Requirements: Copper tubing for reclaimed water shall be wrapped in purple polyethylene film wrap. Pipe manufacturers shall be listed on SPL WW-613.

Standard sizes, dimensions and tolerances shall be as follows:

Table 604.1.C.1.a. Tube Size:

Pipe Label Nominal Tube Size (in)	Outside Diameter		Wall Thickness	
	Outside Dia. (in)	Tolerance (in)	Wall Thickness	Tolerance (in)
3/4	0.875	±0.0003	0.065	±0.0045
1	1.125	±0.00035	0.065	±0.0045
1 ¼	1.375	±0.0004	0.065	±0.0045
1 ½	1.625	±0.00045	0.072	±0.005
2	2.125	±0.0005	0.083	±0.007

604.1.D.1.b. Fittings: All fittings used in customer service connection - tapping mains, connecting meters, etc. - must be in accordance with the requirements of the City's Standard Details. All fittings shall be lead free and shall conform to the requirements below:

- (1) All fittings shall be suitable for use at hydrostatic working pressures up to 150 psi. Flanges shall conform to ANSI B16.1, Class 125 (or Class 250 where so noted), as to dimensions, drillings, etc.
- (2) Connections of all new tubing, and of tubing repairs wherever possible, shall be by flared fittings. Flare connections - and compression connections when permitted - shall be designed to provide a seal and to retain the tubing, without slippage, at a working water pressure of 150 psig.
- (3) Copper fittings threads shall conform to Table 2 and 3, Figure 2 and 3 of AWWA C-800 and ANSI B1.1960 with approximate tolerance of Class 2.

604.1.D.1.c. Brass Goods: All brass stops, brass valves, couplings, bends, connections, nipples and miscellaneous brass pipe fittings and accessories used in meter connections, copper service lines, air release piping assemblies and wherever needed in the water distribution system, shall conform to the standards set within AWWA C-800, except as herein modified or supplemented.

Brass Goods of each type and class shall be compatible with other fittings in common usage for similar purposes. Where not otherwise indicated, all such materials shall meet the following requirements:

- (1) Unless otherwise noted, the goods described herein shall be fabricated of standard Red Brass (Waterworks Brass) meeting ASTM B62 or B584, alloy 83600, consisting of 85 percent copper and 5 percent each of tin, lead and zinc.
- (2) Exposed threads shall be covered with plastic caps or sheeting to protect the threads.
- (3) Corporation stop thread (where used) shall conform to Table 1, Figure 1, AWWA C-800, commonly called the Mueller Thread. Corporation stops with iron pipe threads are also permitted. Iron pipe threads shall conform to ANSI B2, 1-1969 and Table 9, Figure 9, of AWWA C-800.
- (4) Brass pipe shall conform to the weight and dimensions of Table 2 in the appendix for AWWA C-800.

604.1.D.2. Visual Inspection: 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. This inspection shall be made at random on each pipe delivery.

604.1.D.3. Markings: Each length of pipe and fitting shall be marked as required by Permanent marking on the tubing shall include the following at intervals of not more than 5 feet:

- a. Nominal tubing size.
- b. Pressure rating in psi.
- c. The manufacturer's name or trademark code.
- d. Country of origin.

604.1.D.4. Inspection and Testing: Test certificates from a testing laboratory and/or guarantee by the manufacturer. The vendor or CONTRACTOR shall be responsible for submission of a laboratory analysis of the products supplied. The manufacturers own laboratory analysis is acceptable. The certificate of analysis shall state size and type of analysis and results obtained. A statement shall be made and validated that tests confirm compliance with the requirements of this specification.

The OWNER reserves the right to conduct or cause to have conducted independent laboratory tests. Where the results of such tests prove the quality requirements have not been met: (1) the costs of tests shall be charged to the vendor's account, and (2) the entire shipment may be rejected on the basis of such tests.

604.2 CONSTRUCTION METHODS

The construction methods for water pipes shall be done per Item for Water Installation.

604.3 MEASUREMENT AND PAYMENT

Water Pipe will be measured by the linear foot (LF) along the centerline of the pipe for the various sizes and classes of pipe in place, in accordance with these specifications, complete and accepted by the Engineer, including excavation, embedment, and backfill, unless they are included in the bid as a separate pay item.

Payment for pipe, measured as prescribed above, will be made at the unit price bid, when provisions are made directly for payment, per linear foot for the various sizes of pipe, of the materials and class indicated. Mitigation of unstable material, if encountered, trench excavation, and backfill (for all depths) are considered subsidiary to this item unless specifically included as a separate pay item.

Payment shall be full compensation, in accordance with the pay items set in the bid, for excavation, furnishing, hauling and placing pipe including lugs and all incidental and subsidiary materials and work; preparing, shaping, dewatering and shoring of trenches; hauling, placing and preparing bedding; for connecting to new or existing systems or structures; for hauling, moving, placing and compacting backfill materials and all other incidentals necessary to complete the pipe installation as indicated.

605 WATER APPURTENANCES

This item shall consist of furnishing all materials for constructing pipe mains, laterals, stubs, inlet leads, service connections and culverts, including all applicable work such as excavating, bedding, jointing, backfilling, materials, tests, etc. The appurtenances shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer and shall include all joints or connections to new or existing mains, pipes, manholes, inlets, structures, etc. as may be required to complete the work in accordance with specifications and standard published practices of the trade associations for the material specified and to the lines and grades indicated. This item shall consist of pumping, bailing, drainage and Trench Safety Systems for trench walls when indicated. Unless otherwise provided, this item shall consist of the cutting and restoration of pavement and base courses, the furnishing and placing of select bedding, backfilling and cement or lime stabilized backfill, the hauling and disposition of surplus materials, bridging of trenching and other provisions for maintenance of traffic or access as indicated.

605.1 VALVES AND HYDRANTS

This item shall consist of furnishing and installing all, valves, and all other materials including applicable work such as unclassified excavating, bedding, jointing, backfilling, materials, tests, etc. All valve appurtenances shall be manufactured in the United States, unless otherwise specified in the construction documents.

605.1.A. Materials

CONTRACTOR shall submit manufacturer material specifications to OWNER prior to beginning construction. The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of required for completion of the work.

605.1.A.1. Gate Valves: Gate Valves 0-3 inches (in diameter) shall meet or exceeding MSS SP-80, Type 1, Class 125 with treated ends, bronze body, bonnet, wedge and non-rising stem meeting ASTM B 62, having Commercial Grade Aluminum Handwheel and non-asbestos packing. Approved product is: Milwaukee Valve Co. Gate 105 or equal.

Gate Valves 4-16 inches (in diameter) shall meet or exceed applicable requirements of ANSI/AWWA C 509 "Resilient Seated Gate Valves for Water and Sewerage Systems" standard. Gate valves shall be resilient wedge type open left (counter clockwise) with adjustable cast iron box and cover in raised letters with cast on cover. Iron body, iron disc with replaceable rubber seat, non-rising stem, double O-ring seal stuffing box (where the valve stem penetrates the valve body), 2" square wrench nut, rated at 200 psi working pressure. Approved manufacturers are: (1) Mueller, (2) American Flow Control, and (3) Clow (No alternates allowed).

All tees, crosses and connections shall have gate valves at locations determined by the OWNER. For tees, there shall be two valves and for crosses there shall be two valves and for crosses there shall be 3 valves.

605.1.A.2. Pressure Reducing Valves (PRV): All PRVs shall be Class 150, water temperature up to 180° F (max.), cast iron main valve body and cover conforming to ANSI A 48, pilot control system to be cast bronze ASTM B 62 with 303 stainless steel trim. Approved product: Cla-Val Co. Pressure Reducing Valve (or approved equal).

605.1.A.3. Backflow Preventers (BFP): All PFPs (or Double Check Valve Assembly) shall be maximum working pressure of 150 psi, temperature range up to 110°F, bronze check valve body meeting ASTM B 61 (2") or cast iron epoxy coated, otherwise with bronze check valve trim meeting ASTM B 61, assembly demonstrated to have less than 10-psi head loss at rated flow. Approved manufacturer: Cla-Val Co. (or approved equal).

605.1.A.4. Flush Valves: Flush Valve shall have a two-inch pipe, 2" corporation stop with valve box, brass valve with 2" FIP inlet, rubber replaceable seat, brass plunger with O-ring seal, 7/16 in. square operating nut and brass screw, iron top cap capable of being locked, 2" nozzle with cap and chain, traffic break-away coupling. Approved product: The Kupferle Foundry Co. No. 77 Mainguard Hydrant (or approved equal).

505.1.A.5. Air / Vacuum Release Valves (ARV): ARVs shall be globe type with screwed connection, and ends to comply with Class 125 and 250, ANSI B 16.1, Pressure Rating 125 Class - 175 psi max., temperature range to 180°F (max.), main valve body and cover to be cast iron ASTM A-48, brass and bronze trim, bronze pilot controls ASTM B 61. Approved manufacturer is Apco (or approved equal). ARVs shall comply with the following:

- 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.
- b. 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.
- c. Valves shall be rated for at least 150-psi (maximum) normal service pressure.
- d. Valve exterior bodies and covers shall be cast iron.
- e. Internal bushings, hinge pins, float guide and retaining screws, pins, etc., shall be stainless steel or bronze.
- f. Orifice seats shall be Buna-N rubber.
- g. Floats shall be stainless steel, rated at 1000-psi.

605.1.A.6. Fire Hydrants: All fire hydrants shall comply with AWWA C-502 "AWWA Standard for Dry-Barrel Fire Hydrants", be Traffic Model (break-away), and be U.L. listed (246). Cast iron valve top, bottom, upper barrel and weather cover, plated steel bolts and nuts; shall have drain lever, bronze hydrant seat, bronze hydrant rod with self-lubricating, double O-rings, one-piece bronze operating nut, ductile iron base and lower barrel, 1-5¼" nozzle with cover and 2-2½" nozzle. The 5¼" nozzle shall be required to have a Hydra-Shield Hydra-Storz Quick Connect System (No alternates allowed) with cap and locking mechanism. Operating nut shall turn clockwise to close. Operating nut shall be pentagonal. Valve stem design shall meet requirements of AWWA C502. Seat ring shall be bronze (bronze-to-bronze threading) and shall be removable with lightweight stem wrench.

Design working pressure shall be 200-psi and a test pressure of 400-psi.

Inlet shall be side connection hub end for mechanical joint (ANSI A-21.11 – or current). Shoe shall be rigidly designed to prevent breakage.

Lower Barrel shall be rigid to assure above ground break at traffic feature. Bury length of hydrant shall be four (4) feet minimum, five (5) feet maximum (hydrant lead pipe may be elbowed up from main using restrained joints; flanged joints in lead pipes are not allowed). Outlet Nozzles shall be located approximately 18-in above adjacent grade. Flange type connections between hydrant shoe, barrel sections and bonnet shall have minimum of 6 corrosion resistant bolts.

Traffic Feature shall have replaceable breakaway ferrous metal stem coupling held to stem by readily removable type 302 or 304 stainless steel fastenings. Breakaway flange or frangible lugs shall be designed to assure aboveground break. Breakaway or frangible bolts will not be acceptable.

A blue reflective delineator of a type approved by the OWNER shall be placed 2 to 3 feet offset from the centerline of paved streets, on the side of and in line with, all newly installed fire hydrants. CONTRACTOR may use existing installed delineators as a "go-by" when selecting materials.

Below-ground bolts shall be corrosion resistant. The hydrant valve shall be Neoprene, 90 durometer minimum. The seat ring, drain ring, operating nut and nozzles shall be bronze, AWWA C-502 current, containing not over 16 percent zinc. Break-away stem coupling shall be of ferrous material; retaining pins, bolts, nuts, etc. of Type 302 or 304 stainless steel.

605.1.A.6.a. Approved Products: Approved products are (1) Mueller Super Centurion, (2) American Darling 5¼" B-84-B, (3) Clow Medallion, and (4) East Jordan (No alternates allowed).

605.1.A.6.b. Color: Hydrant exterior color shall be Red. Coatings shall be durable and applied to clean surfaces. The coating shall be applied according to coating manufacturer's specifications. Other buried exposed ferrous metal shall receive asphalt-based varnish, or approved equal, applied according to the coating manufacturer's specifications.

605.1.A.6.c. Location: If location is not specified in the drawings all fire hydrants shall be placed within public rights of way and or public easements. Should the contractor determine a conflict exists between the locations shown on the drawings and on-the-ground conditions, he shall notify the engineer immediately so alternate installation provisions may be provided.

Unless otherwise specified fire hydrants shall be placed on block corners or near the center of the block in such a manner as to place all of every lot within a radius of 500 feet of a fire hydrant in residential areas and within a radius of 300 feet in commercial or industrial areas. Hydrant should be placed so that the bottom flange of the body will be a minimum of three (3) inches above finish elevation and maximum nine (9) inches.

605.1.A.6.d. Inspection and Testing: Test certificates from a testing laboratory and/or guarantee by the manufacturer satisfactory to the Engineer shall be furnished for the pipe and fittings to be incorporated in the work. As required by the Engineer, certificates shall be submitted for other materials to be incorporated in the work. These certificates, stating that the materials meet the requirements of the specifications, will be required before permission is given to incorporate such materials in the work.

All tests and inspections called for by the applicable standards shall be performed by the manufacturer. Upon request, results of these tests shall be made available to the OWNER. Each submittal shall indicate the following information:

- (1) Type and size, model number, etc.,
- (2) Manufacturer's name and address of his nearest service facility,
- (3) Number of turns to fully open or close the valve.
- (4) Detailed instructions for calibrating the limit stops for open and closed positions.
- (5) Any other information that may be necessary to operate
- (6) Complete dimensional data and installation instructions for the valve assembly as it is to be installed.
- (7) Complete replacement parts lists and drawings, identifying every part.

605.1.B. Construction Methods

The Contractor shall prepare the excavation for the correct elevation after grading has been properly executed. The Valves and Fire Hydrants shall be set according to the drawings. Backfill material should be free flowing and placed in accordance with item for "Water Installation." Minimum cover depth above the top of pipe shall be 3 feet.

605.1.B.1. Valve Installation: Unless otherwise indicated, main line valves, drain valves and piping, air and vacuum release assemblies and other miscellaneous accessories shall be set and jointed in the manner described for cleaning, laying and jointing pipe. 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.

Valves shall be set in the line with the radius point and the corresponding point of curvature or point of tangency of adjacent curbs or right of way lines. Valves shall be installed so that the tops of operating stems will be at the proper depth 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 in existing streets and installed with the top of the box or casing approximately 6 inches below the standard street subgrade in streets

which are excavated for paving construction or where such excavation is scheduled or elsewhere as directed by the Engineer.

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.

Drainage branches or air blow-offs shall not be connected to any sanitary sewer or submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system (see Contract Documents). Every drain line and every air release line shall have a full sized independent gate valve flanged directly to the main. Flap-valves, shear gates, etc., will not be accepted.

605.1.B.1.a. Valve Box: Unless otherwise indicated, a vertical 6-inch D.I. riser pipe shall be installed over all valve square nuts extended to finish grade. Valve boxes shall be 3 piece screw type cast iron of the extension type. Mueller H-10360 or approved equal. A 24" x 24" x 6" reinforced concrete cap shall be thence constructed at finished grade with an iron cap placed on the end of the riser pipe, acceptable to the regulatory authority. Concrete cap around the valve box is installed on other than on a concrete. CONTRACTOR shall assure that valve boxes are installed in a truly vertical position 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. Refer to City's standard detail for additional information.

Stems of all buried valves shall be protected by valve box assemblies. Valve box castings shall conform to ASTM A-48, Class 30B. Testing shall be verified by the manufacturer at the time of shipment. Each casting shall have cast upon it a distinct mark identifying the manufacturer and the country of origin. Valve box top shall be set horizontal and flush with adjacent grade. Iron box or valve box should not touch or rest on the valve. Bricks or blocks should be placed adjacent to the valve in a manner that neither the bricks nor the valve box rest directly on the valve.

605.1.B.2. Fire Hydrant Installation: Fire hydrants shall be located in a manner to provide accessibility and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized.

Under no circumstances, shall a fire hydrant be installed closer than 9 feet (measured horizontally or vertically) to the outside edge of a sanitary sewer line.

All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the road with the pumper nozzle pointing normal to the road. They shall conform to the finish grade with the hydrant bury mark approximately level with the ground or other finish grade, with the large pumper nozzle approximately 18 inches above grade as indicated without the use of hydrant extensions except where authorized by the Engineer. Each hydrant shall be connected to the main pipe with the 6-inch ductile iron branch. A 6 inch gate valve shall be installed in the line for individual shutoff of each new hydrant. Lower barrel length shall not exceed 5 feet.

Fire hydrants on mains with different pressure from the surrounding service area which are to be used only as air releases or drains shall be permanently painted solid white prior to acceptance for operation and maintenance.

Fire hydrants on mains under construction shall be securely wrapped with a poly wrap bag or envelope taped into place. When the mains are accepted and placed in service the bag shall be removed.

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees or crosses and spigot ends shall be capped. All end plugs or caps shall be secured to the pipe conforming to these specifications.

Where indicated on the plans, existing fire hydrants may require removal to provide clearance for proposed improvements. The existing fire hydrant will be removed and salvaged, removed and disposed, or removed and reset, as called out in the construction plans. A separate pay item will be included for this task, and payment for this task will include all pipe, valves, harnesses, fire hydrant parts, labor, installation, and any incidentals to accomplish the task.

605.1.B.2.a. Fire Hydrant Location: Hydrants between curb and sidewalk on public streets shall be installed as shown on Standard Fire Hydrant Detail, with outermost point of large nozzle cap 6" to 18" behind back of curb. Where walk abuts curb, and in other public areas or in commercial areas, dimension from gutter face of curb to outermost part of any nozzle cap shall be not less than 3 feet, nor more than 6 feet, except that no part of a hydrant or its nozzle caps shall be within 6 inches of any sidewalk or pedestrian ramp. Any fire hydrant placed near a street corner shall be no less than 20 feet from the curb line point of tangency.

605.1.B.2.b. Fire Hydrant Excavation: Below each hydrant, a drainage pit 2 feet in diameter and 2 feet deep shall be excavated and filled compactly with coarse gravel or broken stone mixed with coarse sand under and around the blow of the hydrant, except where thrust blocking is situated and to a level 6 inches above the hydrant drain opening. Fire hydrant 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.

No hydrant drainage pit shall be connected to a sanitary sewer. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete thrust blocking (taking care not to obstruct the hydrant drain holes) or it shall be tied to the pipe with approved metal harness rods and clamps. Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting. The hydrant drainage pit shall not be connected to a sanitary sewer. The drain gravel shall be covered with filter fabric to prevent blockage of voids in the gravel by migration of backfill material. Refer to Item 400 "Paving" for geotextile material specifications. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete thrust blocking (taking care not to obstruct the hydrant drain holes), or the hydrant shall be tied to the pipe with approved metal harness rods and clamps. The fire line shall be provided with joint restraint from the main line to the fire hydrant. Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

605.1.B.3. Protective Covering: Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel components buried and in contact with earth or backfill shall be wrapped with 8-mil (minimum) polyethylene film meeting ANSI/AWWA Specifications 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.

Fire hydrants on mains under construction shall be securely wrapped with a poly wrap bag or envelope taped into place and removed when the mains are accepted and placed in service.

605.1.B.4. Testing and Disinfecting: After the pipe has been installed and backfilled and all services laterals, fire hydrants, valves, and other appurtenances installed and connected, a pressure test, followed by a leakage test, which will then be followed by a system sterilization and Bacteriological Testing. Such test and samples shall be done according to Item for Water Installation.

605.1.C. Measurement and Payment

Measurement and Payment will be made per each (EA) for each water valve (of any type) or fire hydrant installed. Excavation and backfill shall be included in the Unit Price Bid for the Valve or Fire Hydrant. Each bid item shall specify the size (in inches) of the valve installed.

Valves will be installed, including valve stem casing and cover, excavation and backfill, setting, adjusting to grade and anchoring. Pressure control and flow control valve assemblies will include box or vault, setting, adjusting to grade, anchoring in place, adjusting the control device to the required conditions and placing in operation. Pressure reducing valve and assembly will include the main line tap or outlet, all pipe, valves, fittings, gauges, box, concrete cap, manhole structure, or vault and cover.

Fire hydrants will be set, adjusted to grade and anchored in place. The bid price per each will include all clearing, excavation, trench excavation safety, bedding material, fittings, valves, pipe coatings, connection to the existing system, disposal of surplus materials, laying of pipe, backfilling and cleanup.

Standard Blow-Off and assembly will include the main line tap or outlet, all pipe, curb stops, fittings, box, or vault and cover as called for in Standard Blow-Off Detail.

Payment for each water valve or fire hydrant, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the for each water valve or fire hydrant and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing Megalugs, fitting, bends, etc., for completion of the Work.

605.2 JACKING OR BORING

This item shall govern furnishing and installing of encasement and carrier pipe by methods of jacking or boring as indicated on the Drawings and in conformity with this specification. This item shall also include, but not be limited to other construction activities such as traffic control measures, excavation, removal of all materials encountered in jacking or boring pipe operations, disposal of all material not required in the work, grouting, bulkhead installation, backfilling and revegetation. CONTRACTOR shall comply also with the following related cross-reference materials:

SPECIFIC Cross Reference Materials for "Jacking or Boring Pipe"

TxDOT Standard Specifications For Construction And Maintenance Of Highways, Streets, And Bridges

Section 500 "Drainage" of these specifications

TxDOT Testing Procedures

Designation	Description
Tex-114-E	Laboratory Compaction Characteristics & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials

Texas Manual on Uniform Traffic Control Devices (TMUTCD)

Designation	Description
TMUTCD Part VI	Traffic Controls for Street and Highway Construction, Maintenance, Utility and Incident Management Operations
TMUTCD Section 6C	Channelizing Devices
TMUTCD Section 6C-8	Barricade Design
TMUTCD Section 6C-9	Barricade Application
TMUTCD Section 6E	Lighting Devices
TMUTCD Section 6F	Control of Traffic Through Work Areas

RELATED Cross Reference Materials for "Jacking or Boring Pipe"

TxDOT Standard Specifications

Designation	Description
Item 476	Jacking, Boring, or Tunneling Pipe

605.2.A. Materials

CONTRACTOR shall submit manufacturer material specifications to OWNER prior to beginning construction. The submittal requirements for this specification item shall include:

1. Shop drawings identifying proposed jacking or boring method complete in assembled position
2. Trench Safety Plan including pits, trenches and sheeting or bracing if necessary,
3. Design for jacking or boring head,
4. Installation of jacking or boring supports or backstop,
5. Arrangement and position of jacks and pipe guides,
6. Grouting plan, and
7. Materials and method for tying restraints to both ends of the casing.

605.2.A.1. Carrier Pipe: Carrier pipe and encasement pipe shall conform to Specification, "Water Pipe" and "Pipe Casing" as appropriate, as well as "Concrete Encasement and Encasement Pipe" and "Drainage Pipe" and shall be size, type materials, thickness and class indicated on the Drawings, unless otherwise specified.

605.2.A.2. Grout: Grout for void areas shall consist of 1 part Portland cement and 4 parts fine, clean sand mixed with water. The grout shall have a consistency such that the grout will flow into and completely fill all voids. If allowed by the OWNER or designated representative, an air entraining admixture may be added to facilitate placement.

605.2.A.3. Pipe Casing: Pipe casings shall comply with the following:

- a. Steel pipe shall be new, smooth wall carbon steel pipe, which conforms to ASTM Specification A134, with minimum yield strength of 35,000 psi. Pipe shall have a minimum thickness of 3/8 inch for pipe with a diameter of 16 inches and greater.
- b. All steel pipe shall be square cut with beveled ends for welding.
- c. Joints shall be welded.
- d. Steel pipe shall have roundness such that the difference between the major and minor outside diameters shall not exceed 1% of the specified nominal outside diameter or 1/4" whichever is less.
- e. Steel casing shall have an outside circumference which is within 1% of the nominal circumference or which is within 1/2" whichever is less.
- f. Steel casing shall have a minimum allowable straightness deviation in any 10' length of 1/8" inch or less.
- g. Steel Casing shall the following physical requirements:

Table 604.2.A.3.g.(1) Steel Casing Physical Requirements:

STEEL CASING - WATER MAIN		
Pipe Size (Inches)	Minimum Pipe Thickness (Inches)	Pipe Weight (Lbs/Ft)
6	0.375	25.03
8	0.375	33.04
10	0.375	39.30
12	0.375	45.55
16	0.375	62.58
18	0.375	70.59
20	0.375	78.60
24	0.375	94.62
30	0.375	118.65

605.2.A.4. Casing Spacers: This product specification covers casing spacers for use in water supply service. Casing spacers are used to facilitate installing a water pipe inside a casing pipe or tunnel. Casing spacers shall consist of two or more segments of circular steel that bolt together forming a shell around the carrier pipe(s). Casing spacers should protect the carrier pipe and any protective coating or wrapping from damage during the installation, and properly support and electrically isolate the carrier pipe(s) within the casing or tunnel. On occasion multiple carrier pipes may be installed in one casing or tunnel. No direct payment will be made for casing spacers. Furnishing and installation of casing spacers will be subsidiary to pay items for Jacking or Boring Pipe or Steel Casing Pipe.

605.2.A.4.a. Spacers Requirements: The Engineer reserves the right to limit the purchase of casing spacers from the manufacturers and to the models specified as shown at the end of this Section, or as shown in the Construction Drawings, providing such casing spacers conform to the provisions contained herein. In the event of conflicts between these specifications and Casing Spacer details and requirements shown on the Construction Drawings, the Construction Drawings shall take precedence. The spacer shall comply with the following:

- (1) Casing spacers shall be eight inches (8") long for carrier pipes up to 16-inch diameters and twelve inches (12") long for larger carrier pipe sizes. Manufacturer's approval in writing shall be required for installations exceeding 300 ft. in length, carrier pipes in excess of 48-inch diameter or multiple carrier pipes in one casing or tunnel.
- (2) Casing spacers shall have a minimum 14-gauge steel band and 10-gauge steel riser when required. The band, risers and connecting studs shall be welded and cleaned at the factory before the application of a fluidized bed fusion bonded PVC coating. Stainless steel (Type 304) casing spacer is an acceptable alternative.
- (3) The fluidized bed fusion bonded PVC coating shall be between 10-16 mils thickness. The PVC coating shall provide good resistance to acids and alkalize and excellent resistance under ASTM B117 salt spray tests. The coating shall have a minimum 1380volts/mil per ASTM D149-61 short time 0.010" test and a Durometer-shore A@ (10 sec) of 80 per ASTM D1706-61T. Epoxy coatings are not an acceptable alternative.
- (4) The spacers shall have a flexible PVC liner of 0.09- inch thickness with Durometer "A" 85-90 hardness and a minimum 58,000- volt dielectric strength (60,000-volt minimum Surge Test.) Moisture absorption shall not exceed 1%.
- (5) The runners shall be of high pressure molded glass reinforced polyester with a minimum compressive strength of 18,000 psi per ASTM D695, flexural strength of 25, 300 psi per

ASTM D790, tensile strength of 17,600 psi per ASTM D638 and Rockwell hardness (M) of 90 per ASTM D785. The riser shall be designed and fabricated to place the runner (skid) in full contact with the inside surface of the casing pipe. This evenly distributes the load force to all support members. The ends of all runners shall be shaped to resist hanging or sticking inside casing during installation of the carrier pipe. Polyethylene runners are not acceptable.

- (6) Runners shall be a minimum of 1.0 inch in width and a minimum of 7 inches long for carrier pipes up to 16", and a minimum of 2.0 inches in width and 11 inches long for larger carrier pipes. Bolts on runners are not acceptable. The runners shall be attached to the band or riser by 3/8 the wearing surface on the runner. The recess shall be filled with a corrosion inhibiting filler. There shall be four runners per casing spacer for carrier pipes up to 12" diameter, six runners for 14" through 36" and eight or more runners for carrier pipes over 36" diameter.
- (7) The band section shall be bolted together with 5/16" cadmium-plated studs, nuts and washers. There shall be six sets per 8" long casing spacer and eight sets per 12" long spacer. Stainless steel casing spacers shall be furnished with stainless steel studs, nuts and washers.
- (8) Casing spacers shall have ample riser height to limit vertical movement of the carrier pipe in the casing. A minimum of 1" to 2" clearance shall be provided between the top runner and the ID of the casing or tunnel.
- (9) Continuous operating temperatures for the PVC Coated Casing Spacers should not exceed 150°F. Stainless steel casing shall be used in applications where continuous operating temperatures exceed 150°F.
- (10) Unless noted otherwise, casing spacers shall be required on all carrier pipes installed in casing or tunnel applications.
- (11) After insertion of the carrier pipe in the casing, the ends of the casing shall be closed by installing end seals and a 1/8" thick synthetic rubber end seal equal to the PSI Model "C" end seal as manufactured by Pipeline Seal and Insulator, Inc., Houston, TX, or as otherwise noted on the Construction Plans, or approved equal.

605.2.A.4.b. Spacers Quality Assurance: All casing spacers are to be manufactured in accordance to NACE International Recommend Practice RP 0286-97 (Isolation Spacers.) Each casing spacer shall be manufactured in the USA at a facility that has Registered ISO 9002 Quality Management. If on receipt of casing spacers they are found to be non-compliant, the manufacturer shall replace the defective casing spacer with a casing spacer that meets the Engineer's specifications, at no charge.

605.2.A.4.c. Approved Spacers: CONTRACTOR may submit for approval a different type of spacers than the already accepted materials. Already approved casing spacers are:

Table 605.2.A.2.b.(1) Approved Spacers:

Manufacturers	Locations	Model Numers
Pipeline Seal & Insulator, Inc.	Houston, TX	C8G-2 or SI8G-2
Pipeline Seal & Insulator, Inc.	Houston, TX	C12G-2 or SIIG-2
Advance Products & Systems,	Lafayette, LA	APS S112-2 or APS SS112-2
Advance Products & Systems,	Lafayette, LA	APS S18-2 or APS SS18-2
Power Seal Pipeline Products,	Wichita Falls, TX	4810 SS (Stainless steel)
Power Seal Pipeline Products,	Wichita Falls, TX	4810 CS (Carbon steel)
Cascade Waterworks	Yorkville, IL	Style CSS

605.2.B. Construction Methods

The Contractor shall have sole responsibility for the safety of the jacking and boring operations and for persons engaged in the work. The Contractor's attention is directed to the Construction Industry Occupational Safety and Health Administration (OSHA) Standards (29 FR 1926/1920) as published in U.S. Department of Labor publication OSHA 2207, latest revision, with particular attention to Subpart S. The Contractor shall provide an appropriate Trench Safety Plan.

The Contractor is responsible for:

1. Adequacy of jacking and boring operations,
2. Installation of support systems as indicated on the Drawings,
3. Provision of encasement and carrier pipe, and
4. Execution of work involving the jacking operation, the wet or dry method of boring and the installation of encasement pipe simultaneously.

When the grade of the pipe at the jacking or boring end is below the ground surface, suitable pits or trenches shall be excavated to provide sufficient room to conduct the jacking or boring operations and for placement of end joints of the pipe. In order to provide a safe and stable work area, the excavated area shall be securely sheeted and braced to prevent earth caving in accordance with the Trench Safety Plan.

The location of the work pit and associated traffic control measures required for the jacking or boring operations shall conform to the requirements of the Texas Manual on Uniform Traffic Control Devices (TMUTCD) and when along state highway rights of way, shall be approved by TxDOT.

Where installation of pipe is required under railroad embankments, highways, streets, or other facilities by jacking or boring methods, construction shall be undertaken in such a manner that it will not interfere with operation of any railroad, street, highway, utility or other facility and shall not weaken or damage any embankment or structure. All appropriate permits shall be acquired prior to the initiation of the work.

During construction operations, and until the work pits are backfilled and fill material compacted, traffic barricades and warning lights to safeguard traffic and pedestrians shall be furnished and maintained by the Contractor. The Contractor shall submit the proposed pit location and traffic control plan for review by the Engineer or designated representative. The review by the Engineer or designated representative, however, will not relieve the Contractor from his responsibility to obtain specified results in a safe, workmanlike manner.

When grade of pipe at jacking or boring end is below ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking or boring operations and for joining pipe. Work shall be securely sheeted and braced as indicated on the Trench Safety Plan to prevent earth caving and to provide a safe and stable work area.

The pipe shall be jacked or bored from the low or downstream end, if possible. Minor lateral or vertical variation in the final position of pipe from line and grade established by Engineer or designated representative will be permitted at the discretion of Engineer or designated representative provided that such variation is regular and occurs only in one direction and that the final grade of the flow line conforms to the specified direction.

When conforming to details indicated on the drawings, but the bottom of the work pit is unstable or excessively wet or the installation of water and wastewater pipe will result in less than 30 inches of cover, the Contractor shall notify the Engineer or designated representative. The Engineer or designated representative may require the Contractor to install a concrete seal, cradle, cap or encasement or other appropriate action.

Approved neoprene end seals shall be installed at each end of the casing pipe to prevent water and debris from entering the casing pipe.

As soon as possible after the carrier pipe(s), and end-seals are completed, the work pits or trenches, which are excavated to facilitate these operations, shall be backfilled. The backfill in the street ROW shall be compacted to not less than 95 percent of the maximum density conforming to TxDOT Test Method Tex-114-E, "Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil". Field density measurements will be made in accordance with TxDOT Test Method Tex-115-E, "Field Method for Determination of In-Place Density of Soils and Base Materials".

605.2.B.1. Jacking: Heavy-duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating the jacks, an even pressure shall be applied to all jacks used so that the pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The complete jacking assembly shall be placed in order to line up with the direction and grade of the pipe. In general, the embankment material shall be excavated just ahead of the pipe, the material removed through the pipe and the pipe forced through embankment by jacking, into the space thus provided.

The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of no more than 2 inches may be provided for the upper half of the pipe. This clearance shall be tapered to zero at the point where excavation conforms to contour of pipe.

The distance that excavation shall extend beyond the end of the pipe depends on the character of material encountered, but it shall not exceed 2 feet in any case. This distance shall be decreased, when directed by the Engineer or designated representative, if the character of the material being excavated makes it desirable to keep the advance closer to the end of the pipe.

The Contractor may use a cutting edge of steel plate around head end of the pipe extending a short distance beyond the end of pipe with inside angles or lugs to keep cutting edge from slipping back onto the pipe.

When jacking of the pipe is begun, all operations shall be carried on without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at its entire expense.

605.2.B.2. Boring: The boring shall proceed from a work pit provided for the boring equipment and workmen. Excavation for the work pits and the installation of shoring shall be as outlined in the Trench Safety Plan. The location of the pit shall be approved by the Engineer or designated representative. The boring shall be done mechanically using either a pilot hole or the auger method.

In the pilot hole method an approximate 2-inch pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored.

When the auger method is used, a steel encasement pipe of the appropriate diameter equipped with a cutter head to mechanically perform the excavation shall be used. Augers shall be of sufficient diameter to convey the excavated material to the work pit.

Excavated material will be removed from the working pit and disposed of properly. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Water jetting will not be permitted.

In unstable soil formations, a gel-forming colloidal drilling fluid, that consists of at least 10 percent of high grade, carefully processed bentonite, may be used to consolidate the drill cuttings, seal the walls of the hole and furnish lubrication to facilitate removal of the cuttings from the bore.

605.2.B.3. Encasement Pipe: Piping installed as a carrier pipe in a tunnel, pipe casing, etc., shall have uniform alignment, grade, be a ring and conform to the reviewed Shop Drawings. All necessary casing spacers, bedding material, grout cradle or paving, bracing, blocking, end seals, etc., as stipulated by the Contract or as may be required to provide and maintain the required pipe alignment and grade, shall be provided by the Contractor at no cost except as provided by the Bid Items. This shall include casing spacers acceptable to the Owner attached to the carrier pipe in accordance with the manufacturer's recommendations. The end seals (or casing insulators) shall tightly fit the carrier pipe and casing pipe and shall be installed per manufacturer recommendations.

The insertion pushing forces shall not exceed the pipe manufacturer's recommendation. Such carrier piping shall have flexible bolted or gasketed push-on joints pipe installed as follows:

- a. Pipes 21 Inch and Smaller: Prior to placing the pipe in the tunnel, the inside joint recess at the bell shall be buttered with cement mortar. After the joint is engaged, the excess mortar shall be smoothed by pulling a tight fitting swab through the joint. Cement mortar protection shall then be placed in the normal manner to the exterior of the joint and allowed to harden sufficiently to avoid dislodgment during installation. If time is of the essence, a quick setting compound may be used.
- b. Pipes greater than 21 Inch: Each length of pipe shall be pushed into the tunnel as single units. A flexible mastic sealer shall be applied to the exterior of the joint prior to joint engagement. The surfaces receiving the mastic sealer shall be cleaned and primed in accordance with the manufacturer's recommendation. Sufficient quantities of the mastic sealer shall be applied to assure complete protection of all steel in the joint area. The interior of the joint shall be filled with cement mortar in the normal manner after the pipe is in its final position within the tunnel.

605.2.C. Measurement and Payment

Jacking or boring pipe will be measured by the linear foot (LF) of pipe complete in place. Such measurement will be made between the ends of the pipe along the central axis as installed.

Pipe casing will be measured by the linear foot (LF) of pipe complete in place. Such measurements will be made between the ends of the casing along the central axis as installed.

If provided separately, payment for the pipe casing, measured as prescribed above, will be made at the unit price bid per linear foot for the casing size, spacers, other material and class indicated. Payment shall be full compensation, in accordance with the pay items set in the bid, for furnishing, hauling and placing pipe casing including casing spacers, grout, concrete, bulkheads, and all incidental and subsidiary materials and work necessary to complete the installation as indicated.

Payment for Jacking or boring pipe shall be done per the work performed and materials furnished as prescribed by this item and measured as provided will be paid for at the unit bid price per linear foot for "Jacking or Boring Pipe", if provided for in the Unit Price Schedule of type, size and class of encasement and carrier pipe indicated on the Drawings. Unless provided for under a separate pay item, the price shall include full compensation for furnishing, preparing, hauling and installing required materials, encasement pipe, carrier pipe, restraints, end seals, for grouting and for labor, tools, equipment and incidentals necessary to complete work, including excavation, backfilling and disposal of surplus material.

606 WATER INSTALLATION

This item shall govern and control the furnishing and placing of water pipe including pipe fittings, all connections to new or existing pipe, service lines and connections, to the lines and grades shown on the plans. All pipe and fittings shall be of the types, shapes, classes, sizes and dimensions as shown thereon; and as may be required to complete the work as shown on the plans.

606.1 PIPE INSTALLATION

The CONTRACTOR shall furnish, at its own expense, and place in position as directed by the Engineer all necessary batter boards, string lines, plummets, graduated poles, etc., required in establishing and maintaining the lines and grades. The batter boards and all location stakes must be protected from possible damage or change of location.

The contractor shall ensure all requirements of the Texas Commission of Environmental Quality (TCEQ) are complied with. This shall include TECQ Chapter 217 and 290.

Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the Engineer and shall become the property of the Contractor to dispose of on site or at a permitted fill site, without injury to any individual. Such surplus material shall be removed from the work site promptly following the completion of the portion of the utility involved.

606.1.A. Materials

Water pipe and jointing materials shall conform to the requirements of Item for Water Pipes and Water Appurtenances. Unless otherwise specified in the contract, water required for construction and furnished from the OWNER's distribution system shall be paid and accounted for as prescribed by the OWNER. The CONTRACTOR shall make and bear the cost of all necessary arrangements and means for hauling the water. Water shall be furnished free of charge from the OWNER'S main, if available. Construction water, if delivered through a fire hydrant meter, shall be protected by a reduced pressure zone assembly provided at the CONTRACTOR's expense. All materials shall be made in USA. Contractor shall submit to OWNER proof that materials used are made in the USA.

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality.

Compaction of Bedding material by flooding will not be permitted.

606.1.A.1. Jointing: Jointing material shall be per Item 604 Water Pipes.

606.1.A.2. Pipe Bedding Stone: Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C-33 for stone quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 or Table 506.1.A.2.a. Pipe Bedding Stone Gradation:

Table 506.1.A.2.a. Pipe Bedding Stone Gradation:

Sieve Size	Percent Retained by Weight
1½"	0
1"	0-10
½"	40-85
No. 4	90-100
No. 8	95-100

606.1.A.3. Flexible Base: Flexible Base shall be per Item 403 Flexible Base. Base material shall not be allowed to be used within 6" of the pipe.

606.1.A.4. Bedding Sand: Sand for use as pipe bedding shall be clean, granular and homogeneous material composed mainly of mineral matter, free of mud, silt, clay lumps or clods, vegetation or debris. 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.

The resistivity shall not be less than 3000 ohms-cm as determined by TxDOT Test Method Tex-129-E. Size gradation of sand for bedding shall be per Table 506.1.A.4.a. Pipe Bedding Sand Gradation:

Table 606.1.A.4.a. Pipe Bedding Sand Gradation:

Sieve Size	Percent Retained by Weight
¼"	0
No. 60	75-100
No. 100	95-100

606.1.A.5. Pea Gravel: Pea gravel bedding shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C 33. Size gradation shall be per Table 506.1.A.5.a. Pipe Bedding Pea Gravel Gradation:

Table 606.1.A.5.a. Pipe Bedding Pea Gravel Gradation:

Sieve Size	Percent Retained by Weight
¾"	0
½"	0-25
¼"	90-100

606.1.A.6. Select Backfill: This material shall consist of borrow or suitable material excavated from the trench. It shall be free of stones or rocks over 6 inches and shall have a plasticity index of less than 20. The moisture content at the time of compaction shall be within 2 percent of optimum as determined by TxDOT Test Method Tex-114-E. Sandy loam borrow will not be allowed unless shown on the Drawings or authorized by the E/A.

All suitable materials from excavation operations not required for backfilling the trench may be placed in embankments, if applicable. All unsuitable materials that cannot be made suitable shall be considered surplus excavated materials. The Contractor may, if approved by the engineer, modify unsuitable materials to make them suitable for use. Modification may include drying, removal or crushing of over-size material, and lime or cement treatment.

606.1.A.7. Flowable Backfill: Flowable backfill shall consist of a mixture of native soils or manufactured materials, cement and/or fly ash, and water which produces a material with unconfined compressive strength of between 300-psi and 450-psi after 28-days. Any materials used shall be primarily granular, with a plasticity index <12 and with 100% passing a ¾-in. sieve. The flowable mixture shall be mixed in a pug mill, concrete mixer, or transit mixer and shall have a minimum slump of 5-in. The flowable mixture must be allowed to set prior to the placement of any overlying material.

606.1.A.8. Geotextile Filter Fabric for Pipe Bedding: Geotextile filter fabric for pipe bedding material shall be Hanes Geo Components - TerraTex NO4.5 (AOS US Standard Sieve 70) geotextile fabric or approved equal.

606.1.A.9. Bulkheads: The submittal requirements for this item shall include the type (wood, plastic, rubber, etc.) and application (pipe characteristics and location) of bulkheads. Plywood shall be construction grade, ¾ inch thick and need not be new or treated. End caps may be plastic, vitrified clay pipe, rubber or concrete.

606.1.A.10. Fittings: Fittings used with Pressure Pipe shall be AWWA C-110 Full-Body for all pipe sizes, or AWWA C-153 Short-body Ductile Iron Fittings for pipes 4-16 inches. The interior of all fittings and other accessories shall be kept free from dirt and foreign matter at all times and stored in a manner that will

protect them from damage. Interior surfaces or all iron water pipe fittings shall be lined with cement-mortar and seal coated as required by AWWA C-104.

Stockpiled materials shall be stacked so as to minimize entrance of foreign material. 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. PVC, cast iron and ductile iron fittings of the class indicated, furnished in accordance with these specifications will be, complete in place, according to scheduled weights for mechanical joint fittings furnished, including glands, bolts and gaskets. The class of fittings shall be consistent with the type of pipe with which the fittings are included, and shall include all necessary mechanical joints, restraining and / or harnessing hardware, as required and / or as noted on the plans.

606.1.B. Construction Methods

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.

The **pipe zone** is defined as including the pipe bedding, backfill to one-half the pipe diameter (to the spring line) and the initial backfill to 12 inches above the top of the pipe.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. Unless otherwise indicated, all materials shall be delivered to the project by the manufacturer or agent and unloaded as directed by the Contractor. Each piece shall be placed facing the proper direction near to where it will be installed. The interior of all pipes, fittings and other accessories shall be kept free from dirt and foreign matter at all times and stored in a manner that will protect them from damage. Stockpiled materials shall be stacked so as to minimize entrance of foreign matter. The interior of all pipeline components shall be clean, dry and unobstructed when installed.

Piping materials shall not be skidded or rolled against the pipe, etc. and under no circumstances shall pipe, fittings, or other accessories be dropped or jolted. During handling and placement, materials shall be carefully observed and inspected and any damaged, defective or unsound materials shall be marked, rejected and removed from the job site. Minor damage shall be marked and repaired in a manner satisfactory to the Engineer. Joints that have been placed but not joined, backfilled, etc., shall be protected in a manner satisfactory to the Engineer.

Pipe alignment shall be laid out in a manner that avoids 90° bends, or any bends larger than 45°, to the maximum extent possible. If a 90° bend is necessary, then it shall be substituted with a Tee, cap, and valve, size of which shall be match the largest size of the other connecting pipes.

606.1.B.1. Excavation: Trench excavation shall be to the lines and grades shown on the plans or Contract Documents or as required by the specifications for the line work to be installed therein. Excavation for structures shall be sufficient to accommodate forms, where required. Over depth excavation shall be avoided. All excavation, regardless of the materials encountered, shall be unclassified so far as payment is concerned. The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours or to make other adjustments to utility lines in order that the Contractor may proceed with his Work with a minimum delay.

Where excavation for a pipe line is required in an existing City street, a street cut permit is required and control of traffic shall be as indicated in accordance with the latest manual of the Texas Manual on Uniform Traffic Control Devices. Pavement shall be saw-cut on a straight line as directed per these specifications.

Unless otherwise indicated, all underground piped utilities shall be constructed in an open cut in accordance with applicable State Statutes with a trench width and depth described below. Required vertical sides shall be sheeted and braced as indicated to maintain the sides of the required vertical excavation throughout the construction period. Adequacy of the design of sheeting and bracing shall be the responsibility of the design professional. Contractor shall be responsible for installation as indicated. After the pipe has been laid and the backfill placed and compacted to 12 inches above the top of the pipe, any sheeting, shoring or bracing required may be removed with special care to insure that the pipe is not disturbed. As each piece of sheeting is removed, the space left by its removal must be thoroughly filled and compacted with suitable material and provisions made to prevent the sides of the trench from caving until the backfill has been completed. Any sheeting left in place will not be paid for and shall be considered subsidiary to the pipe item bid.

606.1.B.1.a. Excavation Methods: 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 Engineer 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 laid 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, inspected, repaired if necessary, and the earth backfill completed to a depth of two (2) feet unless ordered by the 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 Engineer shall be installed.

Excavate by open cut with trenching machine or backhoe. Do not use excavated material composed of large chunks or clods for backfill, but dispose of such material and provide other suitable material for backfill without additional expense. During excavation, pile material suitable for backfilling in an orderly manner far enough from the bank of the trench to avoid overloading, slides or cave-ins. Remove from site all excavated materials not required or suitable for backfill. Loading and transportation of waste material shall be included in contract price and no additional payment will be made. Grade as necessary to prevent surface water from flowing into trenches, or other excavations.

606.1.B.1.b. 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.

606.1.B.1.c. 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.

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 Engineer will direct the Contractor when and where to place washed gravel.

When rainfall runoff is occurring or is forecast by the U.S. Weather Service, the Contractor shall not perform or attempt any excavation or other earth moving work in or near the flood plain of any stream or watercourse or on slopes subject to erosion or runoff, unless given specific approval by the Engineer. When such conditions delay the work, an extension of time for working day contracts will be allowed in accordance with other sections of the Construction Documents.

606.1.B.2. Trench Excavation: Cut banks of pipe trench as nearly vertical as practical in the pipe zone without violating the requirements for the trench safety system. Remove stones as necessary to avoid point-

bearing. Over excavate wet or unstable soil from the trench bottom to permit construction of a more stable bed for pipe.

Dig the trench the proper width as shown. If the trench width below the top of pipe is wider than specified in this section or shown on the plans, then the Contractor shall install higher class of pipe and/or improved bedding as determined by the Engineer. No additional payment will be made.

Accurately grade the trench bottom to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except where necessary to excavate for bell holes and for proper sealing of pipe joints. Dig bell holes and depressions for joints after the trench bottom has been graded. Make bell holes and depressions for joints no deeper, longer or wider than needed to make the joint properly.

If any excavation is carried beyond the lines and grades required or authorized, the Contractor shall, at his own expense, fill such space with concrete or other suitable material as directed by the Engineer. No additional payment will be made.

The excavation of trench shall not advance more than 100-feet ahead of the completed pipe work except where specifically authorized by the Engineer, or as indicated on the construction drawings.

606.1.B.2.a. Trench Width: Trenches for Water and Wastewater up to 42 inches shall have a width of 1-foot on each side beyond the outside surfaces of the pipe. Pipes more than 42 inches shall have a trench width not to exceed 18-inches on each side beyond the outside surfaces of the pipe. Unless noted otherwise, the minimum depth below the pipe shall be 6-inches.

If trench width within the pipe zone exceeds this maximum, the entire pipe zone shall be refilled with approved backfill material, thoroughly compacted to a minimum of 95% of maximum density as determined by TxDOT Test Method Tex-114-E and then re-excavated to the proper grade and dimensions. Excavation along curves and bends shall be so oriented that the trench and pipe are approximately centered on the centerline of the curve; using short links of pipe and/or bend fittings if necessary.

606.1.B.2.b. Depth of Cover: All pipe and in-line appurtenances shall be laid to the grades indicated. The depth of cover shall be measured from the established finish grade, natural ground surface, subgrade for staged construction, street or other permanent surface to the top or uppermost projection of the pipe.

Piping installed in undisturbed ground and shall be laid with at least 36-in. of cover to natural grade or 48-in. minimum to top of pavement.

606.1.B.2.c. Sheet piling and Bracing: Install, in trenches and other excavations with vertical sides, sheet piling and bracing necessary to support the sides. Sheet piling and bracing shall be so installed as to place no undue or damaging strain on uncompleted work. Any damage resulting from settlement or lack of bracing shall be repaired by the Contractor at his own expense.

The sides of all trenches shall be securely held by bracing and sheet piling which may be removed in units when the level of backfilling has reached the elevation necessary to properly protect the work and adjacent property.

When sheet piling or shoring cannot be safely removed, it shall be left in place. Timber left in place shall be cut off at least 2 feet below the surface.

606.1.B.3. Conflicting Utilities: The Contractor shall conduct his work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of all existing utilities. If at any time the Contractor damages the utilities in place through his operations, the Contractor shall immediately notify the owner of the utility to make the necessary repairs. When active wastewater sewer lines are cut in the trenching operations, temporary flumes shall be provided

across the trench, while open and the lines shall be restored when the backfilling has progressed to the original bedding lines of the sewer so cut.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours or to make other adjustments to utility lines in order that the Contractor may proceed with his work with a minimum of delay and expense. The Contractor shall cooperate with all utility owners concerned in effecting any utility adjustments necessary and shall not hold the City liable for any expense due to delay or additional work because of conflicts arising from existing utilities.

The Contractor shall do all trenching in accordance with the provisions and the directions of the Engineer to the amount of trench left unfilled at any time. All excavation and backfilling shall be accomplished as indicated and in compliance with requirements of OSHA.

Wherever existing utility branch connections, sewers, drains, conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impractical, a deviation from line and grade will be ordered by the Engineer and the change shall be made in the manner directed. 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.

When the Contractor installs a pipe that crosses under a utility or storm sewer structure and the top of the pipe is within 12 inches of the bottom of the structure, the pipe shall be backfilled as shown in the Drawings. When the Contractor installs a pipe that crosses under a utility or storm sewer structure that is not shown in the Drawings, the pipe shall be backfilled as directed by the Engineer. Payment for backfilling pipe at utility or storm sewer structures not shown in the Drawings shall be by Change Order.

606.1.B.3.a. Utility Separation: If not indicated on the drawings, where feasible, water and wastewater lines shall be no closer to each other than 9 feet between outside diameters in all directions and shall be in separate trenches. If the 9 foot separation cannot be achieved, any portion of a new gravity wastewater line within 9 feet in any direction (between OD's) of a potable water line, shall be in a separate trench and constructed of ductile iron, AWWA C -900 (SDR-18) 150 PSI rated PVC in sizes 12 inch, or AWWA C-905 (SDR-25) 165 PSI rated PVC in sizes larger than 12 inches.

If the lines are parallel, they shall not be closer than 4 feet horizontally or 2 feet vertically between OD's with the wastewater lower than the water line. If the lines cross, they may be no closer than 6 inches vertically between OD's with the sewer below the water line and one standard 20 foot length of ductile iron, AWWA C -900 (SDR-18) 150 PSI rated PVC in sizes to 12 inch, or AWWA C -905 (SQR-25) 165 PSI rated PVC in sizes larger than 12 inches shall be centered at the point of crossing the water line.

Unless wastewater manholes and the connection to the sewer can be made completely watertight and tested for no leakage, they must be installed so as to provide a minimum of 9 feet of horizontal clearance from an existing or proposed water line.

No water pipe or appurtenance shall be closer than 3' horizontally, and 1' vertically, from any other utility, including drainage, electrical, or any other franchise utility. No other utility, except another water line, shall be allowed in the same trench as the water main, or appurtenance installed. All franchise utilities (including electrical) shall be installed on the opposite side of the roadway from the location of the water main.

606.1.B.3.b. Utility Staking: CONTRACTOR shall locate and mark all underground facilities within the project area that may cross or be in conflict with the installation of the proposed waterline(s). Sanitary sewer facilities will be located both horizontally and vertically to the extent that confirmation of the separation requirements specified by the Texas Commission on Environmental Quality (TCEQ) can be obtained. Leak tests will be required to determine the extent of required sanitary line replacements and adjustments that

may be required to provide for crossing the proposed waterline above or beneath sanitary lines. No separate measurement or payment will be allowed for staking and marking the proposed and existing alignment(s).

Immediately upon completion of staking and marking the proposed waterline alignment, the Contractor shall comply with the Texas One-Call Notification System and have all underground facilities in the project area plainly marked with temporary paint or stakes. Immediately after the underground facilities have been marked, the Contractor, using the services of an RPLS, shall determine the horizontal location of all marked facilities that are within 15 feet of the proposed waterline alignment and plot those locations on the plan and profile drawings of the construction drawings. The Contractor shall deliver to the Engineer all field notes and a clear legible listing of all marked facility locations in the same coordinate system as used in the construction drawings.

The Engineer will evaluate potential conflicts between existing facilities and the proposed waterline, as well as the separation between existing sanitary sewer facilities and the proposed waterline alignment. The Engineer, at his discretion, may require the Contractor to pothole specific points on any of the potentially conflicting underground facilities to accurately confirm the horizontal and vertical location of potential conflict points. For each potholed location, the Contractor, using the services of an RPLS, shall precisely locate (horizontally and vertically) the requested facility and submit the horizontal and vertical coordinates of the exposed facility to the Engineer for his use. This item shall be considered subsidiary to pipe construction.

606.1.B.3.c. Conflict Evaluation: CONTRACTOR shall physically locate all sanitary sewer mains, laterals, and service lines that cross the proposed waterline alignment. For each sanitary sewer crossing so located, the contractor is required to adhere to the following procedure:

- (1) First, determine whether the sanitary line to be crossed is a pressure line or gravity flow line and determine the type of pipe used for the sanitary line.
- (2) Second, test the sanitary line for leaks as detailed in the following section(s), and report the results to the Engineer. If the leakage test cannot be performed, or if the Engineer cannot determine that the sanitary line is free from leaks, the Contractor shall replace a minimum length of 18 feet of the crossed sanitary sewer line with an equivalent diameter pressure line with a minimum pressure rating of 150 psi. Any joints and / or connections must be at least 9 feet in either direction (measured perpendicularly from the proposed waterline) from the crossing point. Replacement of the sanitary line will be included as a separate pay item.
- (3) Third, the minimum installed clearance of the proposed waterline shall be Per Section for "Utility Separation." If the proposed waterline can be installed to the appropriate minimum clearance as noted above with a minimum of 36 inches of cover, then the proposed waterline should be installed at the appropriate clearance with a minimum length 18 foot joint of waterline pipe centered above the point of crossing and all joints at least 9 feet away (measured perpendicularly from the sanitary line) from the point of crossing. If the sanitary line to be crossed is a pressurized line, the pressurized sanitary line may be adjusted to cross beneath the proposed waterline as shown in the Contract Documents. Replacement of the sanitary line, if required because of leaks, should be combined with any adjustments or realignments necessary to provide adequate crossing clearance, and only one pay item will be allowed for each replacement and / or adjustment.
- (4) Fourth, if the minimum clearances for crossing above the sanitary line cannot be achieved, then the proposed waterline shall be installed to cross beneath the sanitary line with a minimum clearance of at least one foot measured from outside edges of pipes. The proposed waterline shall consist of ductile iron pipe with mechanical joints for a minimum distance of at least 9 feet each side of the crossing point (measured perpendicularly from the sanitary sewer line) as shown in the Contract Documents. Adjustment of the proposed waterline to cross beneath the sanitary sewer line will be included as a separate pay item.

606.1.B.3.d. Testing Wastewater Facilities: For any and all sanitary sewer mains, laterals, or service lines that may cross the proposed waterline alignment the Contractor shall test the conflicting section of sanitary sewer for leaks, and report the results to the Engineer. The tests shall be as specified in AWWA C600 standards. For any and all marked sanitary sewer lines that parallel the proposed waterline alignment and that may be closer to the proposed waterline than allowed by current TCEQ criteria, the Engineer may require the Contractor to test the conflicting section of sanitary sewer for leaks, and report the results to the Engineer. The tests shall be as specified in Sections below or Item for Wastewater.

606.1.B.3.e. Replacing Existing Wastewater Facilities: If tested sanitary sewer facilities cannot be certified to be free from leaks, the Engineer may, at his discretion, require that a portion of the leaking sanitary sewer facility be replaced. The replaced line(s) shall comply with current standards and specifications, and shall conform to the appropriate Contract Documents. Replaced sections of sanitary sewer lines shall pass a pressure and leakage test as specified in AWWA C600 standards. Any section of new sanitary sewer line failing to pass the test shall be replaced with no provision for additional payment.

The tests required for newly installed sections of sanitary sewer line shall be considered subsidiary to the appropriate line replacement, and no separate measurement or payment will be made for such tests.

606.1.B.3.f. Alignment Revision: Within 5 days of receipt of field notes, locations of marked facilities, and test results, the Engineer will recommend any necessary changes to the proposed waterline alignment that may be necessary to avoid underground conflicts and transmit those recommended revisions to the Contractor. The Engineer, at his sole discretion, may direct the Contractor, in writing, to construct the proposed water line to the revised alignment without additional compensation except for appropriate revisions to bid quantities as measured in the field. The Contractor will not be allowed additional costs for revising the proposed water line alignment, unless those additional costs can be completely substantiated and are agreed on and accepted by the Engineer. Within 3 days of receipt of the Engineer's instructions, and before beginning any work on the revised alignment, the Contractor shall advise the Engineer, in writing, of any objections or possible additional cost items that may accrue due to the change in alignment. The Engineer may elect to negotiate and / or accept the revised costs and direct the Contractor to construct the proposed water line to the new alignment, or at his discretion, the Engineer may direct the Contractor to ignore the revised alignment and proceed according to the original alignment. The Contractor's failure to notify the Engineer of any objections, or additional cost requests as described above will constitute the Contractor's acceptance of the revised alignment, based on revised quantities as measured in the field with full payment based on the original contract amount prior to any revisions.

No separate measurement or payment will be allowed for this item except for adjustments of bid quantities as measured in the field, and other costs specifically agreed to and accepted by the Engineer.

606.1.B.4. Bedding: Bedding shall be used where rock is encountered in the trench or when directed by the Engineer. Bedding shall be 6" thick min. measured from any point of natural ground including rock projections to any point on the conduit. (e.g. pipe bell or fitting). Bedding shall be compacted and brought to grade prior to laying pipe. Mounds or blocking pipe to achieve grade is prohibited. Place bedding material evenly and carefully in layers no thicker than 6 inches. Compact with mechanical vibratory tampers, to 95 percent of maximum density, as determined by TxDOT Test Method TX-113/114.

In areas where the excavation in the embedment zone encounters material other than rock (as determined by the Engineer), filter fabric shall be placed prior to bedding placement and extend up the trench an adequate distance to completely wrap the embedment zone with a 6" overlap seam along the top center of the embedment.

606.1.B.4.a. Ground Water Bedding: 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 Engineer will direct the Contractor when and where to place washed gravel.

606.1.B.4.b. Particle Migration: Bedding material shall be compatible with the materials in the trench bottom, walls and backfill so that particle migration from, into or through the bedding is minimized. The following limitations shall apply:

- (1) Sand, alone, shall not be used in watercourses, in trenches where groundwater is present, or in trenches with grades greater than 5 percent.
- (2) Pea gravel or bedding stone, alone, shall not be used in the street right-of-way within 5 feet of subgrade elevation in trenches that are 3 feet or wider.
- (3) Each gravel or bedding stone, alone, shall not be used where the trench bottom, sides, or backfill is composed of non -cementitious, silty or sandy soils having plasticity indices less than 20, as determined by the Engineer.

606.1.B.5. Embedment: Embedment shall be placed in equal lifts along the side of the pipe to prevent lateral displacement and shovel sliced back under the pipe haunch uniformly along both sides.

In the pipe zone, place bedding material evenly and carefully around and over pipe in layers no thicker than 6 inches. Compact with mechanical vibratory tampers to 95 percent of maximum density, as determined by TxDOT Test Method TX-113/114, until there is a cover of not less than 1 foot over utility lines. Take special care not to damage pipe wrapping or coating. In no case should compaction equipment be allowed to contact pipe.

In areas, where the excavation in the pipe zone encounters material other than rock (as determined by the Engineer), filter fabric shall completely wrap the pipe zone with a 6" overlap seam along the top center of the embedment.

In rock excavations, after placement of embedment and prior to backfilling, filter fabric shall be placed over the embedment. Filter fabric width shall be slightly wider than the trench width at the elevation of placement. Longitudinal splices shall be lapped at least 1' and taped.

606.1.B.6. Backfill: Backfill shall be either Select Backfill or Common Backfill. Select Backfill only shall be placed in Streets and Drives. In all other areas either Select Backfill or Common Backfill may be used. Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the Engineer and shall become the property of the Contractor to dispose of on site or at a permitted fill site, without injury to any individual. Such surplus material shall be removed from the work site promptly following the completion of the portion of the utility involved.

Within the 100-year flood plain, sand will not be permitted for backfilling.

606.1.B.6.a. Select Backfill: Beneath streets or other areas to be paved, Select Backfill shall be used for the total depth immediately below the base material and above the select bedding material. Select Backfill shall be of generally granular type material such as base material, road gravel, sand or sandy gravel, free of trash and spongy or otherwise objectionable material (approved by the Engineer) and shall have a Plasticity Index of not more than twenty (20). 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 contain rock, and no more than ten (10) percent shall be as large as six (6) inches. Not more than twenty-five (25) percent shall be clay or clay lumps.

Above the pipe zone, select backfill soil material shall be deposited in 8-inch layers. Each layer shall be compacted to 95 percent of maximum density as determined by TxDOT Test Method TX-113/114. Density tests shall be performed at a rate of one test per lift per 300-ft of trench. During testing the entire length of the lift shall be exposed (i.e. no benching or slope cut for testing multiple lifts). Place compacted fill material to bottom of the pavement section. At the contractor's option, flowable fill may be used in lieu of density testing requirements for select backfill at the contractor's expense. A design submittal must be approved by the Engineer if the contractor elects to use flowable fill.

606.1.B.6.b. Common Backfill: In areas outside of streets and drives, trench backfill above select bedding material may be accomplished with the use of excavated material if the material is suitable for compaction and contains only an occasional rock no more than five (5) inches in its greatest dimension.

- (1) Above the pipe zone, deposit common backfill in 8-inch loose lifts. Compact each layer to 90 percent of maximum density as determined by TxDOT Test Method TX-113/114.
- (2) All forms, lumber, trash and debris shall be removed from manholes and other structures. Backfill shall be placed symmetrically on all sides in layers no thicker than 8 inches. Each layer shall be compacted to 90 percent of maximum density as determined by TxDOT Test Method TX-113/114. Density tests shall be performed at a rate of one test per lift per 500-ft of trench.

606.1.B.7. Pavement Repair: Existing pavement shall be precut, sawed or scored so as to result in an even, 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 material shall then be replaced in three (3) inch layers tamped in place. Replaced base material shall comply with Item for Flexible Base, and in no case be less than 8 inches thick. 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. Removal of excess surfacing beyond the nominal limits of the ditch shall be kept to a minimum, and such areas shall be outlined with straight saw-cuts and included in areas to be repaired as described above. Base material shall be compacted to ninety-five (95) percent of maximum density as determined by TxDOT Test Method TX-113/114. The replaced surface course shall be in conformance with Item for Hot Mix Asphaltic Concrete.

In all paved streets the trench shall be finished in a workmanlike manner consistent 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.

606.1.B.8. Pipe Connections: Where installation of proposed pipes joins existing pipe facilities, the Contractor shall be required to locate, expose, and prepare the ends of existing facilities in an acceptable manner to allow connection of the proposed facilities to provide an overall functioning system with no breaks, leaks or unacceptably rough joints. If necessary, the Contractor shall remove existing pipe bulkheads, replace existing pipe stubs, and / or cut connections into existing as required to make an acceptable connection. The Contractor shall be required to remove any temporary bulkheads, blockages, plugs that were previously put in place to serve temporarily until the proposed facilities in the current project were to be completed. To minimize any inconvenience from outages, the Contractor shall schedule all such connections in advance and such schedule must be approved by the OWNER before beginning any Work.

606.1.B.8.a. Bends: When horizontal or vertical angles in the alignment of pipes are indicated, the bend or angle shall be done using fittings and Megalugs. All pipes 4" in diameter and larger shall be fully restrained with Megalug Restraining Glands at all locations where crossing paved surfaces. In addition, pipe shall be restrained with Megalug Restraining Glands for one full joint of pipe, or to the next bend or fitting requiring restraint beyond the edge of pavement. Angular spacing of all joints shall meet the manufacturer's recommendations for the pipe and accessories being used. Pipe end bells shall be placed upgrade for all wastewater lines.

606.1.B.8.b. Bulkheads: After installation of the utility requiring temporary bulkheads, an end cap or a section of plywood, having dimensions at least 6 inches in excess of the outside pipe diameter shall be attached to the exposed bell or spigot and backfilled immediately after installation. Care shall be exercised to prevent the backfill material from entering the pipe. Bulkheads used with staged construction shall be sound, reasonably free of knots and warps and have a 3 inch minimum nominal thickness.

606.1.B.8.c. Push-on Joints: Just before making a joint, the bell and spigot rings shall be clean and dry. 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 and brought into true alignment. It shall be secured there with bedding material that is carefully tamped under and on each side of the pipe. Care should be taken to prevent dirt or foreign matter from entering the joint space.

606.1.B.8.d. Shop and Field Fabricated Connections: Shop or field fabricated wyes, tees, crosses or bends shall be furnished and installed where indicated or required by the Engineer. Fittings for PVC and DI pipe, shall be shop fabricated. Fittings for HDPE pipe, which is 24-in. in diameter and increasingly larger, may be field fabricated. Care shall be taken in the fabrication that the concrete walls of the pipe are broken back only enough to provide the required finishing opening. The reinforcing mesh or bars in each pipe shall be joined by bending, twisting or spot welding, which shall provide a rigid connection. Concrete or mortar meeting the requirements of Item for Portland Cement Concrete Pavement or Item for Concrete Structures shall be wiped over the reinforcing wires connecting the two-pipe joints, compacted by light blows, shaped to the contour of the pipe barrels, lightly brushed for finish and cured under wet burlap.

606.1.B.8.e. Pipe Laying: No pipe shall be installed in the trench until excavation has been completed, the bottom of the trench graded and the trench completed as indicated. All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. Unless otherwise indicated, all materials shall be delivered to the project by the manufacturer or agent and unloaded as directed by the Contractor. Each piece shall be placed facing the proper direction near to where it will be installed. The interior of all pipeline components shall be clean, dry and unobstructed when installed.

606.1.B.8.f. Pipe Assembly: Angular spacing of all joints shall meet the manufacturer's recommendations for the pipe and accessories being used. Side outlets shall be rotated so that the operating stems of valves shall be vertical when the valves are installed. Pressure pipe shall be laid with bell ends facing the direction of pipe installation. Pipe end bells shall be placed upgrade for all wastewater lines. 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.

606.1.B.8.g. System Shut-offs: The OWNER will make all shutoffs on existing water mains. The Contractor shall be required to notify the OWNER's field representative on the job at least 72 hours prior to the desired time for any shutoff. The field representative will notify any affected utility customers at least 24 hours prior to the shutoff. The OWNER will make the shutoff after ensuring that all appropriate measures have been taken to protect the water system, customers and employees. The OWNER will operate all valves to fill existing mains. Where a newly constructed main has not been placed in service and has only one connection to the public water supply, the Contractor may operate one valve to fill the main after approval has been obtained. The operation of the valve is to be conducted under the immediate supervision of the OWNER's field representative. Water for the Work shall be metered and meter shall be furnished by the Contractor.

606.1.B.9. Thrust Blocking: Pressure pipeline tees, plugs, caps and bends 22-1/2° and larger for pipes less than 24-in Dia.; other bends as directed by the OWNER shall be securely anchored by suitable concrete thrust blocking or by approved metal harness. Unless otherwise indicated, on 24 inch or larger piping, all bends greater than 11-1/4° shall be anchored as described herein. Thrust blocking as described herein including all labor and materials shall be considered subsidiary to pipe installation.

The concrete shall conform to Item for Concrete Structures.

606.1.B.9.a. Concrete Thrust Blocking: 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 OWNER. The blocking shall, unless otherwise indicated, be so placed that the pipe, fittings and joints will be accessible for repair. 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. 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.

All areas receiving concrete thrust blocking shall be wrapped with 8-mil (minimum) polyethylene film as indicated under section for "Protective Covering."

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 and/or standard details and shall be sufficient to withstand the thrust, including water hammer

606.1.B.9.b. Mechanical Joint Restraint: Mechanical joint restraint (MJ) may be used on ductile iron or PVC pipe. Installation shall follow manufacturer's recommendations. Restraining mechanisms for PVC pipe and fittings shall be tested and pressure rated in accordance with ASTM F1674 Standard Test Method for Joint Restraint Products for Use with PVC Pipe. Fabricated thrust restraint systems such as those described below may be approved for use instead of 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. Such restraint systems may only be used where and as specifically detailed and scheduled on approved Drawings.

- (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 above. Location, configuration and description of such products shall be specifically detailed on the Plans. (Add -on attachments such as retainer glands, all-thread rods, etc., are not acceptable.)

606.1.B.9.c. Concrete Encasement, Cradles, Caps and Seals: 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 the OWNER who in turn may require Contractor to install a concrete seal, cradle, cap, encasement or other appropriate action. 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 the Standard Details. The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

606.1.B.9.d. 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.

606.1.B.10. Service Taps: Service taps as shown in Contract Documents shall be located and installed as directed by the OWNER, in the field. Existing water meters may be relocated and reconnected as needed. The Contractor shall replace all existing meters and associated facilities that may be damaged during the relocation at his sole expense. In locations where installation of multiple services is called out, refer to the Contract Documents for multiple service installations. Measurement and payment shall be per each for each installation.

606.1.B.10.a. Meter Box Relocation: Relocation of existing water meter boxes shall be done as shown on the construction plans. CONTRACTOR shall reconnect the newly relocated meter box to the existing water system or the proposed water system, as called out in the plans or Unit Price Schedule and provide a complete service installation for water service.

606.1.B.10.b. Sampling Taps: The Contractor shall provide Permanent Sampling Taps (or other suitable fixtures) at intervals not exceeding 1,000 feet along the proposed water line or pressure wastewater line, with prior approval from the OWNER. Where necessary, the Contractor shall be required to make provisions for Permanent Sampling Taps for future bacteriological testing. Permanent Sampling Taps shall consist of wet taps and shall be constructed using a tapping saddle and corporation stop with meter box. Permanent Sampling Taps shall be clearly marked on the ground with a blue painted PVC riser and indicated in the as-built drawings. Sampling taps shall be located outside of paved surfaces and be sufficiently protected from traffic and other potential damage to the Engineer's satisfaction. The Contractor shall be responsible for submitting the proposed sampling tap size, location, and configuration to the Engineer for approval prior to installation.

606.1.B.10.c. Service Connections: Service connection taps into PVC, AC pipe, CI, or DI pipe 12 inches or smaller shall be made using either a service clamp or saddle or a tapping sleeve as recommended by the pipe manufacturer and as approved by the OWNER. Direct tapping of these pipes will not be permitted. All water service connections shall be installed so that the outlet is at an angle of not more than 45° above horizontal at the main line.

Tapping shall be performed with a sharp shell type cutter so designed that it will smoothly penetrate heavy walled PVC DR-14 and 200-PSI AC and will retain and extract the coupon from the pipe. Precautions should be taken to ensure that the tapping saddle or sleeve is placed on the pipe straight to prevent any binding or deformation of the PVC pipe. The mounting chain or U -bolt strap must be tight. The Contract price for service connections shall be considered subsidiary to Item for Service Tap.

Short single services less than 50-ft shall be a minimum of one (1) inch and short double services a minimum of two (2) inches. Long single services over 50-ft in length shall be a minimum of two (2) inch from main to 2"x1" brass 90° bend and one (1) inch from 90° bend to meter. Long double services shall be a minimum of two (2) inch from main to 2"x1" brass tee and one (1) inch from tee to each meter. Long service lines shall have a valve and box at the tap. Valve to have square nut adapter installed. No male adapters shall be allowed. Short service lines shall have a maximum of one (1) bell between the tap and the meter. All service lines should be belled and should not have any couplings used for connecting pipe segments.

606.1.B.10.d. Wet Connections: The Contractor shall make all wet connections called for by the Contract or required to complete the Work. A wet connection shall include draining and cutting into existing piping and connecting a new pipeline or other extension into the existing pressure piping, forming an addition to the water transmission and distribution network. No water containing detectable amounts of chlorine may be drained, released or discharged until specific planning and appropriate preparations to handle, dilute and dispose of such chlorinated water are approved in advance by the OWNER and the disposal operations will be witnessed by an authorized representative.

The Contract price for wet connections shall be considered subsidiary to Item for Service Tap and shall be full payment for all necessary shutoffs, excavation, removing plugs and fittings, pumping water to drain the lines, cutting in new fittings, blocking and anchoring piping, bedding and backfilling, placing the lines and service and all site cleanup.

606.1.B.10.e. Pressure Taps: The Contractor shall make all pressure taps called for by the Drawings as required to complete the Work. A pressure tap shall consist of connecting new piping to the existing water system by drilling into the existing pipe while it is carrying water under normal pressure without taking the existing piping out of service. The Contractor shall, at his expense; perform all necessary excavation, furnish and install the tapping sleeve, valve and accessories, provide the tapping machine, drill the tap and shall block, anchor and backfill the piping, valve and all accessories, place the new piping in service and perform all site cleanup.

All tapping sleeves shall be constructed of stainless steel full circle gasket and sleeve (wrap-around), either Smith - Blair #663 (formally Rockwell) or the Romac SST model. If a private Contractor makes the tap, an

OWNER's Inspector must be present. "Size on size" taps will not be permitted, unless made by use of an approved full circle gasket stainless steel tapping sleeve. Concrete blocking and plastic cover shall be placed behind and under all tapping sleeves 24 hours prior to making the wet tap.

606.1.B.11. Testing and Disinfecting: After the pipe has been installed and backfilled and all services laterals, fire hydrants, valves, and other appurtenances installed and connected, a pressure test, followed by a leakage test, which will then be followed by a system sterilization and Bacteriological Testing. Such test and samples shall be done according to Item for Water Installation.

606.1.B.12. Hydrostatic Testing: After the pipe has been installed and backfilled and all services laterals, fire hydrants and other appurtenances installed and connected, a pressure test, followed by a leakage test, will be conducted by the Contractor. The Contractor will furnish the pump and gauges for the tests. The specified test pressures will be based on the elevation of the lowest point of the line or section under test. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points.

606.1.B.12. a. Pressure Testing: The entire project, or each valved section, shall be tested at a pressure of 200-psi for a sufficient period (minimum 10 minutes) to discover all leaking or defective materials. Repairs shall be made by the Contractor to correct any leaking or defective materials.

606.1.B.12.b. Leakage Testing: A leakage test will follow the pressure test and be conducted on the entire project or each valved section. The leakage test shall be at 150-psi for at least 4 hours. All service taps and tubing shall be tested up to the angle stop.

Leakage shall be defined as the quantity of water that must be supplied into any test section of pipe to maintain the specified leakage test pressure (see above, "Pressure Pipe Leakage Test") after the air in the pipeline has been expelled and the pipe has been filled with water. The allowable leakage shall comply with AWWA C-600, which defines the allowable leakage as:

$$\text{For Iron Pipe: } L = \frac{\sqrt{SDP}}{148,000} \qquad \text{For Other Pipes: } L = \frac{\sqrt{SDP}}{133,200}$$

Where:

L= Leakage in gallons per hour

S= Length of pipe in feet

D= Pipe Diameter (inside) in inches

P= Pressure in pounds per square inch

If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the indicated allowance.

606.1.B.12.c. Service Charges for Testing: Charges may be required of the Contractor for the regulatory authority's assistance, inspection, etc., when the test results show that leakage is within the indicated allowable units.

If available, the OWNER will provide three times the volume of water in the mains for the purpose of flushing and testing. Water usage over this amount shall be payable by the Contractor at the City's effective bulk rate.

606.1.B.13. Disinfection: The Contractor shall protect all piping materials from contamination during storage, handling and installation. All openings in the pipe shall be closed with watertight plugs when laying pipe is stopped at the close of the day's work. Prior to disinfection, the pipeline interior shall be clean, dry and unobstructed. All dirt, debris, gasket lubrication, etc., shall be washed from the line by swabbing with a sodium hypochlorite solution and/or flushing with clean water.

The Contractor, at his expense, will supply the test gauges and the concentrated disinfecting material and the regulatory authority will supervise and direct the overall sterilization procedure. The Contractor, at his expense, shall provide all other equipment, supplies and the necessary labor to perform the sterilization under general supervision of the regulatory authority.

All valves shall be arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The new pipeline shall then be completely filled with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such proportions that every part of the line has minimum concentration of 50 parts per million (50 ppm or 50 mg/liter) available chlorine.

Unless otherwise indicated, all quantities called for herein refer to measurements by the testing procedures in the current edition of "Standards Methods." The chlorine concentration of each step in the sterilization procedure shall be verified by chlorine residual determinations. This disinfecting solution shall be retained in the piping for at least 24 hours and all valves, hydrants, etc., shall be operated to disinfect all their parts. After this retention period, the water shall contain no less than 25-ppm chlorine throughout the treated section of the pipeline.

This heavily chlorinated water shall then be carefully flushed from the line until the chlorine concentration is no higher than the residual generally prevailing in the existing distribution system or approximately one part per million. Proper planning and appropriate preparations to handle, dilute, and dispose of this strong chlorine solution without causing injury or damage to the public, the water system or the environment must be approved by the regulatory authority before flushing of the line may begin and the flushing shall be witnessed by an authorized representative of the regulatory authority.

After final flushing of the strong disinfecting solution, water samples from the line shall be tested for bacteriological quality by the regulatory authority and must be found free of coliform organisms before the pipeline may be placed in service. One test sample shall be drawn from the end of the main and additional samples collected at intervals of not more than 1,000 feet along the pipeline.

The Contractor, at his expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

Samples for bacteriological analysis shall be collected only from suitable sampling taps in sterile bottles treated with sodium thiosulfate. Samples shall not be drawn from hoses, fire hydrants, etc. The Contractor, at his expense, shall furnish the sterile sample bottles and may, at his discretion, collect the test samples with regulatory authority personnel.

If the initial disinfection fails to produce acceptable sample tests, the disinfection procedure shall be repeated (without extra compensation) until satisfactory test results have been obtained before the piping may be placed in service.

606.1.B.14. Field Investigation: This item shall consist of potholing and / or excavating at critical points as shown on the construction drawings to expose underground facilities that may pose a conflict to the proposed construction, or to provide more information on types, sizes, and other data for underground facilities. When required by field conditions, the exposed area may need to be protected by plating, temporary traffic control measures, or any other measures necessary to protect the public from open excavations.

606.1.B.14.a. Sequencing: Specific requirements for each critical point shall be shown on the construction drawings. Specific facilities to be located shall also be shown on the plans. The Contractor shall be required to perform the investigation by excavating and exposing the specified underground facilities before beginning installation of any proposed facilities that may be in conflict, and as early as feasibly possible during

the overall project schedule. Upon completion of the excavation at the critical point, the Contractor shall notify the Engineer, who shall make site visits as necessary to determine the location, size, orientation, and any other items needed for the Engineer to properly evaluate the potential conflict or proposed installation.

The minimum size of excavation required at each critical point shall be large enough and deep enough to allow the installation and / or relocation of any proposed facilities to be constructed in the area. At the critical point, the Contractor shall excavate sufficiently to provide clearance around and under all underground facilities as needed to allow the Engineer to determine by visual means and by normal means of field measurements whether the proposed construction may be in conflict, and what measures may be required to avoid such potential conflicts, and to obtain any other information required by the Engineer. The Contractor shall cooperate with and assist the Engineer in taking any required field measurements, and all tools, equipment, and personnel required for such measurements shall be furnished by the Contractor.

The Contractor shall provide the services of an RPLS to accurately locate exposed items within a particular critical point. Such services will be provided at the Contractor's sole expense.

Within 5 business days after receiving notice from the Contractor that excavation has been completed at a specific critical point, the Engineer shall complete his field assessments and shall notify the Contractor that the Engineer's field assessments are completed. After receiving such notification, the Contractor may fill the excavation and remove all temporary traffic control and safety devices; or, if the open excavation is outside normal traffic lanes, the Contractor may leave the excavation open and leave all temporary traffic control and safety devices in place until completion of the proposed construction operations at that point.

606.1.B.14.b. Construction Methods: The Contractor shall be required to use non-destructive means of excavation to locate and expose all required items at each critical point. Such means of excavation include, but are not limited to: vacuum trucks, hand excavation, and combinations of hand and machine excavation with probes as required. The Contractor shall be fully responsible for any damage to existing facilities within the area of the critical point, and shall fully restore all facilities within the area to at least the condition existing before the beginning of the Contractor's operations. For all excavations within traffic areas that are left open after normal working hours, plate covers shall be installed that are firmly anchored to cover all open areas and shall be capable of supporting a normal H2O load.

606.1.C. Measurement and Payment

If and only if a specific pay item is included in the bid form for any of the pay items listed below, the installed items shall be measured as noted below and the Contractor shall be paid for each item as noted in the contract documents; otherwise, all items under this Section shall be considered subsidiary to the facility being installed in the trench referenced by this Section. In most cases this item shall be paid under Item for Water Pipes. When a bid item is included for the work under this section, trench shall be measured by the linear foot (LF) for the trench width and depth required for installation of the pipe in accordance with the elevations indicated graphically and appropriate detail as specified in the construction documents.

The work performed and materials furnished as prescribed by this Section and measured as provided under "Measurement" will be paid under the following item if and only if this item is included as a pay item on the bid form; otherwise, all work under this Section shall be subsidiary to the pay item for the facility to be installed in the trench referenced by this Section.

If included in the bid form the **fittings** shall be paid per each (EA) installed in place including Megalugs, Megalug toolset, equipment, labor, and all incidentals to make the connection to the pipe. If not included in the bid tab, payment for fitting and associated accessories shall be considered subsidiary to the item for pipe installation.

Unless specifically included as a bid item, **connections of existing or proposed waterlines** to other existing or proposed waterlines, or capping or plugging of existing waterlines shall not be paid separately. All such connections, fittings, adapters, caps, and plugs shall be considered subsidiary to the installation of pipe.

If included in the bid form existing sections of pipe, and associated fittings, shown to be **abandoned or removed and disposed** of shall be measured and paid by the linear foot (LF). All salvageable fittings shall become the property of the Owner. When shown in the plans, ends of abandoned lines may require caps or plugs. All such caps and plugs, along with any required thrust blocking, will be installed as shown and will be subsidiary to the removal of the associated existing pipe.

If included in the bid form the **service taps** shall be paid per each (EA) installed in place. Measurement shall include locating service line, installing new line, tap and saddle, excavation and backfill, new valve, and all other miscellaneous items needed for the service connection whether the connection is considered a wet connection or not.

If included in the bid form the **Relocation of Meter Box** shall be paid per each (EA) relocated and installed in place. Measurement shall include locating service line, and all additional pipe, labor, and incidentals required to connect the relocated meter box to the existing or to the proposed system as specified.

If included in the bid form the **Utility Staking** will be measured and paid per lump sum basis (LS), with the entire project requirements consisting of one item. If the Contractor elects to perform this task in multiple sections, as described above, payment of the lump sum amount may be prorated as agreed between the Engineer and Contractor. If not included in the bid tab, this item shall be considered subsidiary to pipe installation.

If included in the bid form the **Testing Wastewater Facilities** for Leaks shall be measured and paid per each (EA) basis with each test consisting of one item. Separate measurement and payment will be made for each test of existing sanitary facilities as specifically required by the Engineer. If not included in the bid tab, this item shall be considered subsidiary to pipe installation. No separate measurement or payment will be made for tests of sections of sanitary sewer facilities that are replaced. All costs for testing for these replaced sections shall be included in the appropriate item for wastewater line replacement.

If included in the bid form the **Replacing Existing Wastewater Facilities** shall be measured per linear foot (LF) of installed line, as measured in the field. Any cost of connections to existing lines at each end of the replaced section shall be included in the total cost of each replacement and will not be measured or paid separately. Separate pay items for assorted pipe sizes and for replacement of pressurized lines and replacement of non-pressurized lines are provided. If not included in the bid tab, this item shall be considered subsidiary to pipe installation.

If included in the bid form the **Alignment Revision** as required to cross beneath sanitary sewer lines shall be measured and paid per each (EA), with each adjustment paid as one unit. Pipe, fittings, bends, trench safety, and other items will be paid separately. If not included in the bid tab, this item shall be considered subsidiary to pipe installation.

If included in the bid form the **Field Investigation** shall be measured and paid per Lump Sum (LS), measurement of which shall include temporary traffic control, trench safety, fencing, survey. Payment shall be full compensation for all excavation, backfill, equipment, labor, supervision, materials, temporary traffic control, safety measures, measurement, tools, surveying, and all incidentals necessary to accomplish the complete task. Payment for each critical point shall be measured as described above and paid under the item below. Critical points that are similar in the effort required may be grouped together in a single pay item; individual pay items may be included for each critical point that is expected to be unique in the effort required. If not included in the bid tab, this item shall be considered subsidiary to pipe installation.

606.2 TRENCH SAFETY SYSTEMS

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.

606.2.A. Materials

The Contractor shall immediately notify the Engineer if, in the Contractor's opinion, additional trench safety protection is required in areas where not shown on the plans or not listed in the Unit Price Schedule. The Contractor shall be responsible for applying all such additional protection that may be required, and if, in the opinion of the Engineer, the additional protection is warranted, pay quantities shall be adjusted according to the terms of the contract, provided that such adjustments are allowed under the contract. Refer to Item 506.1 for additional information.

606.2.B. 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.

In accordance with the Laws of the State of Texas and the U.S. Occupational Safety and Health Administration regulations, all trenches over 5 feet in depth in either hard and compact or soft and unstable soil shall be sloped, shored, sheeted, braced or otherwise supported. Furthermore, all trenches less than 5 feet in depth shall also be effectively protected when hazardous ground movement may be expected. Trench safety systems to be utilized for projects within the City shall be provided by the contractor prior to commencement of any excavation exceeding 5 feet in depth.

If design drawings require a trench to be deeper than 5-ft, but no separate pay item has been provided for Trench Safety Systems, then CONTRACTOR shall consider this item to be subsidiary to the utility installation.

In accordance with the U.S. Occupational Safety and Health Administration regulations, when employees are required to be in trenches 4 feet deep or more, adequate means of exit, such as a ladder or steps, must be provided and located so as to require no more than 25 feet of lateral travel.

If trench safety system details were not provided in the plans because trenches were anticipated to be less than 5 feet or more in depth or trenches less than 5 feet in depth are in an area where hazardous ground movement is expected, all construction shall cease, the trenched area shall be barricaded and the City Engineer notified immediately. Construction shall not resume until appropriate trench safety system details, as designed by a registered professional engineer in the State of Texas are submitted to and accepted by the City, and, a bid item for implementation of trench safety systems is added to the contract by change order.

606.2.C. Public Safety

All excavations shall be protected from access by the public at all times. Protection shall include warning tape, barricades, appurtenances, flagging operations, and any other items required to prevent access to any excavation regardless of the size or depth. In no case will excavations be left open during non-working hours

unless protected by H-20 traffic rated steel plates installed and secured to prevent them from being dislodged by traffic.

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.

606.2.D. 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.

606.2.E. 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), judgments 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.

Refer to general provisions for additional information on Indemnification.

606.2.F. Measurement and Payment

If provided, Trench Safety shall be measured per linear foot (LF) along the centerline of the installed safety system, without adjustment for changes in width at manholes, junction boxes, or any other facilities.

Payment for Trench Safety Systems shall be made per unit as described above, up to and including the depths listed on the Unit Price Schedule for each item. Multiple pay items may be included for systems installed at differing depths as required. Such payment shall be full compensation for furnishing, hauling, installing, maintaining, removing, disposing of any materials used in the Trench Safety System, and all incidentals involved in the Trench Safety Systems.

606.3 EXISTING WATER LINE MAINTENANCE

This item shall include the avoidance, protection, relocation, and maintenance of all existing water line and water services within the project limits, until the proposed water system is in place, and all materials, labor and other incidentals required to complete the work, as specified by the Engineer.

606.3.A. Materials

All materials and construction methods shall comply with requirements set forth in the contract documents. The Contractor shall protect, avoid, and relocate existing water facilities as required for completion of other contract items, regardless of whether the specific protection, avoidance, or relocation is shown on the plans or elsewhere in the contract documents.

606.3.B. Measurement and Payment

If included in the bod documents the temporary maintenance of the existing water line will be measured lump sum (LS) complete in place.

When no specific pay item is included in the contract documents for "Temporary Maintenance of Existing Water Line" or "Existing Water Line Maintenance," there shall be no direct payment for this item. All tools, labor, equipment, materials, supervision, and all other costs required for completion of the work described in this Section shall be considered subsidiary to the entire project, and no direct payment will be allowed.

Temporary maintenance of the existing water line, if included in the bid as a specific pay item, shall be measured as specified above and paid for at the contract unit price bid for "Temporary Maintenance of Existing Water Line" or "Existing Water Line Maintenance," which price shall include full compensation for furnishing, preparing, hauling and installing required materials, encasement pipe, carrier pipe, restraints, end seals, for grouting and for labor, tools, equipment and incidentals necessary to complete work, including excavation, backfilling and disposal of surplus material.

606.4 PIPE CONCRETE ENCASEMENT

This item shall govern the furnishing of materials and the methods of constructing a Portland cement concrete encasement. Refer to Item for Jacking or Boring for encasement pipe or pipe casing.

606.4.A. Materials

CONTRACTOR shall submit manufacturer material specifications to OWNER prior to beginning construction. The submittal requirements for this specification item shall include:

1. Type of pipe, construction methods, and sequence.
2. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix.
3. Proposed proportioning of materials for the mortar mix.

The Portland cement concrete shall conform to Item for Structural Concrete and as described in Standard Details.

Pipe shall conform to Item for Water Pipes.

Grout shall consist of not less than 6 sacks Portland cement per cubic yard and clean washed sand mixed with water. The grout shall have a consistency such that the grout will flow into and completely fill all voids. If allowed by the Engineer or designated representative, an air-entraining admixture may be added to facilitate placement.

606.4.B. Construction Methods

When indicated on the Drawings or acceptable to Engineer or designated representative, concrete encasement shall be placed to protect the pipe. Pipe or bedding shall not be placed where:

1. the top of the pipe would have less than 30 inches of cover,
2. the ground water invades the trench, or
3. the trench bottom is of unstable material.

If either of these conditions is encountered, the Engineer or designated representative shall be notified and may direct the Contractor to:

1. encase the pipe with concrete,
2. change pipe material, or
3. use a higher strength class of pipe.

Concrete encasement shall extend from 6 inches below to 6 inches above the outer projections of the pipe over the entire width of the trench in accordance with the Contract Documents.

The ends of the encasement pipe shall be bulkheaded with concrete blocks, bricks or stones, dry-stacked without mortar, sufficient to prevent the intrusion of trench backfill material into the encasement, but fitted loosely enough to facilitate the escape of water from the encasement should carrier pipe leakage or failure occur.

606.4.C. Measurement and Payment

If included in the bid documents the Concrete encasement will be measured by the lineal foot (LF), for size of pipe being encased, complete in place. If not included in the bid documents this item shall be considered subsidiary to Pipe Installation. The measurement will be made between ends of the encasement, along the central axis as installed.

If included for payment, this item shall be measured as provided above and will be paid at the unit bid price per linear foot for "Concrete Encasement" or "Encasement Pipe" of the size indicated on the Drawings. The unit bid price shall include full compensation for furnishing all materials, pipe for all preparation, hauling, installation, all labor, tools, equipment and incidentals necessary to complete the work, including bench excavation and disposal of surplus material.

606.5 ADJUSTING STRUCTURES

This item shall govern the removal and replacement of surfacing, furnishing of materials, adjusting and/or repositioning existing structures, valve boxes, pull boxes, survey monument boxes and water meters, manholes, in accordance with these specifications to the locations or elevations indicated on the Drawings or as directed by the Engineer or designated representative. This item shall also govern any pumping, bailing and drainage required to complete the Work. Trench Safety Systems shall be used as appropriate as described elsewhere in these Specifications.

606.5.A. Materials

The CONTRACTOR shall be required to submit material and construction methods information to the OWNER prior to construction. Submittals should be received by the OWNER earlier in the process; the OWNER is not responsible for any delays caused by the rejection of such submittals or time required to review such information. The submittal requirements of this specification item include:

1. Aggregate type, gradations and physical characteristics for the Portland cement concrete mix.
2. Proposed proportioning of materials for the mortar mix.
3. Type structures and proposed adjustment technique (lowering, raising, lateral displacement).
4. Type structure, repair technique and materials to be furnished (new replacement or reuse of existing) Type of mixing plant and associated equipment including chart indicating the calibration of each cold bin.

Precast reinforced concrete rings and castings in good condition, which are removed from the structures to be adjusted, may be reused with the written approval of the Engineer or designated representative. Additional materials required shall conform to the Contract Documents.

The Portland cement concrete shall be Class A conforming to Item for Concrete for Structures. Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand, by volume based on dry materials. Sufficient water will be added to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for "Fine Aggregate".

606.5.B. Construction Methods

All adjustments shall be completed prior to the placement of the final surface.

Pull box and valve box components scheduled for reuse shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at its own expense.

If the adjustment involves slight lowering or raising a valve box or survey monument box, the outside shell of a slip or screw casing shall be excavated to its full length and adjusted to the proposed grade. Pipe castings shall be excavated to the depth required to cut from or weld a section to the casing as may be needed to adjust the ring to the proposed elevation. The ring shall be welded to the casing prior to pouring concrete around the casing. If the adjustment involves a vertical (lowering or raising) or a horizontal reassignment of a water meter and the property owner's cut off valve, this work shall be completed in accordance with the Contract Documents.

After the adjustments have been completed and cured, structures within any paved area shall be paved as indicated on the Drawings.

606.5.C. Measurement and Payment

Measurement and Payment will be made per each (EA) for each item (of any type) installed. Excavation and backfill shall be included in the Unit Price Bid for the structure adjusted or relocated.

Payment for each structure adjusted or relocated, as prescribed above, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the for each water valve or fire hydrant and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing Megalugs, fitting, bends, etc., for completion of the Work.

606.6 INSPECTION

All pipes (pipes and appurtenances) shall be inspected for conformance to the requirements of this specification. All deficiencies revealed by inspection shall be corrected. If wastewater system testing, as indicated above fails, video inspection meeting the requirements of this specification shall be provided at the Contractor's expense to show that deficiencies have been corrected satisfactorily. Further, the contractor shall provide video in complete segments (manhole to manhole) versus specific deficiency locations. Video inspection shall be done per Item for Drainage Inspection.

All video work shall be conducted under the direct full-time supervision of a NASSCO-PACP certified operator.

606.6.A. Materials

The conduit inspection camera and other materials shall comply with Item for Inspection under Drainage section.

606.6.B. Construction Methods

All video documentation and construction methods shall comply with Item for Inspection under Drainage section.

606.6.C. Measurement and Payment

If provided, Video Inspection shall be measured per linear foot (LF) along the centerline of the inspected pipe, without adjustment for changes in width at manholes, junction boxes, or any other facilities.

Payment for Video Inspection shall be made per unit as described above, up to and including all the depths and pipe sizes listed on the Unit Price Schedule for each drainage item. Such payment shall be full compensation for furnishing, hauling, installing, manpower, electrical, transportation, materials and

equipment, and disposing of any materials used in the Video Inspection, and all incidentals involved in the Video Inspection.

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701 INTRODUCTION

This Item shall govern the control measures necessary to define methods and limits of wastewater improvements, demolition, installation, and other wastewater appurtenances. All items specified herein are intended to comply with the City of Marble Falls Standard Details, the Non-Point Source Pollution (NPS) Manual and Ordinance, and TCEQ requirements for wastewater installation. CONTRACTOR shall notify Engineer if it is noticed discrepancies between this Item and other City/State manuals and ordinances. CONTRACTOR shall be prohibited with continuation of work while knowing of such discrepancies.

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 requirements herein.

The OWNER reserves the right to have required temporary erosion sedimentation and water pollution prevention and control work performed by others should the CONTRACTOR fail to perform required temporary erosion, sedimentation, and water pollution prevention and control work in a timely fashion or should the CONTRACTOR fail to prevent and control soil erosion, damage control, safety, and water and air pollution which may degrade quality of air and water. All costs including engineering and right-of-way costs for the work required shall be borne by the CONTRACTOR. The CONTRACTOR shall reimburse the OWNER for all such costs within 30-days after receipt of the reimbursement request from the OWNER. Failure to submit payment for such reimbursement costs in the time prescribed above may result in the OWNER withholding the reimbursement due from the monthly progress payments to the CONTRACTOR until reimbursement to the OWNER is made.

The contractor shall ensure that all requirements of the Texas Commission on Environmental Quality (TCEQ) are complied with. This shall include TCEQ Chapter 290, Subchapter D: Rules and Regulations for Public Water Systems §§290.38 – 290.47, and TCEQ Chapter 217, Design Criteria for Sewerage Systems.

As the project progresses, the Contractor shall be required to field verify that all proposed installations of water supply appurtenances will meet the clearances specified in TCEQ Chapter 290, §§290.44, and TCEQ Chapter 217, §§215.53 . If the proposed installations may result in inadequate clearances, the Contractor shall immediately stop work and immediately notify the Engineer by telephone and in writing. If the Engineer agrees with the Contractor's assessment, contract time shall be suspended until the conflict can be fully resolved.

The water system must maintain a minimum pressure of 35 psi at all points within the distribution network at flow rates consisting of a minimum of 1.5 gallons per minute for each connection. When fire flow is required, the system must maintain a minimum of 20 psi with combined fire flow demand and domestic usage.

702 DESCRIPTION

This item shall consist of furnishing all pipe and/or materials for constructing pipe mains, manhole assemblies and appurtenances for constructing sewer pipe mains, laterals, service lines, including all applicable work such as excavating, bedding, jointing, backfilling, materials, tests, etc. The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer and shall include all joints or connections to new or existing mains, pipes, valves, manholes, structures, etc. as may be required to complete the work in accordance with specifications and standard published practices of the trade associations for the material specified and to the lines and grades indicated. This item shall consist of pumping, bailing, drainage and Trench Safety Systems for trench walls when indicated. Unless otherwise provided, this item shall consist of the plugging of the ends of abandoned piped utilities cut and left in place and the restoration of existing utilities damaged in the process of excavation, cutting and restoration of pavement and base courses.

This item shall also consist, at no separate pay item, of the removal and disposition of trees, stumps and other obstructions, old structures and portions thereof such as house foundations, old sewers, masonry or concrete

walls, restoration of existing utilities damaged in the process of excavation, the furnishing and placing of select bedding and backfill, and the hauling and disposition of surplus materials, bridging of trenching and other provisions for maintenance of traffic or access as indicated.

CONTRACTOR shall also be responsible for the construction of service lines from the main to the cleanout location behind the curb or near the property line. The Contractor shall make all required connections to existing lines. Water lines shall not be located closer than nine (9) feet from sewer lines or reuse distribution lines unless otherwise approved by the City Engineer. All work will be subject to inspection by an authorized representative of the City and no work will be accepted until all construction and testing have been completed in accordance with the applicable plans and these specifications and to the satisfaction of the OWNER. Any work found not to be acceptable shall be removed and replaced at the Contractor's expense. The Contractor shall notify the OWNER prior to starting work and prior to covering any water lanes in place.

The OWNER shall at all times have free access to the manufacturer's plant while production in progress, and may at any time refuse to accept pipe made when the plant is failing to follow the stipulations of the specifications in regard to workmanship, or failing in provisions to insure a uniform product coming within the permissible variations of the specifications. The OWNER may reject pipe if adequate means and methods are not provided so as to insure the manufacture of a product of uniform high quality.

702.1 DAMAGE PRECLUSION

CONTRACTOR TO REPORT UTILITY LINE DAMAGE: CONTRACTOR shall protect and cause no damage to existing structures or other utilities as specified in Item under Existing Structures Location. If any utility, structure, line, service, or appurtenance to a utility is damaged, the CONTRACTOR shall notify the owner of that utility, structure, line, service, or appurtenance to a utility, immediately. *[NOTE: If there are specific local, state, or federal laws or regulations regarding damage notifications, the CONTRACTOR shall comply with those applicable laws or regulations in addition to following the requirements of this specification.]*

703 EXISTING STRUCTURES LOCATION AND PROTECTION

CONTRACTOR shall determine the location of existing structures, utilities and appurtenances shall proceed according to the specifications herein. BIDDERS must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location and sizes of pipe or conduits of various kinds in place. Where the exact depth of any utility or obstruction is not shown on a plan, excavation shall be made prior to reaching the obstruction in order to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary. Extra compensation shall not be paid for such delays. Refer to Item for Demolition for additional information on existing structures location and protection, or replacing and relocation.

704 WASTEWATER PIPES

This item shall consist of furnishing of all piping for constructing pipe mains, laterals, stubs, service connections, services leads, and fittings. All pipe and appurtenances shall be manufactured in the United States, unless otherwise specified in the construction documents. The pipe shall be of the sizes, types, classes and dimensions indicated herein or designated by the Engineer. Pipe shall be cured in accordance with the applicable ASTM Designations for each type of pipe as referred to below.

The contractor shall contact the municipality or water district, as appropriate, a minimum of 48 hours prior to making any connections or performing any work that may have an impact on that entity's facility to arrange inspection by the entity.

704.1 MATERIALS

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the Engineer at the pipe manufacturing plant and at the project site prior to and during installation.

All pipe and appurtenances shall be manufactured in the United States, unless otherwise specified in the construction documents. The pipe shall be of the sizes, types, classes and dimensions indicated herein or designated by the Engineer.

The contractor shall ensure all requirements of the Texas Commission of Environmental Quality (TCEQ) are complied with. This shall include but not limited to TECQ Chapter 217, 222, and 290.

The materials listed below are also referenced in the following specifications:

1. *AWWA C905-97; Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.*
2. *ASTM D1784; Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.*
3. *ASTM D2122; Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings.*
4. *ASTM D3139; Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.*
5. *ASTM F477; Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.*
6. *ASTM D3034 and F679; physical dimensions and tolerances and meet the testing requirements thereof for all components.*

704.1.A. PVC Pipe

All non-pressure polyvinyl chloride (PVC) wastewater pipe shall be DR-26 of the rigid (UNPLASTICIZED) type and must bear the National Sanitation Foundation seal of approval for potable wastewater pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Contractor may provide an "or equal" material subject to inspection and OWNER approval. Non-pressure pipe designates those line which are not anticipated to convey effluent while being subjected to internal pressure not exceeding 10-psi.

For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 Inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer's requirements. The tape shall be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.

704.1.A.1. Pressure Pipes 0-3.5 inches: PVC Pipe and fittings shall be Type I, Grade 1, Schedule 40, 200 psi. The pressure rating of the pipe shall be no less than three times the pressure head rating. All fittings shall be of Schedule 40 or heavier plasticized polyvinyl chloride. Fittings may be solvent welded. This pipe diameter shall be strictly used for pressure wastewater lines. All gravity service lines shall have a minimum diameter of 4" and all gravity main wastewater line shall have a minimum diameter of 8".

704.1.A.1.a. Physical Requirements: Pipe shall be extruded from 100 percent virgin unplasticized Type 1, Normal Impact Polyvinyl Chloride (PVC) to conform to the following minimum physical properties:

Table 704.1.A.1.a.(1) PVC Physical Requirements:

Physical Description	Quantity
Specific Gravity	1.36-1.40
Tensile Strength at 78°F (PSI)	7,500
Compression Strength (PSI)	9,400
Modulus of Elasticity	410,000
Coefficient of Linear Expansion	0.000067 K/C
Izod Impact at 78°F (ft.lbs./in.notch)	0.7-1.5
Burning Rate	Self-Extinguishing
Heat Distortion at 264 PSI	160°F

Standard sizes, dimensions and tolerances for DR-18 pipe shall be per the following table:

Table 704.1.A.1.a.(2) PVC Physical Requirements:

Pipe Label Nominal Tube Size (in)	Diameter		Min. Wall Thickness	
	Outside Dia. (in)	Inside Dia. (in)	Wall Thickness	Tolerance (in)
1.5	1.900	1.700	0.090	±0.032
2.0	2.375	2.129	0.113	±0.046
2.5	2.875	2.581	0.137	±0.060
3.0	3.500	3.146	0.167	±0.740
3.5	4.000	3.596	0.190	±0.088

704.1.A.1.b. Visual Inspection: Pipe shall be homogenous throughout and free from visible cracks, holes or foreign materials. Pipe shall be free from blisters, wrinkles and dents. This inspection shall be made on each length of pipe.

704.1.A.1.c. Markings: All PVC pipe shall be continuously and permanently marked with the following information: manufacturer's name, pipe size, class or schedule, type of pipe and material. When used for potable water line, the pipe shall bear the seal of the National Sanitation Foundation.

704.1.A.1.d. Inspection and Testing: Test certificates from a testing laboratory and/or guarantee by the manufacturer satisfactory to the Engineer shall be furnished for the pipe and fittings to be incorporated in the work. As required by the Engineer, certificates shall be submitted for other materials to be incorporated in the work. These certificates, stating that the materials meet the requirements of the specifications, will be required before permission is given to incorporate such materials in the work.

The cost of this inspection and testing will be paid for by the Contractor and shall be included in his price bid for such materials complete in place.

Any material brought on the ground for use in the work and deemed by the Engineer as unsuitable or not in conformity with the specifications shall be removed from the site of the work by the Contractor upon receipt of written notice from the Engineer to that effect.

704.1.A.1.e. Material Handling: The Contractor is cautioned to exercise care in handling, loading, unloading and storing PVC pipe and fittings. All PVC pipe and fittings will be stored under cover before using and will be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subject to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded until said section of pipe is cut out and rejoined with a coupling.

Pipe ends and fittings shall be covered or otherwise protected from foreign material entering the pipe and fittings until immediately prior to placing the pipe and fittings.

704.1.A.1.f. Threaded Connections: Where PVC to metal connections are required, the Contractor shall work the metal connections first. A non-hardening pipe dope such as Permatex #2, or equal, shall be used on all threaded PVC to metal joints and light wrench pressure is all that should be used. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded.

704.1.A.2. Pressure Pipes 4 - 12 inches: PVC Pipe shall be DR-18 AWWA C900 of the rigid (UNPLASTICIZED) type, and must bear the National Sanitation Foundation seal of approval for wastewater pipe. Each joint of pipe shall consist of single continuous extrusion. All pipe requirements shall meet the requirements as outlined under Section 604.

704.1.A.3. Pressure Pipes 14 - 24 inches: Pipe shall be DR-18 AWWA C905 Polyvinyl Chloride (PVC) Wastewater Transmission Pipe. This product specification covers 14-inch nominal diameter through 24-inch nominal diameter polyvinyl chloride (PVC) potable water transmission pipe with integral bell and spigot joints. The pipe shall be extruded from Class 12454-A or 12454-B PVC compound as defined in ASTM D-1784 and provide for a hydrostatic design basis (HDB) of 4,000 psi (27.58 MPa). The pipe outside diameters shall conform to dimensions of cast iron pipe (CI). All pipe furnished shall be in conformance with American Water Works Association (AWWA) Standard C905-97, or latest revision thereof. All definitions are defined according to AWWA C905-97 Section 1.2 Definitions. All pipe requirements shall meet the requirements as outlined under Section 600.

704.1.A.4. Non-pressure Pipes 4 - 24 inches: Pipe shall be SDR-26/PS-115 AWWA C110 Polyvinyl Chloride (PVC) Wastewater Gravity Pipe. Pipe must bear the National Sanitation Foundation seal of approval for wastewater pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe shall be non-pressure rated at 160 psi, SDR-26 or thicker. All pipe shall meet ASTM requirements for flattening, impact resistance, stiffness, joint tightness and extrusion quality as specified in ASTM D3034, ASTM D2412, or F679.

Pipe shall have push-on, rubber gasket joints of the bell and spigot type with thickened integral bells or of the double spigot type with thickened coupling sleeves 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. All belled end pipe shall have tapered sockets to create an interference type fit, which shall meet or exceed dimensional requirements and the minimum socket length for pressure-type belled sockets as defined in ASTM D2672. Solvent welding of PVC water pipe shall not be allowed.

Concrete thrust blocking shall be placed behind bends and tees. Concrete support cradles or blocking shall be required for support of all valves and AWWA C110 fittings.

704.1.A.4.a. Physical Requirements: Pipe shall be extruded from 100 percent virgin un-plasticized Type 1, Normal Impact Polyvinyl Chloride (PVC) to conform to the following minimum physical properties:

Table 704.1.A.4.a.(1) PVC Physical Requirements:

Pipe Label Nominal Tube Size (in)	Diameter		Min. Wall Thickness	
	Outside Dia. (in)	Inside Dia. (in)	Wall Thickness	Tolerance (in)
4	4.215	3.891	0.162	-
6	6.275	5.793	0.241	-
8	8.400	7.754	0.323	-
10	10.500	9.692	0.404	-
12	12.500	11.538	0.481	-
15	15.300	14.124	0.588	-
18	18.701	17.359	0.671	-
21	22.047	20.465	0.791	-
24	4.000	23.025	0.889	-

704.1.A.4.b. Visual Inspection: Pipe shall be homogenous throughout and free from visible cracks, holes or foreign materials. Pipe shall be free from blisters, wrinkles and dents. This inspection shall be made on each length of pipe.

704.1.A.4.c. Markings: Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

- (1) Nominal pipe size and OD base (e.g., 4 CIPS).
- (2) The type of plastic material (e.g. PVC 12454B).
- (3) The standard Dimension Ratio and the pressure rating in psi for water at 73 F (e.g., SDR 26/PS-115, 160 psi).
- (4) The ASTM designation with which the pipe complies (D2241).
- (5) The manufacturer's name or code and the National Sanitation Foundation (NSF) mark.

704.1.A.4.d. Material Handling: The Contractor is cautioned to exercise care in handling, loading, unloading and storing PVC pipe and fittings. All PVC pipe and fittings will be stored under cover before using and will be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subject to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded until said section of pipe is cut out and rejoined with a coupling.

Pipe ends and fittings shall be covered or otherwise protected from foreign material entering the pipe and fittings until immediately prior to placing the pipe and fittings.

704.1.A.4.e. Fittings: All vertical and horizontal deflections greater than 2° shall be made through the manhole. Otherwise, for special pre-approved location or maintenance items, all fittings shall conform to AWWA C-110 Full-Body for all pipe sizes or AWWA C-153 Short-Body Ductile Iron Fittings. All ductile iron fittings shall be Megalug Restraining Glands. 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.

704.1.A.5. Non-pressure Pipes 4 - 24 inches: Pipe shall be SDR-26/PS-115 AWWA C110 Polyvinyl Chloride (PVC) Wastewater Gravity Pipe. Pipe must bear the National Sanitation Foundation seal of approval for wastewater pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe shall be non-pressure rated at 160 psi, SDR-26 or thicker. All pipe shall meet ASTM requirements

704.1.A.6. Purple Reclaimed Pipes 0-3.5 inches: PVC Pipe and fittings shall be Type I, Grade 1, Schedule 40, 200 psi purple color with belled ends. The compound is PVC 1120 with a cell class of 12454B, per ASTM D1784. The Schedule series is produced in strict compliance to ASTM D1785. In accordance with NSF, and complies with NSF/ANSI Standard 14 and Standard 61. Sch.40 pipe is installed per ASTM D2855. The joints should conform to ASTM D2672, the solvent cement to ASTM D2564 and the primer to ASTM F656.

704.1.A.7. Purple Reclaimed Pipes 4-12 inches: PVC Pipe shall be DR-18 AWWA C900 of the rigid (UNPLASTICIZED) type, and be of purple color marked with "CAUTION RECLAIMED WATER - DO NOT DRINK" at intervals not to exceed 5-feet. Each joint of pipe shall consist of single continuous extrusion. All pipe requirements shall meet the requirements as outlined under Section 604. The gasket shall be reinforced with a steel band and meet the requirements of ASTM F477. Pipe shall have an integral bell end with a locked-in factory installed gasket and shall meet the joint requirements of ASTM D3139.

704.1.A.3. Pressure Pipes 14 - 24 inches: Pipe shall be DR-18 AWWA C905 Polyvinyl Chloride (PVC) Wastewater Transmission Pipe. This product specification covers 14-inch nominal diameter through 24-inch nominal diameter polyvinyl chloride (PVC) potable water transmission pipe with integral bell and spigot joints. The pipe shall be extruded from Class 12454-A or 12454-B PVC compound as defined in ASTM D-1784 and provide for a hydrostatic design basis (HDB) of 4,000 psi (27.58 MPa). The pipe outside diameters shall conform to dimensions of cast iron pipe (CI). All pipe furnished shall be in conformance with American Water Works Association (AWWA) Standard C905-97, or latest revision thereof. All definitions are defined according to AWWA C905-97 Section 1.2 Definitions. All pipe requirements shall meet the requirements as outlined under Section 600.

704.1.B. Ductile Iron Pipe

Ductile-iron pressure pipe 4-in. through 64-in. shall conform to the American National Standard for Ductile-Iron Pipe Centrifugally Cast for Water or Other Liquids. Contractor may provide an "or equal" material subject to inspection and OWNER approval. Ductile Iron Pipe shall conform to AWWA C-151 for mechanical joint pipe unless otherwise specified in the construction plans. Alternatively, push-on joint pipe may be used if all pipe joints are restrained in accordance with the requirements provided in this section.

704.1.B.1. Physical Requirements: All pipe requirements shall meet the requirements as outlined under Section 604.

704.1.C. PE Pipe

The polyethylene (PE) tubing pressure-rated for wastewater pipes ¾" through 2" shall meet or exceed the requirements of ASTM D-2737. All polyethylene plastic tubing shall be high density, high molecular weight plastic tubing meeting ASTM D-2737, pressure rated at 200 psi working pressure and must bear the National Sanitation Foundation seal of approval for potable water service and meet AWWA C-901. Contractor may provide an "or equal" material subject to inspection and OWNER approval.

604.1.C.1. Physical Requirements: All pipe requirements shall meet the requirements as outlined under Section 604.

704.1.D. ABS Pipe

Acrylonitrile Butadiene Styrene (ABS) non-pressure pipe 4-in. through 6-in. shall conform to ASTM D2661, Type I or IV. Fittings shall be ABS complying with ASTM D2661, solvent cement joints complying with ASTM D2235 or threaded joints. ABS pipe shall only apply to wastewater laterals. ABS pipe 6" or greater shall only connect to the collector main via a manhole. No ABS pipe will be allowed as a collector pipe.

704.1.D.1. Physical Requirements: All pipe requirements shall meet the requirements as outlined under Section 604. Pipe shall be laid in 20' segments. No 10' segment lengths will be allowed.

704.1.E. HP Pipe

High Performance polypropylene resin pipe (HP) will be allowed for gravity pipes over 12" Dia. HP Pipe shall conform to ASTM F2736 and/or ASTM F2764 on a gravity flow sanitary sewer projects. Pipe shall be triple walled and have double gasketed joints, and tested per ASTM F2736. The HP joint performance should exceeds the 10.8 psi laboratory performance standards per ASTM D3212. In the field, each section of HP may be tested by a low pressure air test, according to ASTM F1417. Fittings and connections shall provide a watertight connection according to the requirements of ASTM D3212. Gaskets, when present, shall meet ASTM F477. The ADS triple wall HP Pipe products have been pre-approved from the City. Any products not listed must be submitted to the Engineer 14 days prior bid opening, with no exceptions.

704.2 CONSTRUCTION METHODS

The construction methods for water pipes shall be done per Item for Wastewater Installation.

704.3 MEASUREMENT AND PAYMENT

Wastewater Pipe will be measured by the linear foot (LF) along the centerline of the pipe for the various sizes and classes of pipe in place, in accordance with these specifications, complete and accepted by the Engineer, including excavation, embedment, and backfill, unless they are included in the bid as a separate pay item.

Payment for pipe, measured as prescribed above, will be made at the unit price bid, when provisions are made directly for payment, per linear foot for the various sizes of pipe, of the materials and class indicated. Mitigation of unstable material, if encountered, trench excavation, and backfill (for all depths) are considered subsidiary to this item unless specifically included as a separate pay item.

Payment shall be full compensation, in accordance with the pay items set in the bid, for excavation, furnishing, hauling and placing pipe including lugs and all incidental and subsidiary materials and work; preparing, shaping, dewatering and shoring of trenches; hauling, placing and preparing bedding; for connecting to new or existing systems or structures; for hauling, moving, placing and compacting backfill materials and all other incidentals necessary to complete the pipe installation as indicated.

705 WASTEWATER APPURTENANCES

This item shall consist of furnishing all materials for constructing pipe mains, laterals, stubs, inlet leads, service connections, including all applicable work such as excavating, bedding, jointing, backfilling, materials, tests, etc. The appurtenances shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer and shall include all joints or connections to new or existing mains, pipes, manholes, inlets, structures, etc. as may be required to complete the work in accordance with specifications and standard published practices of the trade associations for the material specified and to the lines and grades indicated. This item shall consist of pumping, bailing, drainage and Trench Safety Systems for trench walls when indicated. Unless otherwise provided, this item shall consist of the cutting and restoration of pavement and base courses, the furnishing and placing of select bedding, backfilling and cement or lime stabilized backfill, the hauling and disposition of surplus materials, bridging of trenching and other provisions for maintenance of traffic or access as indicated.

705.1 VALVES

This item shall consist of furnishing and installing all, valves, and all other materials including applicable work such as unclassified excavating, bedding, jointing, backfilling, materials, tests, etc. All valve appurtenances shall be manufactured in the United States, unless otherwise specified in the construction documents.

705.1.A. Materials

CONTRACTOR shall submit manufacturer material specifications to OWNER prior to beginning construction. The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of required for completion of the work.

605.1.A.1. Gate Valves: Gate Valves 0-3 inches (in diameter) shall meet or exceed the requirements as outlined under Section 605.

605.1.A.2. Pressure Reducing Valves (PRV): All PRVs shall meet or exceed the requirements as outlined under Section 605.

605.1.A.3. Flush Valves: Flush Valve shall meet or exceed the requirements as outlined under Section 605.

505.1.A.4. Air / Vacuum Release Valves (ARV): ARVs shall be globe type with screwed connection, and shall meet or exceed the requirements as outlined under Section 605.

605.1.B. Construction Methods

The Contractor shall prepare the excavation for the correct elevation after grading has been properly executed. The Valves shall be set according to the drawings. Backfill material should be free flowing and placed in accordance with item for "Water Installation." Minimum cover depth above the top of pipe shall be 3 feet.

605.1.B.1. Valve Installation: Unless otherwise indicated, this item shall meet or exceed the requirements as outlined under Section 605.

605.1.B.1.a. Valve Box: Unless otherwise indicated, this item shall meet or exceed the requirements as outlined under Section 605.

605.1.B.3. Protective Covering: Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel components buried and in contact with earth or backfill shall be wrapped with 8-mil (minimum) polyethylene film meeting ANSI/AWWA Specifications C-105-current, with all edges and laps taped securely to provide a continuous and watertight wrap. This item shall meet or exceed the requirements as outlined under Section 605.

605.1.B.4. Testing and Disinfecting: After the pipe has been installed and backfilled and all services laterals, fire hydrants, valves, and other appurtenances installed and connected, a pressure test, followed by a leakage test, which will then be followed by a system sterilization and Bacteriological Testing. Such test and samples shall be done according to Item for Pipe Installation.

605.1.C. Measurement and Payment

Measurement and Payment will be made per each (EA) for each valve (of any type) or fire hydrant installed. Excavation and backfill shall be included in the Unit Price Bid for the Valve or Fire Hydrant. Each bid item shall specify the size (in inches) of the valve installed.

Valves will be installed, including valve stem casing and cover, excavation and backfill, setting, adjusting to grade and anchoring. Pressure control and flow control valve assemblies will include box or vault, setting, adjusting to grade, anchoring in place, adjusting the control device to the required conditions and placing in operation. Pressure reducing valve and assembly will include the main line tap or outlet, all pipe, valves, fittings, gauges, box, concrete cap, manhole structure, or vault and cover.

Fire hydrants will be set, adjusted to grade and anchored in place. The bid price per each will include all clearing, excavation, trench excavation safety, bedding material, fittings, valves, pipe coatings, connection to the existing system, disposal of surplus materials, laying of pipe, backfilling and cleanup.

Standard Blow-Off and assembly will include the main line tap or outlet, all pipe, curb stops, fittings, box, or vault and cover as called for in Standard Blow-Off Detail.

Payment for each water valve or fire hydrant, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the for each water valve or fire hydrant and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing Megalugs, fitting, bends, etc., for completion of the Work.

705.2 JACKING OR BORING

This item shall govern furnishing and installing of encasement and carrier pipe by methods of jacking or boring as indicated on the Drawings and in conformity with this specification. This item shall also include, but not be limited to other construction activities such as traffic control measures, excavation, removal of all materials encountered in jacking or boring pipe operations, disposal of all material not required in the work, grouting, bulkhead installation, backfilling and revegetation. CONTRACTOR shall comply also with the following related cross-reference materials:

SPECIFIC Cross Reference Materials for "Jacking or Boring Pipe"

TxDOT Standard Specifications For Construction And Maintenance Of Highways, Streets, And Bridges

Section 500 "Drainage" of these specifications

TxDOT Testing Procedures

Designation	Description
Tex-114-E	Laboratory Compaction Characteristics & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials

Texas Manual on Uniform Traffic Control Devices (TMUTCD)

Designation	Description
TMUTCD Part VI	Traffic Controls for Street and Highway Construction, Maintenance, Utility and Incident Management Operations
TMUTCD Section 6C	Channelizing Devices
TMUTCD Section 6C-8	Barricade Design
TMUTCD Section 6C-9	Barricade Application
TMUTCD Section 6E	Lighting Devices
TMUTCD Section 6F	Control of Traffic Through Work Areas

RELATED Cross Reference Materials for "Jacking or Boring Pipe"

TxDOT Standard Specifications

Designation	Description
Item 476	Jacking, Boring, or Tunneling Pipe

705.2.A. Materials

CONTRACTOR shall submit manufacturer material specifications to OWNER prior to beginning construction. The submittal requirements for this specification item shall include:

1. Shop drawings identifying proposed jacking or boring method complete in assembled position
2. Trench Safety Plan including pits, trenches and sheeting or bracing if necessary,
3. Design for jacking or boring head,
4. Installation of jacking or boring supports or backstop,

5. Arrangement and position of jacks and pipe guides,
6. Grouting plan, and
7. Materials and method for tying restraints to both ends of the casing.

605.2.A.1. Carrier Pipe: Carrier pipe and encasement pipe shall conform to Specification, "Wastewater Pipe" and "Pipe Casing" as appropriate, as well as "Concrete Encasement and Encasement Pipe" and "Drainage Pipe" and shall be size, type materials, thickness and class indicated on the Drawings, unless otherwise specified.

605.2.A.2. Grout: Grout for void areas shall consist of 1 part Portland cement and 4 parts fine, clean sand mixed with water. The grout shall have a consistency such that the grout will flow into and completely fill all voids. If allowed by the OWNER or designated representative, an air entraining admixture may be added to facilitate placement.

605.2.A.3. Pipe Casing: Approved materials for pipe casing are steel and Reinforced Concrete Pipe (RCP). RCP shall conform to ASTM C-76, Class IV or better. Unless otherwise indicated, this item shall meet or exceed the requirements as outlined under Section 605.2.

605.2.A.4. Casing Spacers: Unless otherwise indicated, this item shall meet or exceed the requirements as outlined under Section 605.2.

705.2.B. Construction Methods

The Contractor shall have sole responsibility for the safety of the jacking and boring operations and for persons engaged in the work. The Contractor's attention is directed to the Construction Industry Occupational Safety and Health Administration (OSHA) Standards (29 FR 1926/1920) as published in U.S. Department of Labor publication OSHA 2207, latest revision, with particular attention to Subpart S. The Contractor shall provide an appropriate Trench Safety Plan.

The Contractor is responsible for:

1. Adequacy of jacking and boring operations,
2. Installation of support systems as indicated on the Drawings,
3. Provision of encasement and carrier pipe, and
4. Execution of work involving the jacking operation, the wet or dry method of boring and the installation of encasement pipe simultaneously.

Unless otherwise indicated, this item shall meet or exceed the requirements as outlined under Section 605.2.

705.2.C. Measurement and Payment

Jacking or boring pipe will be measured by the linear foot (LF) of pipe complete in place. Such measurement will be made between the ends of the pipe along the central axis as installed.

Pipe casing will be measured by the linear foot (LF) of pipe complete in place. Such measurements will be made between the ends of the casing along the central axis as installed.

If provided separately, payment for the pipe casing, measured as prescribed above, will be made at the unit price bid per linear foot for the casing size, spacers, other material and class indicated. Payment shall be full compensation, in accordance with the pay items set in the bid, for furnishing, hauling and placing pipe casing including casing spacers, grout, concrete, bulkheads, and all incidental and subsidiary materials and work necessary to complete the installation as indicated.

Payment for Jacking or boring pipe shall be done per the work performed and materials furnished as prescribed by this item and measured as provided will be paid for at the unit bid price per linear foot for "Jacking or Boring Pipe", if provided for in the Unit Price Schedule of type, size and class of encasement and carrier pipe indicated on the Drawings. Unless provided for under a separate pay item, the price shall include full compensation for

furnishing, preparing, hauling and installing required materials, encasement pipe, carrier pipe, restraints, end seals, for grouting and for labor, tools, equipment and incidentals necessary to complete work, including excavation, backfilling and disposal of surplus material.

705.3 MANHOLES

This item shall consist of furnishing and installing all, manholes assemblies, junctions, and all other materials including applicable work such as unclassified excavating, bedding, jointing, backfilling, materials, tests, etc. All manhole appurtenances shall be manufactured in the United States, unless otherwise specified in the construction documents. The pipe and manholes shall be of the sizes, types, classes and dimensions indicated herein or designated by the Engineer and shall include all connections to new or existing mains and pipes as may be required to complete the work in accordance with referenced specifications and standard published practices of the trade associations for the material specified and to the lines and grades indicated. This item shall consist of pumping, bailing, drainage and Trench Safety Systems (as required) for trench walls. Unless otherwise provided, this item shall consist of the removal and disposition of trees, stumps and other obstructions, old structures and portions thereof such as house foundations, old sewers, masonry or concrete walls, the plugging of the ends of abandoned pipe utilities cut and left in place, restoration of existing utilities damaged in the process of excavation, cutting and restoration of pavement and base courses, the furnishing and placing of select bedding and backfill, and the hauling and disposition of surplus materials, bridging of trenching and other provisions for maintenance of traffic or access as indicated.

705.3.A. Materials

CONTRACTOR shall submit manufacturer material specifications to OWNER prior to beginning construction. The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of required for completion of the work. CONTRACTOR shall provide precast reinforced concrete sewer manholes as indicated on the drawings and complying with ASTM C-478. The submittal requirements of this specification item include:

1. Type, size and manufacturer of manhole (diameter of water or wastewater manhole), structure (precast, cast in place; Standard, Tee, etc), and materials and equipment to be furnished (brick, concrete, seals, rings, covers, etc.). The contractor shall be required to submit shop drawings showing the design and details for each precast large base manhole. The submittal shall include certification that each precast large base manhole has been designed for installation and service at the depth and location shown on the drawings.
2. Aggregate types, gradations and physical characteristics for the Portland cement concrete and mortar mix.
3. Proposed Acceptance testing procedure and associated test equipment and materials Type structures and proposed adjustment technique (lowering, raising, lateral displacement). Submittal of test Records is required and shall include as a minimum the following items. The test records shall also be included as part of the Project records turned in with the acceptance package.
 - a. Name of the manhole manufacturer
 - b. Interior surface coating type and application method for Wastewater Manholes
 - c. Model and manufacturer of vacuum tester
 - d. Date tested/date re-tested
 - e. Passed/failed and state what was done to correct the problem
 - f. Test Method Used
 - g. Location/station of manhole
 - h. Precast/cast-in-place bottom
 - i. Any repairs made to the joints.
4. Proposed product for coating the interior surface of new and/or existing wastewater manholes.

705.3.A.1. Manhole Top: The Top shall be precast concrete of concentric cone, eccentric cone, or flat top type as of a size indicated on the drawings.

705.3.A.2. Manhole Base: The Base shall be precast concrete with base riser section and separate slab base or base riser section with an integral floor of a size as indicated on the drawings.

705.3.A.3. Pipe Connectors: All Pipe Connectors shall be resilient, complying with ASTM C-923.

705.3.A.4. Frame and Cover: All Frames and Covers shall be water tight, cast iron, complying with ASTM A-48 for Class 20, gray cast iron, uniform in quality, free from sand, blow holes, hard spots, shrinkage defects, swells, cracks and other injurious defects. Manufactured holes in Cover shall be clean and free of plugs. Machine bearing surfaces of Frames and Covers to provide even bearing in position in which the Manhole Cover is seated on Frame. Cover shall have lettering cast into Top reading "Sanitary Sewer." Cover should not have another City's name on it. Rings and covers shall be minimum 30-in Dia.

705.3.A.5. Mortar and Grout: Mortar shall be composed of one part Portland cement, one part masonry cement (or $\frac{1}{4}$ part hydrated lime), and sand equal to $2\frac{1}{2}$ to 3 times the sum of the volumes of the cements and lime used. The sand shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item for "Concrete For Structures." Mortar shall not be used for any purpose on the inside of wastewater manholes.

Grout shall be the non-shrink type conforming to ASTM C 1107, Packaged, Dry, Hydraulic Cement Grout (Non-shrink), Grade C. Grout shall be used as packaged, with the mixed ingredients requiring only the addition of water.

705.3.A.6. Temporary Manhole Plugs: Temporary Manhole Plugs shall consist of a mechanical type pipe plug, as approved by the Engineer. Prior to ordering any material, the Contractor shall submit, for the Engineer's approval, supplier's shop drawings for Temporary Manhole Plugs.

705.3.A.7. O-rings and Wedge Seals: O-rings and wedge seals for the joints of all wastewater manholes, when indicated on the Drawings, shall conform to the requirements of ASTM C443. The connections between reinforced concrete wastewater manhole structures and pipes shall meet the requirements of ASTM C923.

705.3.B. Construction Methods

The Contractor shall prepare the excavation for the correct elevation after grading has been properly executed. The Manhole shall be set according to the drawings. Backfill material should be free flowing and placed in accordance with item for "Water Installation." Minimum cover depth above the top of pipe shall be 4 feet.

705.3.B.1. Manhole Installation: Manhole base may be either cast-on-site or monolithic round, precast reinforced concrete base sections. Bottom of precast sections shall have a minimum thickness of 12 inches unless indicated otherwise, and be reinforced with minimum #4 bars at 18" on center each way. Bottom shall project no less than 6 inches beyond the outside walls of base to form flange to resist uplift. Provide base with cutouts, or holes, to receive pipe and connections. Locate lowest edge of holes or cutouts no less than 6 inches above inside surface of floor of base.

Precast sections shall be 48 inches in diameter for pipe sizes up to and including 30 inches, and shall be as indicated on drawings for pipe sizes over 30 inches.

Invert channels shall be smooth, accurately shaped, and in accordance with the drawings. Invert may be formed directly in the concrete of the manhole base, shaped by mortar, or constructed by laying full section of pipe straight through the manhole and cutting out the top half after the concrete base is constructed and set. Top of the manhole invert outside flow channels shall be steeply sloped to channels. The invert shall have a minimum fall of 0.10 of a foot between the inlet and outlet. Manhole barrel sections shall have tongue-and-groove or O-ring joints. Joints shall be sealed with Neenah Foundry Company Manhole Sealant, Sylvax or approved equal.

Where pipes are connected to the manhole base or barrel, the space between the pipe and hole shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form a watertight barrier. The gaskets shall be "Press-Wedge," "Res-Seal," or approved equal. O-rings and wedge seals for the joints of all

wastewater manholes, and for manholes when indicated on the Drawings, shall conform to the requirements of ASTM C443. All pipes indicated to be plugged shall be plugged at the connection to the structure using 3,000 psi concrete.

705.3.B.2. Drop Connection Installation: Where gravity lateral or main pipe connects to the manhole, and if this connection elevation is over 18-inches from the bottom, the connection shall be made via an outside drop connection. The drop connection shall be made per the City's Standard Details. The connection shall be made via two cores into the manhole. The extrapolated spring line pipe (top connection) shall have a swivel check valve. The bottom connection shall be 0.2' higher than the outflow pipe.

Where force lateral or main pipe connects to the manhole, and if this connection elevation is over 6-inches from the bottom, the connection shall be made via an inside drop connection. The drop connection shall be made per the City's Standard Details. The connection shall be made via one cores into the manhole. The extrapolated spring line pipe (top connection) shall have capped cleanout. Pipe shall be secured to the manhole via non corrosive braces. The bottom connection shall be 3" higher than the outflow pipe.

705.3.B.3. Construction of Inlets: Concrete foundation shall be 8 inches thick; grout inlet invert around sewer pipe smooth and slope to sewer line invert. Cut off protruding inlet lead, sewer lines or stub-outs flush with inside of wall. Adjust inlet plate frames to line, grade, and slope required, and grout in place with cement mortar. Set inlet rings and frames in cement mortar on finished wall, and adjust final elevation. Set top of cover flush with adjacent paved surface or finished grade.

705.3.B.4. Manhole Top Adjustment: Build-up manholes so that cover, when placed, is at the designated elevation. Place not less than 2 precast concrete grade rings, with a total thickness of not more than 12 inches under the casting. Items not covered in this section shall comply with Section 606.5, Item for Adjusting Structures.

705.3.B.3. Protective Covering and Waterproofing: PVC waterstops, hydrophilic waterstops, joint wrapping, and waterproofing compounds shall be installed as specified. The Contractor shall measure the coating thickness according to ASTM D 6132.

705.3.B.3.a. Cement Covering: The interior surfaces of all Portland cement concrete wastewater manholes and junction boxes shall have coated seams at minimum 6" on either side of the seam. The finished product shall have a smoothed surface ready for epoxy painting. Nondestructive Measurement of Dry Film Thickness of Applied Organic coatings over concrete shall be done using an Ultrasonic Gage. Thickness measures shall be made at locations designated by the Engineer or designated representative. All thickness measurements shall be witnessed by the Engineer or designated representative.

705.3.B.3.b. Polyurethane Lining: This Item shall govern approved methods and materials for the coating of brick and concrete structures by spray-application of a monolithic 100% solids, rigid, ultra-high-build, polyurethane lining system in combination with a high strength, fiber reinforced cementitious liner to eliminate infiltration, provide corrosion protection, repair voids and enhance structural integrity. These structures include, but are not limited to manholes, junction boxes, wet wells, lift stations and pump stations. Contractor shall submit material specifications to OWNER for approval.

This specification references the American Society for Testing and Materials (ASTM) standards and specifications, which are made a part hereof by such reference and shall be the latest edition and revision thereof.

D-543 Test Methods for Resistance of Plastics to Chemical Reagents D-638 Tensile Properties of Plastics
D-695 Compressive Properties of Rigid Plastics
D-790 Flexural Properties of Unreinforced and Reinforced Plastics D-4060-95 Taber Abrasion Test
D-4541 Pull-off Strength of Coatings Using a Portable Adhesion Tester D-2584 Volatile Matter Content
D-2240 Durometer Hardness, Type O
C-109 Compressive Strength of Hydraulic Cement Mortars Additional Standards

CONTRACTOR shall verify that the manufacturing company operates under ISO 9000:2000 guidelines and Certify that the products comply with the test specification.

CONTRACTOR shall pressure wash and clean structure. Fill bug holes, joints, honeycombs and around pipe penetrations with a Cementitious Repair Material as needed. Apply a minimum of 80 mils thickness of a Protective Coating Material (PCM), (i.e. The Spray Wall Lining System as manufactured by Spray-Roq, Inc.) or pre-approved equal. Equal products must be approved a minimum of two (2) weeks prior to bid date. In order for a product to be considered equal to the approved products, the submitted product must provide proof of successfully meeting the above requirements. An applicator that has been trained and certified by the manufacturer must install all products.

Application method of existing structures shall be to pressure wash and clean structure. Stop any infiltration using appropriate products and methods (injection grout/hydraulic cement). Fill bug holes, joints, honeycombs and around pipe penetrations with a 0.5" cementitious repair material as needed. Apply a minimum of 125 mils thickness of a Protective Coating Material (PCM). The PCM material shall have the following characteristics:

1. The PCM shall be a spray applied, ultra high-build, self-priming polyurethane resin system.
2. The PCM shall be 100% solids and VOC (Volatile Organic Compounds) free.
3. The PCM shall have the ability to reinstate structural integrity, provide infiltration control, and supply chemical resistance to the structure.
4. The PCM shall be a two component (A and B) resin system that uses a heated plural component spray system. After the components are mixed, the PCM shall gel in about 10 seconds with a "tack-free" condition after one minute.
5. In its final state, the PCM shall be rigid and capable of being applied at any thickness in a single mobilization.

The grout or Cementitious Repair Material (CRM) shall have the following characteristics:

1. The CRM shall be a factory blended, rapid setting, high early strength, calcium aluminate corrosion resistant non-shrink grout that is specifically formulated for use in the underground wastewater environment.
2. The CRM shall be capable of being troweled or pneumatically spray applied.
3. The CRM shall be mixed with water only and applied according to manufacturer recommendations.
4. The CRM must be compatible with the Protective Coating Material that is going to be used. The CRM manufacturer must certify compatibility.

The Hydraulic Cement Material (HCM) shall have the following characteristics:

1. The HCM shall be specifically designed to stop minor water infiltration and develop high- early strengths.
2. The HCM shall be capable of being hand mixed and applied in either a "wet" or "dry" state.
3. The water used to mix the HCM should be clean and free of contaminants.
4. The HCM should be formulated with calcium silicate, calcium aluminate cements, mineral fillers, and specially selected additives for set control.
5. The HCM should be used according to the manufacturer recommendations.

Chemical Grout Material) shall have the following characteristics:

1. The chemical grout shall be a semi ridged injection grout designed for sealing larger volume leaks in concrete cracks and fissures.
2. The chemical grout shall be capable of filling voids, stabilize soils or gravel.
3. The chemical grout shall be a two part system (grout and accelerator) that, when it makes contact with water, is designed to set-off and cut-off gushing water. Set times must be adjustable.
4. The water used to activate the chemical grout must be in the range of pH3-10 for proper cross-linking of the materials and optimum foam quality.
5. Once cured, the chemical grout shall become closed cell polyurethane foam that is resistant to most organic solvents, mild acids, alkali, petroleum and micro-organisms.

705.3.B.3.c. Flow Control: The Contractor will be responsible for establishing flow control of existing manholes, where required, in advance of all rehabilitation jobs. For structures with small inflow and outflow pipe diameters (6" to 12"), any and all cost for flow control shall be included in the price bid manhole coating.

The CONTRACTOR can use the Plugging and Blocking in which A sewer line plug shall be inserted into the upstream manhole and downstream manhole as necessary. The Contractor shall be held responsible for any damage caused by flooding and will take care to avoid this occurrence. Where flow is large enough to require bypass pumping, the Contractor will do so in accordance with current NASSCO Specifications. The Contractor shall prepare and submit one (1) Bypass Flow Control Plan that will be typically used for the project. The bypass pumping system capacity must be sized to meet all potential flows (i.e. no sanitary sewer overflows (SSO) allowed). The Contractor will be held responsible for any damage caused by flooding and will take care to avoid this occurrence. The Contractor is responsible for all installation, operation, and maintenance of the system. The Contractor must provide manpower, fuel, and necessary utilities required by the systems. Ready- use, stand-by pumping must be available and achieved by backing up pumps size for size (100% back-up capacity) in case of emergency situations, equipment malfunction, or higher than anticipated flows. The Contractor must make their own determination of flow quantities and characteristics. The Bypass Flow Control Plan and Bypass pumping operation for pipe sizes larger than 12" will be paid under a separate pay item. Bypass pumping set up and tear down shall be subsidiary to the bypass pumping operation line items.

705.3.B.3.d. Coating Installation: Prior to any worker entry into any structure to be rehabilitated, proper ventilation and strict confined space OSHA regulations shall be followed. Failure to do so shall be grounds for removal from the project. The Contractor will coordinate with the Owner on appropriate traffic control measures and working times.

705.3.B.3.d.(1) Surface Preparation: Prior to any coating application the following steps should be taken to prepare the surface:

1. The applicator must inspect all surfaces to be rehabilitated and notify the Owner's representative of any noticeable disparities in the conditions that are different than the original assessment and designated condition.
2. All concrete that is not sound or has been damaged by chemical exposure shall be removed to sound concrete surface.
3. All contaminants, including: oils, grease, incompatible and/or damaged existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts or other contaminants, must be completely removed prior to any surface applications. Contaminant removal and surface preparation methods must be based upon the designated conditions of the substrate and the requirements of the rehabilitation products.
4. Surfaces must be cleaned and abraded to produce a sound concrete surface with adequate profile and porosity to provide a strong bond between the existing structure and the rehabilitation products.
5. Pressure water cleaning using equipment capable of 5,000 psi at 5 gpm, with a zero degree rotating nozzle, shall be used to clean and free all foreign material within the manhole. It may be necessary to clean using a detergent or steam when grease or oils are present. All residues and materials resulting from the process of cleaning the structure must be captured and removed.
6. All voids, joints, cracks, pipe penetrations, bug holes, honeycombs, etc. shall be repaired using an approved CRM.
7. Repair and/or rebuild benches and inverts to owner specifications using an approved CRM.
8. The applicator shall determine the locations where infiltration is occurring and the process to use for stopping the active flow. For small leaks, a quick setting hydraulic cement product may be used.
9. If the Applicator determines that the flow is too significant for hydraulic cement, a hydrophobic polyurethane injection chemical grout shall be used. The applicator shall follow manufacture recommendations.

705.3.B.3.d.(2) Protective Coating: The following steps should be taken to for the installation of the coating:

1. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, and spray equipment.
2. The resin-based, 100% solids, polyurethane liner shall be manually sprayed on to all surfaces by a trained technician who is experienced in the application of the specific PCM and has been certified by the manufacturer.
3. The structure shall be completely dry prior to PCM application. The use of a heater with a high velocity air blower may be used. An approved HCM may also be used to dry suspect areas.
4. Prior to the PCM application, a test panel shall be sprayed to inspect the quality of the product. The technician shall check the test panel for appropriate color and mixing of the components. This will also insure that all equipment is functioning properly.
5. The spray technician will begin spraying product at the bottom of the structure (benches and inverts) one side at a time. A flash coat will be sprayed to heat up the surface to increase the bonding characteristics.
6. The process is repeated from the bottom of the structure to the top. Although not harmful to the PCM, the use of a ventilating system or ripcord shall be used to minimize "dusting" or "over-spray".
7. A trained technician will calculate the appropriate amount of material needed to cover the intended area. A counter on the pumping system shall be used to determine the amount of product actually used.
8. Once the PCM is applied, any and all flow may be reinstated to the structure.

705.3.B.3.d.(3) Pre-approved Materials: The following products have been pre-approved from the City. Any products not listed must be submitted to the Engineer thirty days prior to scheduled application, with no exceptions. PCM: SprayWall™ from SprayRoq, Inc. CRM: Strong Seal MS2@C, Strong Seal@ Bench Mix, Strong Seal High Performance Mix from The Strong Company, Inc., Structural Repair Mortar, RS Patch from Manhole Rehab, Inc., Fuquay – MSP from Fuquay, Inc. Chemical Grout Material: Hydro Active Cut@ from Deneef Construction Chemicals, Inc. HCM: Strong-Plug@ from the Strong Company.

705.3.B.4. Testing and Restoration: After the pipe has been installed and backfilled and all services laterals, manholes are installed, and other appurtenances installed and connected, a pressure test, followed by a leakage test. Such tests shall be done according to Item for Pipe Installation.

705.3.B.4.a. Leak Testing (Exfiltration Method): Manholes shall be tested for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing, vacuum testing, or other acceptable methods. If a manhole fails a leakage test, the manhole must be made water tight and retested. This method may only be used when ground water is not present. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. For a 4 foot diameter manhole, this quantity converts to a maximum permissible drop in the water level (from the top of the manhole cone) of 0.05 inches per foot of manhole depth or 0.5 inches for a 10 foot deep manhole.

Alternative test methods must ensure compliance with the above allowable leakage. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled to the top with water, and maintained full for at least one (1) hour. For concrete manholes, a wetting period of 24 hours may be used prior to testing in order to allow saturation of the concrete. If the manhole fails to pass the initial test method as described in (A) Test by the Vacuum Method and, if allowed, (B) Test by the Exfiltration Method, or if visible groundwater leakage into the manhole is observed, the Contractor shall locate the leak, if necessary by disassembly of the manhole. The Contractor shall check the gaskets and replace them if necessary. The Contractor may re-lubricate the joints and re-assemble the manhole, or the Contractor may install an acceptable exterior joint sealing product on all joints and then retest the manhole. If any manhole fails the vacuum and/or exfiltration test twice, the Contractor shall

consider replacing that manhole. If the Contractor chooses to attempt to repair that manhole, the manhole must be retested until it passes.

705.3.B.4.b. Vacuum Testing: To perform a vacuum test, plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering a manhole. **Do not** place grout in horizontal joints before testing. Stub-outs, manhole boots, and pipe plugs must be secured to prevent movement while a vacuum is drawn. CONTRACTOR use a minimum 60 inch/lb torque wrench to tighten the external clamps that secure a test cover to the top of a manhole. A test head must be placed at the inside of the top of a cone section, and the seal inflated in accordance with the manufacturer's recommendations.

There must be a vacuum of 10 inches of mercury (5-psi) inside a manhole to perform a valid test. A test shall not begin until after the vacuum pump is off. A manhole passes the test if after 5.0 minutes and with all valves closed, the vacuum is at least 9.0 inches of mercury (4.5-psi). Tampering with the test equipment will not be allowed.

705.3.B.4.c. Lining Testing: High Voltage Spark Test - After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment. Surface shall first be dried, an induced holiday shall then be made on to the coated concrete or metal surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.

Adhesion Testing - The adhesion tests shall be performed on a minimum of one or 10% of all rehabilitated structures, whichever is greater, or as shown on the Plan and/or specified in the Special Provisions. Adhesion testing shall be conducted after the lining or coating system has cured in accordance with ASTM D4541 (Steel) or ASTM 7234 (Concrete). A minimum of one 20 mm dolly shall be affixed to the lined surface of the structure at the upper section or cone area, mid-section and at the bottom, unless otherwise specified in the Special Provisions. Each testing location shall be identified by the Engineer. The adhesive used to attach the dollies to the liner shall be rapid setting with tensile strength in excess of the liner material and permitted to cure in accordance with manufacturer recommendations. Prior to pull test, the Contractor shall utilize a scoring device to cut through the coating until the substrate is reached. Extreme care shall be required while scoring to prevent micro cracking in the coating, since cracks may cause failures at diminished strengths. Failure due to improper dolly adhesive or scoring shall require retesting.

The pull tests in each area shall meet or exceed 200 psi, and shall include subbase adhered to the back of the dolly or no visual signs of coating material in the test hole. Pull tests with results between a minimum 150 psi and 200 psi shall be acceptable if more than 50% of the subsurface is adhered to the back of the dolly. A test result can be discarded, as determined by the Engineer, if there is a valid non-statistical reason for discarding the test results as directed by Sections 8.4 and 8.5 of ASTM D4541 and ASTM D7234.

If any test fails, a minimum of three additional locations in the section of the failure shall be tested, as directed by the Engineer. If any of the retests fail, all loosely adhered or un-adhered liner in the failed area, as determined by the Engineer, shall be removed and replaced at the Contractor's expense. If a structure fails the adhesion test, one additional structure or 10% of the initial number of structures selected for testing shall be tested at the discretion of the Engineer and/or as specified in the Special Provisions.

NOTE: The mil thickness will be measured and confirmed with the scored and pulled test samples. In structural repairs (partially or fully deteriorated design assumptions), it is critical to confirm the design thickness with the pulled sample as adhesion is not assumed in the ASTM 1216-09 design. The primary purpose of the pull test in structural rehabilitation is to confirm applied thickness, not adhesion. Any derived adhesion is further enhancement to the final installation strength of the rehabilitated structure.

A final visual inspection shall be made by the Inspector and manufacturer's representative. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by Applicator. The utility system be available to be put back into service as soon as the final inspection has taken place.

705.3.B.4.d. Cleanup: After testing, and prior to final inspection, clean sewer lines, manholes and inlets of dirt, sand, rocks, boards or debris. Remove such material from site and properly dispose of it. Begin cleaning operations at upstream end of line, cleaning one section of line from manhole to manhole.

It shall be the Contractor's responsibility to keep the construction site neat, clean and orderly at all times. Cleanup shall be vigorous and continuous to minimize traffic hazards or obstructions along the streets and to the driveways. Trenching, backfill and cleanup shall be coordinated as directed by the Engineer. The Engineer shall regulate the amount of open ditch and may halt additional trenching if cleanup is not adequate for orderly traffic flow and access.

705.3.B.4.e. Warranty: The Contractor must warrant all Work against defects in materials and workmanship for a period of one year, unless otherwise noted, from the date of final acceptance of all Work contained in the project. The Contractor must repair such defects in materials or workmanship within 30 calendar days of receipt of written notice of defects.

705.3.C. Measurement and Payment

Measurement and Payment will be made per each (EA), for each standard manhole (of any type) installed. A standard manhole shall be up to 8' in depth which shall be measured from the top cover of the manhole to the spring line of the lowest draining pipe. Excavation, bedding, and backfill shall be included in the Unit Price Bid for the Manhole. Each bid item shall specify the size (in inches) of the manhole installed.

Measurement and Payment of "Extra Depth" manholes will be made per each (EA) (of any type) installed. An Extra Depth Manhole shall be greater than 8' in depth which shall similarly be measured from the top cover of the manhole to the spring line of the lowest draining pipe. Excavation, bedding, and backfill shall be included in the Unit Price Bid for the Manhole. Each bid item shall specify the size (in inches) of the manhole installed.

Measurement and Payment of Manhole Adjustments will be made per each (EA) (of any type) installed. An Extra Excavation, bedding, and backfill shall be included in the Unit Price Bid for the Manhole. Each bid item shall specify the number and elevation of the manhole adjusted and installed.

Payment for each manhole, new or adjusted, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the for each manhole and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems, testing, lining, drop connection(s) including inside or outside drop connections; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing megalugs, temporary plugs, fitting, bends, installing cover, seals, connection of existing or proposed pipes, anchoring, and venting structure, concrete collar, adjusting to grade with grade ring, new services leads (up to 5'), coating or protective covering, inspection and testing, and all incidentals associated with installation of a functional and acceptable manhole in place including pressure or sealed manholes, etc., for completion of the Work.

705.4 APPURTENANCES

This item shall consist of furnishing and installing all appurtenances for constructing sewer pipe mains, manholes, laterals, stubs, service connections, services leads, fittings, and all other materials including applicable work such as unclassified excavating, bedding, jointing, backfilling, materials, tests, etc. All appurtenances shall be manufactured in the United States, unless otherwise specified in the construction documents. The contractor shall ensure all that requirements of the Texas Commission on Environmental Quality (TCEQ) are complied with. This shall include TCEQ Chapter 217, Design Criteria for Sewerage System.

705.4.A. Grinder Pump System

Grinder pump units shall be provided with two backflow prevention devices (one check valve at the tank and one at the connection of service line to the pressure collection line with a shut off valve on the main side of the backflow device at the connection to the main and shall be easily accessible for maintenance. Check valves should be of a swing check type with external levers. Rubberball check valves may be used.

Grinder pump system will be installed, including check valves, fiberglass or precast concrete well and cover, excavation and backfill, setting, adjusting to grade and anchoring. Pressure control and flow control valve assemblies will include box or vault, setting, adjusting to grade, anchoring in place, adjusting the control device to the required conditions and placing in operation. The grinder pump system shall include electrical box, floats, SCADA, and all associated appurtenances for a finished and functioning grinder pump system.

705.4.B. Odor Control Unit

This item shall govern and control the furnishing and installation of a chemical feed system to be used for the prevention of hydrogen sulfide in the sewage collection system. Contractor shall determine dosage by field test of hydrogen sulfide concentrations in solution at the receiving manhole at different times of the day. The chemical feed system including pumps, controls, tanks, concrete slab, piping and other appurtenances shall be complete, in place and functioning. The work shall include the initial setting of the metering pumps to achieve the necessary dosage to maintain sulfides between 0+ and 0.5 ppm in solution at the receiving manhole and 2000 gallons of approved nitrate solution (Bioxide).

705.4.B.1. Materials: The odor control unit shall be Siemens brand or approved equal. The contractor shall be required to submit for the Engineer's review and approval of product information, shop drawings and submittals on the following components is required prior to installation:

- a. Metering Feed Pumps
- b. Feed Control System (Schematics, Component Data Sheets)
- c. Liquid Storage Tanks
- d. Piping and Appurtenances
- e. Sulfide Control Chemical (Bioxide)
- f. Concrete Slab Design

The chemical feed system specified shall be used to meter a nitrate solution (Bioxide) into the sewage collection system for the prevention of hydrogen sulfide. All components of the feed system shall be provided by a single manufacturer who shall have sole-source responsibility for the system. All components furnished shall be of the type specified and compatible for use with sulfide controlling chemicals. All components (except tank) will be mounted in a compact 316 stainless steel, weatherproof enclosure with stainless steel dead front panel and stainless steel hardware.

705.4.B.1.a. O&M Manuals: CONTRACTOR shall also be required to submit complete Operation and Maintenance manuals to the Owner. These manuals shall include at a minimum:

- (1) Information on hazards associated with the system and the appropriate safety precautions
- (2) Material Safety Data Sheet for a Nitrate Solution
- (3) Equipment installation, maintenance, and startup instructions
- (4) Troubleshooting guide
- (5) Individual operation and maintenance information on major system components; including, but not limited to the following: Chemical Feed Pumps and Controls, Liquid Storage Tanks, Control Schematics, Component Catalog Data

705.4.B.1.b. Piping and Appurtenances: All piping, suction and discharge, shall be standard 1/2" (size optional), Schedule 80 PVC. All valves, fittings, and connectors shall be Schedule 80 PVC. All above ground underground primary fill lines shall be 2". Fill line shall have a 2" stainless steel male camlock with a 2" plastic female camlock cap. All chemical feed seals shall be compatible with the chemicals to be used in the regular operation, maintenance, and cleaning of the feed system. All fittings shall be solvent-welded or threaded.

705.4.B.1.c. Chemical Product: The material supplied shall be an aqueous solution of calcium nitrate containing a minimum of 3.5 pounds of nitrate-oxygen per gallon. The material shall be capable of reducing the dissolved hydrogen sulfide concentration in wastewater to less than 0.1 mg/l. The material shall be free of any objectionable odor-producing compounds. The pH of the material shall not be less than 4.0 nor greater than 7.5. The material shall contain no hazardous substances as defined by both the Federal EPA's and State CERCLA lists. The material shall be exempt from Federal DOT placard requirements. Recommended handling procedures for the material shall require protective gloves and safety glasses only. Any material recommending more sophisticated equipment (i.e. face shield, body suit, etc.) during routine handling shall not be considered.

705.4.B.2. Construction Methods: This item shall govern the installation of the Odor Control Unit and associated appurtenances. The contractor shall ensure all requirements of the Texas Commission of Environmental Quality (TCEQ) are complied with.

705.4.B.2.a. Metering Pumps: Two (2) metering/feed pumps shall be furnished with necessary suction and discharge piping. The feed pumps shall be bellows type with polypropylene bellows, and viton inlet and outlet poppet valves. The chemical feed pumps furnished shall have a capacity range appropriate for the anticipated flow required per Section 705.4.B.1 and conform to one of the items per the Table 705.4.B.2.a.(1) *Chemical Feed Pumps Requirements:*

Table 705.4.B.2.a.(1) Chemical Feed Pumps Requirements:

Flow Rate (ml/min)	Max RPM	Max Discharge Pressure (psi)
5-50	10	40
12-120	24	40
63-630	60	20
105-1050	100	20
151-1510	145	20

The pumps shall be self-priming capable of suction lifts, when dry, up to seven feet, and with bellows full, they will prime up to twenty (20) feet. Flow rate of each pump shall be adjustable by (a) diameter of bellows, and (b) adjustment of stroke length. A calibration cylinder and valves will be installed to calibrate pump feed rates. Pump suction and discharge shall be 3/8" I.D. polypropylene barbed connection for "T" tubing. A 1-1/2" wye strainer will be installed. Pump motor shall be 115 volt, 60 Hz, single phase, 2.7 amp.

705.4.B.2.b. Feed Controls: CONTRACTOR shall provide one 115 volt, 60 Hz, single phase, 20 amp electrical service to Control Panel and control wiring from Lift Station control system as needed. The control panel enclosure shall be constructed of stainless steel and shall be rated NEMA 4X. It shall be equipped with a door with a continuous hinge. The hinged door shall have two latches and shall be capable of locking via padlock. The enclosure shall be mounted on the control stand, which shall contain the calibration stand. Mounted in the front panel will be:

- (1) 1-15 amp breaker, 115 volt
- (2) 2-HOA switches with L.E.D. Indicator Lights
- (3) 1-Ground fault receptacle
- (4) 1-Ventilator fan

The Process System Controller will be activated by a relay switch at the lift station control system so that the pumps will automatically turn ON/OFF with the lead pump cycles. A manual control, so either of the chemical feed pumps can be turned on or off at the site, will also be required. All control system design, fabrication, and wiring shall conform to the standards of Underwriter's Laboratories, National Electrical Code, and any other applicable federal, state, or local codes. A main power disconnect shall be located in the control stand.

Pump control box to be mounted on a 316 stainless steel pedestal which is also used to house a 1,000 ml calibration tube used for the calibration of the chemical feed pump(s). A 3-way valve will be located at the top and bottom of the calibration tube to facilitate flow measurement. Access inside this pedestal is accomplished through a door located on the front of the pedestal.

705.4.B.2.c. Liquid Storage Tanks: CONTRACTOR shall provide one (1) molded, seamless, high density cross-linked, polyethylene tank, per ASTM D 1888-93, Type I, with minimum capacity of 2400 gallons. Tank shall be placed on the lift station slab and leveled as necessary. The tank shall have one 24" (min.) gasketed and bolted manway, one 2" PVC "U" vent with screened opening. The tank will have a level gauge in gallons and clear PVC sight glass. The tank will have one 2" PVC filler line located in the top of the tank terminating with a 2" ball valve and stainless steel camlock male coupling with a PVC cap. The system shall contain no less than 2,000 gallons of nitrate solution.

All fittings with the exception of the overfill protection site glass, shall be located on the tank top or dome. No penetration of the tank side-wall shall be made. Plastic fittings shall be bulk-head or two-flange style and shall be constructed of PVC. There shall be 4 bolts on any bolted flanges up to and including 3-inch, 8 bolts on fittings 4"-8" in diameter and 12 bolts on 10"-12" diameter fittings. All bolts shall be all thread design with heads completely encapsulated in polyethylene. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4" of the threads closest to the bolt head. The polyethylene shall be color coded to distinguish bolt material: (Green-316 stainless steel, Red-Hastelloy "C", Blue-Monel, Black-Titanium). Each bolt shall have a gasket which is on the inside of the vessel. Openings that are cut in the vessel to install fittings shall not have sharp corners. Holes shall have minimum clearance to insure best performance of fittings. For all flanged connectors, the flange drilling and bolting shall be in accordance with ANSI/ASME B-16.5 for 150 psi pressure class straddling the principle centerline of the vessel.

705.4.B.2.e. Concrete Slab: The concrete slab shall be constructed in accordance with the odor control unit manufacturer's approved submittal. The concrete slab shall be installed to properly provide for all equipment and appurtenances required to establish a fully functioning odor control unit. The concrete slab shall be constructed of minimum Class A concrete with 2 rows of number 4 steel rebar on 12-inch centers (minimum) in accordance with Item for Structural Concrete.

705.4.B.2.f. Inspection and Testing: Before shipping the equipment, the Manufacturer shall perform shop tests. These tests shall include at a minimum a Visual inspection of all equipment, and a complete assembly, start-up, and wet-test of feed pumps and calibration piping.

After installation, the contractor shall contact the Engineer to perform system operation test at the site. The performance of the system shall be demonstrated to reduce hydrogen sulfide to meet with the odor control levels set forth in these Specifications. Manufacturer shall make any changes to the system, at his own expense or CONTRACTOR'S own expense.

705.4.B.2.g. Warranty: Each system supplied shall have a warranty covering all components. The system shall be warranted complete, free from defects in materials and workmanship for a period of one (1) year after installation. The chemical storage tank shall be warranted to a period of five (5) years. The supplier shall also monitor performance, provide monthly reports of sulfide testing and make dosage adjustments necessary during the first year of operation. All testing shall be documented and submitted to the Owner on a monthly basis and a log book shall be kept on site to record all activities related to the system.

705.4.C. Lift Station

This item shall consist of the furnishing and installation of a lift station wet well the furnishing and installation of lift station pumps, piping, fittings, thrust blocking, valves, control panel, electrical components, valve vault with access cover and all other lift station components between, and including, the pumps and union at the discharge side of the valve vault and associated appurtenances in accordance with these specifications and as shown in the construction plans. Additional requirements related to this item in the form of Special Provisions or Special

Specifications may be included in the Project Manual. It is the Contractor's sole responsibility to read, understand, and comply with all such additional requirements.

Related Specification shall include Item for Structural Concrete, Wastewater Pipe and Appurtenances, TxDOT Item 442, ASTM C478-07, ASTM D3753, TCEQ 30 TAC Chapter 217, Chapter 290, AISI, ANSI, ASTM, OSHA, National Electric Code (NEC), and SSPC.

705.4.C.1. Materials: The Manufacturer of materials below are considered pre-approved. CONTRACTOR may submit an equal brand of a different manufacturer to the OWNER for approval. The acceptable manufacturers are Hanson Pipe & Precast for pre-cast concrete wet wells and, L.F. Manufacturing, Inc. for fiberglass wet wells

705.4.C.1.a. Submittals: No work shall be performed in connection with the fabrication or manufacture of materials and equipment nor shall any accessory or appurtenance be purchased until the drawings and date thereof have been approved by the Engineer and Owner, except at the Contractor's own risk and responsibility. CONTRACTOR shall submit shop drawings and operations and maintenance manuals. Both the submittals and operation and maintenance manuals shall include drawings and descriptive information in sufficient detail to show kind, size, and arrangement; the external connections, anchorages, and supports required, as well as dimensions needed for installation and correlation with other materials and equipment. Data submitted shall include drawings showing essential details of any changes proposed by the Contractor and all required wiring and piping layouts. If the cut-sheets contain information not pertaining to the supplied equipment, all extraneous information shall be clearly crossed out and pertinent information highlighted.

Bill of Materials for the wet well shall include at a minimum the following information: type of concrete pipe sections or fiberglass basin (as specified in the construction plans), concrete top, concrete support ring (if required in the construction plans) bonding agent, water-stop gasket, ram-neck, joint sealer, grout, pipe penetration seal, coatings, vent, freeze proof water spigot, and access cover. If an alternate to the specifications is requested, product information must be submitted with the Bill of Materials.

Product information shall be provided for the following: concrete pipe sections or fiberglass basin, bonding agent, water-stop gasket, ram-neck, joint sealer, grout, pipe penetration seals, coatings, vent, and access cover.

CONTRACTOR shall submit the following appurtenance information:

- (1) Explosion proof submersible Non-Clog Pump (Schematic, Pump Performance Data, Pump Electrical Data) and appurtenances (seals, power cords, motor, bearings and shaft, impeller, guide rails, lifting chains, and casing)
- (2) NEMA 4X Control Panel System (Monitoring, Settings, Timer)
- (3) Piping, Valves, and Appurtenances
- (4) Electrical Service Schematic, including wire/conduit material and sizing, placement of meter pole and service leads
- (5) Concrete valve vault with access cover

If an alternate to the specifications is requested, product information must be submitted with the Bill of Materials.

705.4.C.1.b. Warranty: The Contractor shall bear full responsibility for the proper installation of the wet well. Any deviation or exception from these specifications will be allowed only at the Engineer's discretion. The Contractor and Manufacturer shall guarantee that the wet well's structure shall be free from defects in design, materials and workmanship for one year from date of acceptance by the Owner.

705.4.C.1.c. Well Material: Wet well material may be precast concrete or fiberglass. A concrete anti-floatation ring, consisting of Class A concrete, shall be constructed per the dimensions and reinforcing schedule provided in the construction plans. Pipe penetrations shall be pipe sleeves and conduit penetrations shall be sealed with Deneef Injecto or approved equal. If C-478 concrete pipe sections are used, wet well slab and wall surface shall be coated with a bonding agent (i.e. concrete glue). The base water-stop gasket shall be Synko-Flex or approved equal and shall be applied at the slab/wall interface prior to installing grout. A second water-

stop seal shall be applied at the end of C-478 pipe prior to keying into slab. The pipe should be keyed into the slab a minimum of 4 inches. Ram-neck shall be used to seal between joints. Canusa Wrapid Seal shall be installed on the outside of each joint according to manufacturer's instructions. Wet well fillets shall be grouted with fiber-filled grout or approved equal. Pipe penetrations shall be pipe sleeves and conduit penetrations shall be sealed with Deneef Injecto or approved equal. The sectional wet well shall be anchored to base with a minimum of 6 anchor collars using Hilti HIT or HVA anchors. The wet well floor must be grouted to provide a smooth finish with a minimum 10% slope toward the pump intake.

705.4.C.1.c.(1) Precast Concrete: Wet well may be constructed using C-478 concrete pipe sections (refer to ASTM C478-07). Base shall be constructed of minimum Class A concrete with 2 rows of number 4 steel rebar on 12-inch center (minimum) or W12 welded wire mesh. The wet well may be constructed using precast base and sections. Product must meet or exceed ASTM C-478 requirements. All concrete section joints shall be sealed with "O"-rings. Canusa Wrapid Seal shall be installed on the outside of each joint according to manufacturer's instructions.

705.4.C.1.c.(2) Fiberglass: Fiberglass wet well shall be installed per the manufacturer's approved specifications. Product must meet or exceed ASTM D-3753. Base shall be constructed of minimum Class A concrete with 2 rows of number 4 rebar on 12-inch center (minimum) or W12 welded wire mesh.

705.4.C.1.c.(3) Cast in Place: If the wet well is poured in place, pipe penetrations shall be wall pipe, and conduit penetrations shall be sealed with Deneef Injecto or approved equal.

705.4.C.1.c.(4) Coatings: All internal surfaces of the wet well and external surfaces of the internal piping and appurtenances shall be coated with a spray-wall process including a minimum thickness of 80 mils of Sprayroq (Sprayroq, Inc., 4707 Alton Court, P. O. Box 101717, Birmingham, Alabama 35210), or approved equivalent, and shall be coated outside with coal tar epoxy according to the Manufacturer's recommendations for use in wet wells.

705.4.C.1.d. Appurtenances: The wet well access hatch shall be sized large enough for removal of any equipment or piping inside the wet well, but in no case shall be less than 36" x 48". All lifting chains, float cables, and power cables, etc. shall be mounted so that they are easily accessible from the lift station hatch without personnel entering wet well. The wet well shall be easily accessible for portable hoisting equipment. The wet well floor must be grouted to provide a smooth finish with a minimum 10% slope toward the pump intake. All metal hardware and fasteners used in the wet well shall be 300 series stainless steel.

Wet well vents shall be constructed of coated ductile iron pipe or schedule 40 stainless steel and be a minimum diameter of 4 inches. Vents shall be sized based upon maximum air change at maximum pumping rate. The end of the vent shall terminate at least six inches above the top of the slab, or 1 foot above the 100-year floodplain elevation, whichever is higher. The vent pipe shall be topped with a 180-degree bend and a protective stainless steel screen to prevent the introduction of foreign objects, insects, or rodents into the wet well.

A freeze proof water spigot for cleaning lift station wet well shall be provided, including a 2-inch connection to a water main and installation of a 2-inch Schedule 80 PVC water supply line. The spigot shall be constructed so as to provide a minimum 24 inches above finished grade. The water supply line shall include a gate valve with valve box and a Reduced Pressure Zone (RPZ) backflow prevention assembly, including valve vault.

705.4.C.1.d.(1) Access Covers: Approved access cover: Style "FLE-AOSH" SINGLE LEAF access hatch with Safe Hatch WASTEWATER. Each hatch shall be designed to combine covering of the opening, fall through protection per OSHA standard 1910.23 and controlled confine space entry per OSHA standard 1910.146. Material shall be 6061-T6 aluminum for bars, angles and extrusions. 1/4" diamond plate shall be 5086 aluminum. Unit designed for Pedestrian Traffic only at 300 PSF. Deflection shall not exceed 1/150th of the span.

Cover shall be equipped with a stainless steel hold open arm. To highlight the hold open arm feature, the entire hold open arm must be supplied with a "red" powder coat finish. Any hold open arm not supplied with red powder coat finish shall not be accepted. Door shall automatically lock open in the 90-degree position. Hold open arm shall be fastened to the frame with a 1/2" grade 316 stainless steel bolt.

Angle frame shall be of extruded aluminum, with a continuous 1-1/2" anchor flange. Exterior of frame in contact with concrete shall be supplied with a 3-mil thickness of "Tufcoat 3.5 PR" Industrial Coating by Dupont. Application procedure shall be in accordance with manufacturer. Isolation coating shall not be substituted. Frame to be supplied with two lengths of aluminum nutrail factory installed in the hatch frame. The nutrail is to accommodate the fastening of upper guiderail brackets, cable holders, and other misc wetwell items. Any access hatch that is not factory supplied with two lengths of nutrail will not be accepted as equal.

Hinges shall be of heavy-duty design. Material shall be stainless steel with a 3/8" grade 316 stainless steel pin. Hinges shall be bolted to the angle frame and diamond plate, with grade 316 stainless steel bolts and ny-lock nuts. Aluminum hinges, or stainless steel hinges not utilizing a 3/8" diameter stainless steel pin shall be considered as equal.

Cover to be supplied with a grade 316 stainless steel recessed Slamlock, with keyway protected by a threaded stainless steel plug. Plug shall be flush with the top of the 3/4" diamond plate. Slamlock shall be fastened with four grade 316 stainless steel bolts and washers. Slamlocks that fasten with only two grade 316 stainless steel bolts and washers shall not be accepted as equal.

Unit shall be supplied with a Recessed Padlock Clip (RPC). RPC shall be supplied with its own separate hinged cover for owner access to the owner supplied padlock. The separate hinged cover MUST be supplied with a spring-loaded cover so that there is no possibility of the cover being left in the "open" position, which would cause a trip hazard. RPC's that are not supplied with a spring-loaded cover shall not be accepted.

The safety grate shall be made of 6061-T6 aluminum and designed per the "Specifications for Aluminum Structures", by the Aluminum Association, Inc., 5th Edition, Dec. 1986 for "Bridge Type Structures. Safety Nets, or Safety Grates that are fabricated from FRP, or other poly / fiberglass blend or base shall not be accepted as equal to a fabricated aluminum grate.

The grating shall be designed to withstand a Pedestrian Load of 300 PSF. Grate openings shall allow for visual inspection, limited maintenance and float adjustments while the safety grate fall through protection is left in place. Design must assure that the fall through protection is in place before the door can be closed, thereby protecting the next operator.

Each grate shall be provided with a permanent hinging system, which will lock the grate in the 90-degree position once opened. Each grate supplied with a locking device (for owner's padlock) that will prevent unauthorized entry to the confined space. The grating system will allow anyone to make visual inspection and float adjustments without entering the confined space. Any safety grates that do not have this internal locking option shall not be accepted. Grate shall be coated with OSHA type safety orange color two part epoxy paint. Welding shall be in accordance with ANSI/AWS D1.2-90 Structural Welding Code for Aluminum.

705.4.C.1.e. O&M Manuals: CONTRACTOR shall also be required to submit complete Operation and Maintenance manuals to the Owner. These manuals shall include at a minimum:

- (1) Installation information
- (2) Parts List
- (3) Maintenance Instructions
- (4) Shop Drawings
- (5) Product, service, and warranty information

Both the submittals and operation and maintenance manuals shall include drawings and descriptive information in sufficient detail to show kind, size, and arrangement; the external connections, anchorages, and supports required; and dimensions needed for installation and correlation with other materials and equipment. Data

submitted shall include drawings showing essential details of any changes proposed by the Contractor and all required wiring and piping layouts. If the cut-sheets contain information not pertaining to the supplied equipment, all extraneous information shall be clearly crossed out and pertinent information highlighted.

705.4.C.2. Construction Methods: Installation of the lift station shall be performed in accordance with all applicable standards. All concrete and reinforcing for slabs shall be constructed in accordance with Item for Structural Concrete and TxDOT Item 442. Bedding material shall consist of a minimum envelope of 2 feet around the outside diameter of the wet well in accordance with Item for Manhole. All backfill material outside of the 2 foot envelope shall consist of common backfill.

705.4.C.2.a. Wet Well Installation: Prior to backfilling, the Contractor shall, at his sole expense, have the location and elevation of all wet well openings and pipe stubs checked by an RPLS. The RPLS shall provide a signed and sealed certification of the actual locations and elevations in the project coordinate system (horizontal and vertical). The Contractor shall submit the survey data to the Engineer for review. No backfill shall be placed until the Engineer has accepted the opening and stub elevations and locations in writing. The Contractor, at his sole expense, shall adjust the wet well installation as required to conform to the construction drawings. The Contractor shall include all survey data in the project as-built drawings.

The wet well shall be tested for leaks. Prior to backfilling, the wet well shall be filled with water for 24 hours. The Engineer and the local governing authority's inspector shall inspect the wet well and certify it free of any leaks before backfilling begins.

Painted surfaces shall be protected against impact, abrasion, discoloration, or other damage during shipment. All painted surfaces which are damaged prior to acceptance of the equipment shall be re-painted to the satisfaction of the Inspector and Engineer.

Deliver, unload, and store products on site in a manner that prevents damage. Refer to related specifications for other storage handling requirements.

705.4.C.2.b. Pump, Electrical, and Appurtenances Installation: All other requirements other than the wet well shall conform to the below minimum requirements. This item is not intended to conflict the TCEQ requirements. If such conflict occurs, then the TCEQ requirements shall govern.

Electrical equipment and electrical connections in the wet well shall meet or exceed National Fire Prevention Association (NFPA) 70 National Electric Code (NEC) explosion proof requirements. Electrical enclosures shall comply with NEMA 4X standards. An audio visual alarm system shall be installed adjacent, and connected to the control panel. An auto-dialer or Supervisory Control and Data Acquisition (SCADA) system connected to a continuously monitored location must be provided in a separate housing adjacent to the control panel. CONTRACTOR shall also install A tested quick-connect mechanism or appropriately sized transfer switch to allow for a portable generator to be connected must be provided if no permanent onsite generator is provided.

Illumination shall be provided to completely illuminate the lift station, and all of its components. Placement of the illumination assembly shall be performed so as to maximize visibility around and inside the wet well, control panel, odor control unit, and valve vault. Illumination requirements shall include illumination assembly, pole foundation, wiring and conduit, pull boxes, service pole attachments, and illumination testing and configuration as outlined in Section 3000 and indicated in the construction plans. The luminaire shall be a Type II, full cutoff luminaire with photoelectric control set to turn on at dusk and off at dawn. A 30-foot tall pole and associated pole foundation shall be installed in accordance with the construction documents. Locations and sizing for all wire, conduit, pull boxes, and service pole attachments shall be determined in the field subsequent to coordination with the electric utility provider. Once determined, this information shall be submitted the Engineer for approval. All requirements for providing a fully functioning illumination system shall be considered subsidiary to the pay item for this specification, and no separate pay item shall be provided.

Valve vaults shall require drains with schedule 40 PVC drain line discharges to the wet well. The discharge to the wet well shall include a flap valve sufficient to prevent gas from entering the valve vault. The discharge line from each pump shall require a gate valve with a position indicator, and a swing check valve with an external lever, be installed inside a valve vault.

Submersible pumps shall require minimum Series 300 stainless steel guide rails and lifting chains to allow for removal and replacement of pumps without personnel entering or dewatering the wet well.

All piping internal and outside of the wet well to the union at the discharge side of the valve vault shall be fully restrained and thrust blocked (where possible) and shall consist of ductile iron Class 350. Ductile iron pipe shall be lined internally with Protecto 401 epoxy lining, or approved equal.

705.4.C.2.e. Inspection and Testing: Before shipping the equipment, the Manufacturer shall perform shop tests. These tests shall include at a minimum a Visual inspection of all equipment, and a complete assembly, start-up, and wet-test of feed pumps and calibration piping.

After installation, the contractor shall contact the Engineer to perform system operation test at the site. Upon completion of installation of the Lift Station Pump(s) and all associated items included in this specification, the Contractor shall conduct at least one on-site demonstration as required by the Engineer to show that the installed pump(s) and all systems are fully functional with settings as specified in the Contract Documents. If any deficiencies are noted during any demonstration, the Contractor shall remedy such deficiencies and conduct additional tests and demonstrations as needed to verify that all deficiencies have been fully remedied.

705.4.C.2.f. Warranty: Each system supplied shall have a warranty covering all components. The system shall be warranted complete, free from defects in materials and workmanship for a period of one (1) year after installation. The Contractor shall bear full responsibility for the proper installation of the lift station pumps, piping, control panel, electrical components, valve vault, and other components required by this specification. Any deviation or exception from these specifications shall be clearly noted in writing with the bid submittal.

705.4.C. Measurement and Payment

Measurement will be made per each (EA) for each **grinder pump system** (of any type). Excavation and backfill shall be included in the Unit Price Bid for the grinder pump system. Each bid item shall specify the size (in inches) of the pumps and well installed.

Measurement will be made per each (EA) for each **Odor Control Unit**. Excavation, backfill, and revegetation shall be included in the Unit Price Bid for the grinder pump system.

Measurement will be made per Lump Sum (LS) for each **Lift Station Unit**. Excavation, backfill, and revegetation shall be included in the Unit Price Bid for the grinder pump system.

Payment for each **Grinder Pump System**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for Grinder Pump to include warranty, excavation, furnishing, hauling, placing the for each grinder pump system and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing Megalugs, fitting, bends, etc., for completion of the Work to provide a functioning item.

Payment for each **Odor Control Unit**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid to include materials, labor, tools, equipment and other incidental necessary for completion of the Work.

Payment for each **Lift Station**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid to include warranty, hauling and testing, materials, labor, tools, equipment, valves, electrical systems and control, communication, excavation and blasting, final grading, fencing and gates if not separate bid item, revegetation and erosion control, check valves, pressure and flow meters, fittings, and other incidental necessary for completion of the Work for a functioning unit in place.

706 WASTEWATER INSTALLATION

This item shall govern and control the furnishing and placing of wastewater pipe including pipe fittings, all connections to new or existing pipe, service lines, manholes, and connections, to the lines and grades shown on the plans. All pipe and fittings shall be of the types, shapes, classes, sizes and dimensions as shown thereon; and as may be required to complete the work as shown on the plans.

706.1 PIPE INSTALLATION

The CONTRACTOR shall furnish, at its own expense, and place in position as directed by the Engineer all necessary batter boards, string lines, plummets, graduated poles, etc., required in establishing and maintaining the lines and grades. The batter boards and all location stakes must be protected from possible damage or change of location.

The contractor shall ensure all requirements of the Texas Commission of Environmental Quality (TCEQ) are complied with.

Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the Engineer and shall become the property of the Contractor to dispose of on site or at a permitted fill site, without injury to any individual. Such surplus material shall be removed from the work site promptly following the completion of the portion of the utility involved.

706.1.A. Materials

Pipe and jointing materials shall conform to the requirements of Item for Wastewater Pipes and Wastewater Appurtenances. Unless otherwise specified in the contract, water required for construction and furnished from the OWNER's distribution system shall be paid and accounted for as prescribed by the OWNER. The CONTRACTOR shall make and bear the cost of all necessary arrangements and means for hauling the water. Water shall be furnished free of charge from the OWNER'S main, if available. Construction water, if delivered through a fire hydrant meter, shall be protected by a reduced pressure zone assembly provided at the CONTRACTOR's expense. All materials shall be made in USA. Contractor shall submit to OWNER proof that materials used are made in the USA.

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality.

Compaction of Bedding material by flooding will not be permitted.

706.1.A.1. Jointing: Jointing material shall consist with the requirements outlined per Item 704 Wastewater Pipes.

706.1.A.2. Pipe Bedding: Pipe bedding materials shall consist with the requirements outlined per Item 606 for Water Installation.

706.1.A.3. Select Backfill: This material shall consist with the requirements outlined per Item 606 for Water Installation.

706.1.A.4. Flowable Backfill: Flowable backfill shall consist with the requirements outlined per Item 606 for Water Installation.

706.1.A.5. Geotextile Filter Fabric for Pipe Bedding: Geotextile filter fabric for pipe bedding material shall be Hanes Geo Components - TerraTex NO4.5 (AOS US Standard Sieve 70) geotextile fabric or approved equal.

706.1.A.6. Bulkheads: The submittal requirements for this item shall include the type (wood, plastic, rubber, etc.) and application (pipe characteristics and location) of bulkheads. Plywood shall be construction grade, 3/4 inch thick and need not be new or treated. End caps may be plastic, vitrified clay pipe, rubber or concrete.

706.1.A.7. Fittings: Fittings used with Pressure Pipe shall consist with the requirements outlined per Item 606 for Water Installation.

706.1.A.8. Field Investigation: This Item shall consist with the requirements outlined per Item 606 for Water Installation.

706.1.B. Construction Methods

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.

The **pipe zone** is defined as including the pipe bedding, backfill to one-half the pipe diameter (to the spring line) and the initial backfill to 12 inches above the top of the pipe.

The wastewater and purple pipe reuse shall construction methods shall be consistent with Item 606 for Water Installation. All bends on gravity lines shall be installed through the manholes. No bends, and fittings will be allowed on gravity lines.

706.1.B.1. Hydrostatic Testing: After the pipe has been installed and backfilled and all services laterals, fire hydrants and other appurtenances installed and connected, a pressure test, followed by a leakage test, will be conducted by the Contractor. The Contractor will furnish the pump and gauges for the tests. The specified test pressures will be based on the elevation of the lowest point of the line or section under test. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points.

606.1.B.1. a. Pressure Testing: The entire project, or each valved section, shall be tested at a pressure of 200-psi for a sufficient period (minimum 10 minutes) to discover all leaking or defective materials. Repairs shall be made by the Contractor to correct any leaking or defective materials.

606.1.B.1.b. Leakage Testing: A leakage test will follow the pressure test and be conducted on the entire project or each valved or manhole section. Test sanitary sewer facilities for leakage after completion of installation and backfill. Repair damage resulting from test at no cost to the owner, and any line that fails the test. Perform tests in presence of Engineer; submit test results and calculations. Pressure test must use the larger of 50 psi (pounds per square inch) above the normal operating pressure (total calculated head) of a force main or 150 psi. Contact engineer to determine normal operating pressure. A temporary valve for pressure testing may be installed near the discharge point of a force main and removed after a test is successfully completed. A pump isolation valve may be used as an opposite termination point. A test must involve filling a force main with water. A pipe must hold the designated test pressure for a minimum of 4.0 hours. The leakage rate must not exceed 10.0 gallons per inch diameter per mile of pipe per day. If the quantity of leakage exceeds the maximum amount calculated, remedial action shall be taken to reduce the leakage to an amount with the allowed limit.

The leakage test shall be at 150-psi for at least 4 hours. All service taps and tubing shall be tested up to the angle stop.

706.1.B.1.c. Low Pressure Test: A low pressure air test must follow the procedures described in American Society for Testing And Materials (ASTM) C-828, ASTM C-924, or ASTM F-1417, or other procedure approved by the executive director of the TCEQ. Plug each end of section to be tested with pneumatic plug. Add air to test section to bring air pressure to 5 psig; allow to stabilize while maintaining pressure. As pressure starts to drop, the interval required for pressure to drop from 4.5 psig to 3.5 psig shall be timed. A pipe segment passes the test if after the time below (minutes) and with all valves closed, the pressure is no less than 4.5-psi. Tampering with the test equipment will not be allowed. For sections of pipe less than 36-inch average inside diameter, the following procedure shall apply unless the pipe is to be joint tested. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 psig to 2.5 psig shall be computed from the following equation:

$$T = \frac{0.085 \times D \times K}{Q}$$

Where:

- T = time for pressure to drop 1.0 pound per square inch gauge in seconds
- K = 0.000419xDxL, but not less than 1.0
- D = average inside pipe diameter in inches
- L = length of line of same pipe size being tested, in feet
- Q = rate of loss, 0.0015 cubic feet per minute per square foot internal surface shall be used

The minimum permissible pressure drop time shall be per the table below.

Table 706.1.B.1.c.(1) Allowed Pressure Drop Time:

Table C.3. - Testing Pipe Diameter (inches)	Minimum Time (seconds)	Maximum Length for Minimum Time (feet)	Time for Longer Length (seconds/foot)
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1020	133	7.693
21	1190	114	10.471
24	1360	100	13.676
27	1530	88	17.309
30	1700	80	21.369
33	1870	72	25.856

The OWNER may stop a test if no pressure loss has occurred during the first 20% of the calculated testing time. If any pressure loss or leakage has occurred during the first 20% of a testing period, then the test must continue for the entire test duration as outlined above or until failure. A testing procedure for pipe with an inside diameter greater than 33 inches must be approved by the engineer on a case by case basis.

706.1.B.12.c. Service Charges for Testing: Charges may be required of the Contractor for the regulatory authority's assistance, inspection, etc, when the test results show that leakage is within the indicated allowable units.

If available, the OWNER will provide three times the volume of water in the mains for the purpose of flushing and testing. Water usage over this amount shall be payable by the Contractor at the City's effective bulk rate.

706.1.C. Measurement and Payment

If and only if a specific pay item is included in the bid form for any of the pay items listed below, the installed items shall be measured as noted below and the Contractor shall be paid for each item as noted in the contract documents; otherwise, all items under this Section shall be considered subsidiary to the facility being installed in the trench referenced by this Section. In most cases this item shall be paid under Item for Water Pipes. When a bid item is included for the work under this section, trench shall be measured by the linear foot (LF) for the trench width and depth required for installation of the pipe in accordance with the elevations indicated graphically and appropriate detail as specified in the construction documents.

The work performed and materials furnished as prescribed by this Section and measured as provided under "Measurement" will be paid under the following item if and only if this item is included as a pay item on the bid form; otherwise, all work under this Section shall be subsidiary to the pay item for the facility to be installed in the trench referenced by this Section.

If included in the bid form the **fittings** shall be paid per each (EA) installed in place including Megalugs, Megalug toolset, equipment, labor, and all incidentals to make the connection to the pipe. If not included in the bid tab, payment for fitting and associated accessories shall be considered subsidiary to the item for pipe installation.

Unless specifically included as a bid item, **connections of existing or proposed pipes** to other existing or proposed pipes, or capping or plugging of existing pipes shall not be paid separately. All such connections, fittings, adapters, caps, and plugs shall be considered subsidiary to the installation of pipe.

If included in the bid form the existing sections of pipe, and associated fittings, shown to be **abandoned or removed and disposed** of shall be measured and paid by the linear foot (LF). All salvageable fittings shall become the property of the Owner. When shown in the plans, ends of abandoned lines may require caps or plugs. All such caps and plugs, along with any required thrust blocking, will be installed as shown and will be subsidiary to the removal of the associated existing pipe.

If included in the bid form the **service taps** shall be paid per each (EA) installed in place. Measurement shall include locating service line, installing new line, tap and saddle, excavation and backfill, new valve (if applicable), single or double cleanout as shown, and all other miscellaneous items needed for the service connection whether the connection is considered a wet connection or not.

If included in the bid form the **Utility Staking** will be measured and paid per lump sum basis (LS), with the entire project requirements consisting of one item. If the Contractor elects to perform this task in multiple sections, as described above, payment of the lump sum amount may be prorated as agreed between the Engineer and Contractor. If not included in the bid tab, this item shall be considered subsidiary to pipe installation.

If included in the bid form the **Testing Wastewater Facilities** for Leaks shall be measured and paid per each (LF) basis with each test consisting of measurement along the alignment of the main pipe including the manholes, valve, service lines, and other appurtenances in place. Separate measurement and payment will be made for each test of existing sanitary facilities as specifically required by the Engineer. If not included in the bid tab, this item shall be considered subsidiary to pipe installation. No separate measurement or payment will be made for tests of sections of sanitary sewer facilities that are replaced. All costs for testing for these replaced sections shall be included in the appropriate item for wastewater line replacement.

If included in the bid form the **Replacing Existing Wastewater Facilities** shall be measured per linear foot (LF) of installed line, as measured in the field. Any cost of connections to existing lines at each end of the replaced section shall be included in the total cost of each replacement and will not be measured or paid separately. Separate pay items for assorted pipe sizes and for replacement of pressurized lines and replacement of non-

pressurized lines are provided. If not included in the bid tab, this item shall be considered subsidiary to pipe installation.

If included in the bid form the **Alignment Revision** as required to cross water and other lines shall be measured and paid per each (EA), with each adjustment paid as one unit. Pipe, fittings, bends, trench safety, and other items will be paid separately. If not included in the bid tab, this item shall be considered subsidiary to pipe installation.

706.2 TRENCH SAFETY SYSTEMS

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. This item shall be consistent with the item 606.2 for the Trench Safety Systems for water pipes.

706.3 EXISTING WASTEWATER LINE MAINTENANCE

This item shall include the avoidance, protection, relocation, and maintenance of all existing pipes and services within the project limits, until the proposed system is in place, and all materials, labor and other incidentals required to complete the work, as specified by the Engineer.

706.3.A. Materials

All materials and construction methods shall comply with requirements set forth in the contract documents. The Contractor shall protect, avoid, and relocate existing water facilities as required for completion of other contract items, regardless of whether the specific protection, avoidance, or relocation is shown on the plans or elsewhere in the contract documents.

706.3.B. Measurement and Payment

If included in the bod documents the temporary maintenance of the existing lines will be measured lump sum (LS) complete in place.

When no specific pay item is included in the contract documents for "Temporary Maintenance of Existing Line" or "Existing Line Maintenance," there shall be no direct payment for this item. All tools, labor, equipment, materials, supervision, and all other costs required for completion of the work described in this Section shall be considered subsidiary to the entire project, and no direct payment will be allowed.

Temporary maintenance of the existing wastewater and/or purple pipe reuse line, if included in the bid as a specific pay item, shall be measured as specified above and paid for at the contract unit price bid for "Temporary Maintenance of Existing Line" or "Existing Line Maintenance," which price shall include full compensation for furnishing, preparing, hauling and installing required materials, encasement pipe, carrier pipe, restraints, end seals, for grouting and for labor, tools, equipment and incidentals necessary to complete work, including excavation, backfilling and disposal of surplus material.

706.4 PIPE CONCRETE ENCASEMENT

This item shall govern the furnishing of materials and the methods of constructing a Portland cement concrete encasement. Refer to Item for Jacking or Boring for encasement pipe or pipe casing. This item shall be in accordance with Item 606.4 Pipe Concrete Encasement for water lines.

706.5 INSPECTION

All pipes (pipes and appurtenances) shall be inspected for conformance to the requirements of this specification. All deficiencies revealed by inspection shall be corrected. If wastewater system testing, as indicated above fails, video inspection meeting the requirements of this specification shall be provided at the Contractor's expense to show that deficiencies have been corrected satisfactorily. Further, the contractor shall provide video in complete segments (manhole to manhole) versus specific deficiency locations. Video inspection shall be done per Item for Drainage Inspection.

All video work shall be conducted under the direct full-time supervision of a NASSCO-PACP certified operator.

706.5.A. Materials

The conduit inspection camera and other materials shall comply with Item for Inspection under Drainage section.

706.4.B. Construction Methods

All video documentation and construction methods shall comply with Item for Inspection under Drainage section.

706.5.C. Measurement and Payment

If provided, Video Inspection shall be measured per linear foot (LF) along the centerline of the inspected pipe, without adjustment for changes in width at manholes, junction boxes, or any other facilities.

Payment for Video Inspection shall be made per unit as described above, up to and including all the depths and pipe sizes listed on the Unit Price Schedule for each drainage item. Such payment shall be full compensation for furnishing, hauling, installing, manpower, electrical, transportation, materials and equipment, and disposing of any materials used in the Video Inspection, and all incidentals involved in the Video Inspection.

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801 INTRODUCTION

This Item shall govern the replacement or planting of landscaping. Measures set forth herein shall control and be applicable until all landscaping improvements have been established.

802 REMOVAL, PROTECTION, AND REPLACEMENT OF LANDSCAPING

802.1 DESCRIPTION

No trees shall be removed unless so noted on the plans or upon the specific approval of the OWNER. Where plants, shrubbery, etc., are adjacent to the line of the work and are not to be removed or are designated on the plans to be removed and replaced, the CONTRACTOR shall protect such plants, shrubbery, etc. by substantial wooden boxes and guards and shall not permit machinery or employees to scrape, tear the limbs from, damage or attach guy cables to them. If, in the opinion of the OWNER, such plants, shrubbery, etc., would be damaged by machinery, etc., hand excavation may be required. Shrubby, plants, etc. shall be removed with a ball of dirt about their roots and shall be carefully stored and given proper attention.

Sod shall be removed in squares cut out with a sharp spade and of such sizes that they may be handled conveniently without breaking. They shall be carefully stored and given proper attention. During hot, dry weather, the stored sod shall be protected by covering with canvas or burlap.

The CONTRACTOR shall be responsible for all damage to adjacent trees, plants, shrubbery, etc., and any such damage shall be remedied to the satisfaction of the OWNER. All damaged limbs over 1-inch in diameter shall be sawed clean adjacent to the damaged area or at the trunk and dressed with acceptable tree wound treatment material, unless dressing is waived by the OWNER.

Where sod, shrubbery, plants, etc., are removed in making the excavation, such areas shall have the same sod, shrubbery, plants, etc., of the same kind and in good condition, replaced in their prior positions. Trees that are to be removed and subsequently replaced shall be designated on the plans. When backfilling is completed, the sod, shrubbery, plants, etc. shall be carefully replaced in their original location and the area thoroughly wet down.

802.2 MEASUREMENT AND PAYMENT

The cost of removal shall be paid for as a separate contract pay item if a separate pay item is provided; otherwise, the costs thereof shall be included in such pay items as are provided in the proposal and contract. The cost of protection shall not be paid for as a separate contract pay item; the costs thereof shall be included in such pay items as are provided for in the proposal and contract.

The cost of replacement shall be paid for as a separate contract pay item if a separate pay item is provided; otherwise, the costs thereof shall be included in such pay items as are provided in the proposal and contract.

803 TREE PROTECTION

803.1 DESCRIPTION

This item shall consist of the erection, maintenance and removal of tree protection for the purpose of protecting trees at locations specified by the Contract Documents. No trees shall be removed unless so noted on the plans or upon the specific approval of the OWNER. Trees under this section are classified such plants with 4-inch diameter caliper or higher as measured at chest height. The CONTRACTOR shall be responsible for all damage to adjacent trees and any such damage shall be remedied to the satisfaction of the OWNER. All damaged limbs over 1-inch in diameter shall be sawed clean adjacent to the damaged area or at the trunk and dressed with acceptable tree wound treatment material, unless dressing is waived by the OWNER.

The CONTRACTOR shall not damage or remove any trees unless authorized by the OWNER. Any tree pruning proposed to complete the work shall be submitted and approved by the OWNER prior to the work being started.

Unless otherwise stated in the contract, the CONTRACTOR shall take measures to protect existing trees during construction. Measures shall include, but not limited to, hand excavation or by other than open cut excavation under the drip line of existing trees. Payments for all protective measures are contingent on the CONTRACT.

803.2 CONSTRUCTION METHODS

Where trees, are adjacent to the line of the work and are not to be removed or are designated on the plans to be removed and replaced, the CONTRACTOR shall protect such trees by substantial wooden boxes and guards and shall not permit machinery or employees to scrape, tear the limbs from, damage or attach guy cables to them. If, in the opinion of the OWNER, such trees would be damaged by machinery, etc., hand excavation may be required. Trees to be relocated shall be removed with a ball of dirt about their roots and shall be carefully stored and given proper attention.

803.3 MEASUREMENT AND PAYMENT

Tree protection will be measured each (EA) complete in place. Such measurements will be made for all items required to erect, maintain and remove the tree protection for the duration of the project. Payment shall be full compensation, in accordance with the pay items set forth in the bid, for furnishing all materials, labor and all incidental and subsidiary materials for performing all operations necessary to complete the work.

804 TOPSOIL

804.1 DESCRIPTION

This Item shall consist of furnishing and placing topsoil, free from rock and foreign material, as indicated on the plans, to the lines and grades as established by the construction plans.

804.2 MATERIALS

All excavated material which is suitable for topsoil shall be used before any topsoil is obtained from a borrow source. Topsoil shall be secured from borrow sources as required to supplement suitable material secured from project excavation. Topsoil material secured from excavations shall be stockpiled at locations approved by OWNER. Approved topsoil shall be a minimum thickness of 6-inches unless otherwise specified on the plans, and shall be placed on areas formed to the line and grade specified in the plans.

804.3 MEASUREMENT AND PAYMENT

Topsoil secured from borrow sources shall be measured by the square yard (SY) in place on the project site. Measurements for payment shall be made only on topsoil secured from borrow sources. All work performed as ordered and measured as provided under this Item shall be paid for at the unit price bid for topsoil. The price shall be full compensation for excavating (except as noted below), loading, hauling, placing and furnishing all labor, equipment, tools, supplies and incidentals necessary to complete the work.

All labor, equipment, tools and incidentals necessary to place salvage topsoil as specified shall be included in the price bid for Item under Unclassified Street Excavation or Item for Unclassified Channel Excavation. All excavation required by this Item in cut section shall be measured in accordance with provisions for the various excavation items involved with the provision that excavation shall be measured and paid for once only, regardless of the manipulations involved.

805 FERTILIZER

805.1 DESCRIPTION

Fertilizer shall be a commercial product, uniform in composition, free flowing, with uniform particle size, minimal dust, and suitable for application with approved equipment. Fertilizer may be a natural organic, synthetic organic or inorganic fertilizer. A sample label or specification of proposed fertilizer(s) to be used shall be submitted to the OWNER for approval.

All fertilizer used shall be delivered in original bags or containers clearly labeled to show analysis of the contents. Fertilizer shall be in good physical condition. Fertilizer which has been exposed to high humidity and moisture or has become caked or otherwise damaged, making it unsuitable for use, shall be rejected.

The fertilizer is subject to testing by the OWNER in accordance with the Texas Fertilizer Law. A fertilizer shall be used with an analysis as indicated below. The figures in the analysis represent the percent of nitrogen, phosphoric acid and potash nutrients, respectively, as determined by the methods of the Association of Official Agricultural Chemists. In the event it is necessary to substitute a fertilizer of a different analysis with a lower concentration, the total amount of nutrients furnished and applied per unit area shall equal or exceed that specified for each nutrient.

805.2 MATERIALS

805.2.A. Pre-planting Application

Fertilizer analysis shall be based on soil test results and the nitrogen requirements for the turf grass specified. If the OWNER waives soil testing, fertilizer analysis shall be, by weight, in a 1-1-1 or 1-2-1 (N-P-K) ratio (such as 13-13-13 or 10-20-10,) and 10- to 15-percent sulphate and traces of iron and zinc as required and approved by the OWNER.

Pre-planting application rate shall be 1 0-lbs.-fertilizer-per-1,000-sq.ft.

805.2.B. Post-planting Application

Fertilizer analysis shall be based on soil test results and the nitrogen requirements for the turf grass specified. If the OWNER waives soil testing, fertilizer analysis shall be as specified below except that for autumn applications a complete fertilizer with a 4-1-2 to 3-1-2 (N-P-K) ratio shall be applied.

Fertilizer shall contain 30- to 50-percent slow release nitrogen, unless specified otherwise by the OWNER.

1. **Seeds or Sprigs:** As soon as new growth starts after seeding or sprigging, grass shall be fertilized every 10- to 14-days with 0.75- to 1.0-lb.-nitrogen-per-1,000-sq.ft. Applications shall alternate between nitrogen only fertilizer whose analysis is, by weight, 21-0-0 or 45-0-0 (N-P-K) and a complete fertilizer with a 3-1-2 or 4-1-2 (N-P-K) ratio (such as 21-7-14).
2. **Sod:** Fertilizer analysis shall be based on soil test results. Fertilizer shall be applied every 4- to 6-weeks at 1.0-lb.-(actual) nitrogen-per-1,000-sq.ft.

805.3 MEASUREMENT AND PAYMENT

Fertilizing shall not paid for as a separate pay item and shall be considered subsidiary to other Landscaping pay items as specified by the Contract Documents. Fertilizing shall be complete in place, as provided in the proposal and contract. The contract unit price shall be the total compensation for furnishing and placing all fertilizing, for all rolling and tamping, for all water, for disposal of all surplus material, and for all material, labor, equipment, tools and incidentals necessary to complete the work, all in accordance with the plans and these specifications.

806 SODDING

806.1 DESCRIPTION

Sodding shall consist of furnishing and planting grass as designated on the plans and in accordance with the requirements of this specification and special conditions.

806.2 MATERIALS

Sod shall "Cynodon dactylon" (Common Bermudagrass), "Buchloe dactyloides" (Buffalograss), an approved hybrid of Common Bermudagrass, or an approved Zoysiagrass. Sod shall consist of stolons, leaf blades, rhizomes, and roots with a healthy, virile system of dense, thickly matted roots throughout the soil of the sod for a thickness not less than 0.75-in. Other types may be accepted with prior OWNER approval and if landscape drawings are sealed by a Texas Licensed Landscape Architect.

Sod shall be alive, healthy, vigorous, free of insects, disease, stones, and undesirable foreign materials, weeds and grasses deleterious to its growth or which might affect its subsistence or hardiness when transplanted. The grass shall have been mowed prior to sod cutting so that the height of the grass shall not exceed 2-inches.

Bermudagrasses and zoysiagrasses shall have been grown on sand or sandy loam soils. Sod shall not be harvested or planted when its moisture condition is so excessively wet or dry that its survival shall be affected. Sod shall be protected from exposure to wind, sun and freezing. If sod is stacked, it shall be kept moist and shall be stacked roots to roots and grass to grass.

Sod to be placed between curb and walk and on terraces shall be the same type grass as adjacent grass or existing lawn as long as all sodding complies with this section. Sod to be placed during the dormant stage of these grasses shall be inspected by the OWNER to verify that the grass is acceptable.

806.3 CONSTRUCTION METHODS

All sod shall have been machine cut to uniform soil thickness of ½-in. ± 1/8-in. All sod shall be of the same thickness. Rectangular sections of sod may vary in length, but all shall be of equal width and of a size that permits the sod to be lifted, handled and rolled without breaking. Broken pads and torn, uneven ends shall be rejected.

After the designated areas have been completed to the lines, grades and cross sections shown on the plans and as provided for in other items of the contract, the surface shall be worked to a minimum depth of 4-in with a disc or tiller, and sodding of the type specified shall be performed in accordance with the requirements hereinafter described. Fertilizer shall be applied and tilled. Sodding shall be either plugging or solid.

The sod shall be placed on the prepared surface with the edges abutting one another. Adjacent rows of sod shall be staggered. In areas where the sod may be displaced, 4 staples shall be installed every square yard to secure the sod. Staples shall conform to the specification outlined under Erosion Control Blanket.

Sodded areas shall immediately be watered with a minimum of 5 gallons of water per square yard or as needed and in the manner and quantity as directed by the Engineer. Subsequent watering shall be applied at a rate of 3 gallons of water per square yard or as needed and in the manner and quantity as directed by the OWNER.

Care shall be taken at all times to retain native soil on the roots of the sod during the process of excavating, hauling and planting. Sod material shall be kept moist from the time it is dug until planted. When so directed by the OWNER, the sod existing at the source shall be watered to the extent required prior to excavating. Sod material shall be planted within 3-days after it is excavated unless preserved by techniques such as shrink wrapping and transporting in refrigerated trucks, in which case the OWNER shall approve the time interval between excavation and planting.

When necessary, the sodded areas shall be smoothed after planting has been completed and shaped to conform to the cross section previously provided and existing at the time sodding operations were begun. Any excess dirt

from planting operations shall be spread uniformly over the adjacent areas or disposed of as directed by the OWNER, so that the completed surface shall present an aesthetical appearance.

806.3.A. Plugging

Furrows parallel to the curb line or sidewalk lines, 12-in. on centers or to the dimensions shown on the plans, shall be opened on areas to be sodded. In all furrows, sod approximately 3-in.-square shall be placed on 12-in. centers at proper depth so that the top of the sod shall not be more than ½-in. below finished grade. Holes of equivalent depth and spacing may be used instead of furrows. Soil shall be firm around each block; then the entire sodded area shall be carefully rolled with a heavy, hand roller developing 15- to 25-lb.-per-square-inch compression. Hand tamping may be required on terraces.

806.3.B. Solid Sodding

At locations on the plans, or where directed, sod blocks shall be carefully placed on the prepared areas. Sod shall be so placed that the entire designated areas shall be covered. Any voids left in the solid sodding shall be filled with additional sod and tamped. The entire sodded area shall be rolled and tamped to form a thoroughly compact solid mass. Surfaces of solid sod which, in the opinion of the OWNER, may slide due to the height or slope of the surface or nature of the soil, shall, upon direction of the OWNER, be pegged with wooden pegs driven through the sod block to the firm earth, sufficiently close to hold the sod firmly in place.

806.3.C. Fertilizing Sod

Fertilizing shall consist of providing and distributing fertilizer over such areas as are designated on the plans and in accordance with these specifications. The fertilizer shall be applied uniformly over the area specified to be fertilized and in the manner directed. Fertilizer for sod shall comply with applicable provisions of Item for Fertilizer.

806.3.D. Watering and Finishing Sod

Sodded areas shall be thoroughly watered immediately after they are planted. Large areas shall be planted by irrigation zones, so areas can be watered as soon as they are planted. Sod shall be subsequently watered and mowed at such time and in a manner and quantity directed by the OWNER until completion and final acceptance of the project by the OWNER.

Sod shall not be considered finally accepted until the sod has started to peg down (roots growing into the soil), and is free from dead blocks or rolls of sod.

806.4 MEASUREMENT AND PAYMENT

Plugging and solid sodding shall be measured for payment in square yards (SY) of sodded area completed in accordance with the plans and specifications. Plugging or solid sodding, as the case may be, shall be paid for at the contract unit price per square yard (SY), complete in place, as provided in the proposal and contract.

The contract unit price shall be the total compensation for furnishing and placing all sod, for all rolling and tamping, for all water, for disposal of all surplus material, and for all material, labor, equipment, tools and incidentals necessary to complete the work, all in accordance with the plans and these specifications.

807 SEEDING

807.1 DESCRIPTION

Seeding shall consist of preparing the ground, providing and planting seed or a mixture of seed of the kind specified along and across such areas as may be designated on the plans and in accordance with these specifications.

807.2 MATERIALS

All material for seeding turf-grass provided shall be in accordance with these specifications and as noted in the plans and contract documents. Prior to planting, CONTRACTOR shall provide the OWNER with the State of Texas Certificate stating analysis of purity and germination of seed.

Seed shall be labeled in accordance with U.S. Department of Agriculture rules and regulations.

807.2.A. Bermuda Grass Seed

Turfgrass seed shall be "Cynodon Dactylon" (Common Bermuda Grass). The seed shall be harvested within 1-year prior to planting, free of Johnsongrass, field bind weed, dodder seed, and free of other weed seed to the limits allowable under the Federal Seed Act and applicable seed laws. The seed shall not be a mixture. The seed shall be hulled, extra fancy grade, and have a germination and purity that shall produce, after allowance for Federal Seed Act tolerances, a pure live seed content of not less than 85%. Pure Live Seed (PLS) Percent shall be determined using the formula: Percent Pure Live Seed = %Purity x [(%Germination +%Firm or Hard Seed) / 100]

807.2.B. Ryegrass Seed

Turfgrass seed shall be "Lolium multiflorum" (Italian or Annual Ryegrass). The seed shall be harvested within 1-year prior to planting and shall be free of perennial ryegrass seed, other grass seed and weed seed to the limits allowable under the Federal Seed Act and applicable seed laws. Seed shall be at least 95% pure, treated with fungicide, and shall have a 90% minimum germination rate.

807.2.C. Sprigs

Turfgrass sprigs and stolons shall be "Cynodon Dactylon" (Common Bermuda Grass) (Hybrid Bermuda Grass of the Tifway 419/ Tifton 10/Tifgreen Strain). Sprigs shall be acquired from a healthy stand of grass, free of weeds and other grasses. The source is to be inspected and approved by the OWNER. Sprigs and stolons are to be delivered and planted within 24-hours of harvest unless special precautions are taken to prevent drying of sprigs to assure optimum rooting.

807.3 CONSTRUCTION METHODS

After the designated areas have been completed to the lines, grades and cross sections shown on the plans and as provided for in other items of this contract, seeding of the type specified shall be performed in accordance with the requirements hereinafter described. All seeding operations shall be performed by either "drilling" or "cultipacker" process or approved equivalent. Seed shall be covered by +1/4-in topsoil. The OWNER may reject seeded area on the basis of weed populations.

807.3.A. Planting Season and Application Rates

All planting shall be done between the dates specified for each grass type except when specifically authorized in writing. The seeds planted per acre shall be of a type specified with the mixture, rate and planting dates as shown in Table 807.3.A.1. Seeding Turfgrass Rate, or as specified by the OWNER.

Table 807.3.A.1. Seeding Turfgrass Rate

Seeding Type	Planting Season	Seed and Rate
Type I	March through September	Bermuda Grass, hulled, 50-lb.-PLS*-per-acre
Type II	October through February	Rye Grass, 100-lb.- PLS*-per-acre combined with Bermuda Grass, unhulled, 20-lb.- PLS*-per-acre
Other	specified on the plans	specified on the plans

* Pure Live Seed (PLS) IS determined by multiplying the gross weight times purity times the germination. (For example, a 1 00-lb. bag with 85% purity and 80% germination: PLS = pounds in bag x purity x germination= 100-lb. x 0.85 x 0.80 = 60.8-lb. of pure live seed.)

807.3.B. Broadcast Seeding

Area to be treated shall be rough graded and raked. Seed or seed mixture in the quantity specified shall be uniformly distributed over the areas shown on the plans and where directed. If the sowing of seed is by hand, rather than by mechanical methods, the seed shall be sown in two directions at right angles to each other. Seed and fertilizer may be distributed at the same time, provided the specified uniform rate of application for both is obtained.

807.3.B.1. Native Wildflower Seeding: The seed bed shall be prepared as specified above. Seeding shall consist of broadcast seeding and shall comply with the following distribution rates:

- a. Bluebonnets shall be applied at a rate of 0.15 pounds per 1000 square feet
- b. Indian Blanket shall be applied at a rate of 0.10 pounds per 1000 square feet
- c. Missouri Primrose shall be applied at a rate of 0.05 pounds per 1000 square feet
- d. Claspng Coneflower shall be applied at a rate of 0.05 pounds per 1000 square feet
- e. Purple Horsemint or Lemon Mint shall be applied at a rate of 0.05 pounds per 1000 square feet
- f. Plains Coreopsis shall be applied at a rate of 0.05 pounds per 1000 square feet
- g. Pink Evening Primrose shall be applied at a rate of 0.05 pounds per 1000 square feet
- h. Indian Paintbrush shall be applied at a rate of 0.05 pounds per 1000 square feet

807.3.C. Disced Seeding

Soil over the area shown on the plans as directed to be seeded shall be loosened to a minimum depth of 3-in. All particles in the seedbed shall be reduced to less than 1-in. in diameter, or they shall be removed. The area shall then be finished to the line and grade as specified under Item for Watering, Maintaining, and Finishing Seeded Areas.

Seed or seed mixture specified shall then be planted at the rate required, and application shall be made uniformly. If the sowing of seed is by hand rather than by mechanical methods, seed shall be sown in two directions at right angles to each other. Seed and fertilizer may be distributed at the same time, provided the specified uniform rate of application for both is obtained. After planting, the seed shall be raked or harrowed into the soil to a depth of approximately 0.125-in.

807.3.D. Hydraulic Mulching

All mulch shall be cellulose fiber mulch and shall be refined specifically for lawn hydraulic mulch applications. Use "Conwed" or an approved equal. Adhesive (Tacking) agents for mulch may include guar gum, polyacrylamide, or other tacking agent, as approved by the OWNER. Tacking agent shall be evenly distributed in the hydraulic mulch before land application in the proportion recommended by the mulch manufacturer.

Seed or seed mixture, in the quantity specified, shall be uniformly distributed over the areas shown on the plans or where directed. Seed and fertilizer are to be distributed as water slurry, and the mixture shall be applied to that area to be seeded within 30-minutes after all components are placed in the equipment. Fertilizer shall conform to the applicable requirements of Item for Fertilizer. After placement is completed, the planted area shall be watered sufficiently to assure uniform moisture from the surface to a minimum 6-in. depth.

807.3.E. Fertilizing

Fertilizing shall consist of providing and distributing fertilizer over such areas as are designated on the plans and in accordance with applicable requirements of Item for Fertilizer. The fertilizer shall be applied uniformly over the area specified to be fertilized and in the manner directed.

807.3.F. Watering, Maintaining, and Finishing Seeded Areas

Seeded areas shall be thoroughly watered immediately after they are planted. Seeded areas shall be watered as directed by the OWNER at least twice daily for at least 14-days after seeding in such a manner as to prevent washing of the slopes or dislodgment of the seed. Water shall be applied to the cultivated areas until a minimum depth of 6-inches is thoroughly moistened. CONTRACTOR shall re-seed washed areas. The CONTRACTOR shall be responsible for proper watering until final acceptance.

Seeded areas shall be maintained, including watering and mowing, at such time and in a manner and quantity directed by the OWNER until completion and final acceptance of the project by the OWNER. At minimum, the CONTRACTOR shall maintain the seeded area until each of the following conditions is achieved: vegetation is evenly distributed, without large bare areas, and covers 70% of the seeded area.

Where applicable, the shoulders, slopes and ditches shall be smoothed after seeding has been completed and shaped to conform to the cross section previously provided and existing at the time planting operations were begun.

807.4 MEASUREMENT AND PAYMENT

Acceptable material for broadcast seeding, disced seeding, and hydraulic mulching shall be measured by the square-yard (SY) complete in place.

The work performed and materials furnished and measured as provided in this Item shall be paid for at the unit price for broadcast seeding, disced seeding, or hydraulic mulching of the type specified, as the case may be. The price shall be full compensation for furnishing all materials, including water for seed-fertilizer slurry and hydraulic mulching, fertilizer, and for performing all operations necessary to complete the work. This shall include all watering required to assure the grass will continue to grow. If this item is not provided then water shall be considered subsidiary to other landscape items.

808 MULCHING AND BLANKETS

808.1 MATERIALS

808.1.A. Straw Mulch

Straw Mulch shall be oat, wheat or rice straw, Prairie Grass, Bermuda Grass, other straw or hay approved by the Engineer/Architect. The straw or hay shall be free of Johnson Grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be molded or rotted.

808.1.B. Cellulose Fiber Mulch

Cellulose Fiber Mulch (Natural Wood) shall be natural cellulose fiber mulch produced from grinding clean whole wood chips. The mulch shall be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizers and other additives. The mulch shall be such, that when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.

808.1.C. Wood Fiber Mulch

Wood Fiber Mulch (Newsprint) shall be produced from ground newsprint with a labeled ash content not to exceed 7 percent. The mulch shall be designed for used in conventional planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizers and other additives. The mulch shall be such, that when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.

808.1.D. Erosion Control Blanket

Approved product includes Contech Excelsior Standard Plus (or approved equal).

Blanket shall have mesh top and bottom - $\frac{1}{2}$ " x $\frac{3}{4}$ " and have a nominal weight of 80 lbs. per 62 feet being 4 feet in width. Blankets shall be machine-produced used curled Aspen wood fibers with 80% of the content 6 inches or longer, evenly distributed throughout the blanket. Wood fiber shall be secured to polypropylene mesh. Blankets shall be smolder resistant without use of external additives. All polymeric components shall be photodegradable in the presence of naturally occurring ultraviolet light.

Staple blankets securely to soil as soon as installed using 6" x 6" x 1" U-shaped steel staples, .091" (11 gauge) diameter minimum.

Blankets shall be utilized on all slopes, including cuts, fills, channels, etc., exceeding an angle of 3:1, but not greater than 2 ½:1, or as indicated by the Engineer.

808.1.E. Erosion Control Mat

Approved product includes Contech ECRM C-50 (or equal). Mat shall be installed at a width of 4 feet, stapled in accordance with manufacturer's recommendations, in the bottom of all roadside ditches where the ditch profile grade exceeds 7%, and other locations specified by the Engineer. No mat shall be required where the Engineer specifically utilizes other methods of ditch bottom protection as shown on the Drawings.

808.1.F. High Shear Stress Soil Retention Blanket

Approved product includes North American Green P550 (or equal).

The blanket shall meet or exceed the requirements of TxDOT Class 2 – “Flexible Channel Liner” Type J, with a shear stress range of 0–12 pounds per square foot. Or equal items must be included in TxDOT approved product list under the appropriate class, type, and shear stress range. All or equal items must be submitted to the Engineer for approval.

Staple blankets securely to soil as soon as installed using 6" x 6" x 1" U-shaped steel staples, .091" (11 gauge) diameter minimum. Blankets shall be utilized as indicated by the Engineer.

808.2 CONSTRUCTION METHODS

Small brush or tree limbs, except Juniper, which have been shredded, may be used for mulching Native Grass seeding.

Straw mulch shall be spread uniformly over the area indicated or as designated by the Engineer at the rate of 2 to 2½ tons of straw per acre. The actual rate of application will be designated by the OWNER/Engineer/Architect. Straw may be hand or machine placed and adequately secured.

Cellulose and wood fiber mulch shall be spread uniformly over the area indicated or as designated by the OWNER/Engineer/Architect at the rate of 45 to 80 lbs. per 1000 square feet.

808.3 MEASUREMENT AND PAYMENT

Acceptable material for Blankets shall be measured by the square-yard (SY) complete in place.

The work performed and materials furnished and measured as provided in the Items for Blankets and Mats shall be paid for at the unit price per square-yard (SY). The price shall be full compensation for furnishing all materials, including water, all materials, and for performing all operations necessary to complete the work.

The work performed and materials furnished and measured as provided in the Items for Mulch shall **not** be paid for separately but shall be considered subsidiary to other landscape items.

808 REJECTION

Landscape materials may be rejected for failure to meet any of the requirements of this specification or as shown on the plans or in the contract specifications. OWNER may not reimburse contractor for any and all landscape work not completed or done incorrectly.

SECTION 900
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901 INTRODUCTION

This Item shall govern the control measures necessary to define methods and limits of electrical, communication, fencing, structures, and other miscellaneous improvements, demolition, installation, and adjustment of appurtenances. All items specified herein are intended to comply with the City of Marble Falls Standard Details, the Non-Point Source Pollution (NPS) Manual and Ordinance, and TCEQ requirements for utility installation. CONTRACTOR shall notify Engineer if it is noticed discrepancies between this Item and other City/State manuals and ordinances. CONTRACTOR shall be prohibited with continuation of work while knowing of such discrepancies.

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 requirements herein.

The OWNER reserves the right to have required temporary erosion sedimentation and water pollution prevention and control work performed by others should the CONTRACTOR fail to perform required temporary erosion, sedimentation, and water pollution prevention and control work in a timely fashion or should the CONTRACTOR fail to prevent and control soil erosion, damage control, safety, and water and air pollution which may degrade quality of air and water. All costs including engineering and right-of-way costs for the work required shall be borne by the CONTRACTOR. The CONTRACTOR shall reimburse the OWNER for all such costs within 30-days after receipt of the reimbursement request from the OWNER. Failure to submit payment for such reimbursement costs in the time prescribed above may result in the OWNER withholding the reimbursement due from the monthly progress payments to the CONTRACTOR until reimbursement to the OWNER is made.

902 DESCRIPTION

This item shall consist of furnishing all pipe and/or materials for constructing pipe mains, and appurtenances of the items mentioned in the introduction for constructing such improvements, including all applicable work such as excavating, bedding, jointing, backfilling, materials, tests, etc. The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer and shall include all joints or connections to new or existing mains, pipes, valves, manholes, structures, etc. as may be required to complete the work in accordance with specifications and standard published practices of the trade associations for the material specified and to the lines and grades indicated. This item shall consist of pumping, bailing, drainage and Trench Safety Systems for trench walls when indicated.

The OWNER shall at all times have free access to the manufacturer's plant while production in progress, and may at any time refuse to accept pipe made when the plant is failing to follow the stipulations of the specifications in regard to workmanship, or failing in provisions to insure a uniform product coming within the permissible variations of the specifications. The OWNER may reject pipe if adequate means and methods are not provided so as to insure the manufacture of a product of uniform high quality.

903 ELECTRICAL

This item shall consist of furnishing of all piping for constructing electrical conduits, laterals, stubs, service connections, services leads, electrical pull boxes and fittings, communications systems, communications manholes, communications pull boxes, and appurtenances. All pipe and appurtenances shall be manufactured in the United States, unless otherwise specified in the construction documents. The pipe shall be of the sizes, types, classes and dimensions indicated herein or designated by the Engineer. Pipe shall be cured in accordance with the applicable ASTM Designations for each type of pipe as referred to below.

The contractor shall contact the municipality or water district, as appropriate, a minimum of 48 hours prior to making any connections or performing any work that may have an impact on that entity's facility to arrange inspection by the entity.

903.1 COMMUNICATIONS

This item shall consist of furnishing and installing conduit for communications systems, communications manholes, communications pull boxes, and appurtenances as shown on the revised construction drawings. The conduit type and size, the communications manholes, and communications pull boxes shall be as indicated on the construction drawings.

903.1.A. Materials

All conduit shall be schedule 40 PVC electrical conduit. All conduit shall be connected using waterproof solvent welded joints. All bends shall be made using sweeping elbows with the largest standard bend radius available for the type and size conduit used. For bends with a non-standard degree of curvature (11-1/4 deg., 25 deg., etc.), the Contractor shall fabricate a bend of the applicable degree of curvature by cutting a standard 90 or 45 degree bend to the appropriate length.

Communications manholes shall be fully capable of sustaining H20 wheel loads on a continuing basis under constant traffic operations without damage or settlement. Communications pull boxes shall be capable of sustaining a single H20 wheel load on an occasional basis without damage. Lids and/or tops on communications manholes and communications pull boxes shall be capable of being bolted in place. All communications manholes and communications pull boxes shall have the word: "Communications" permanently cast or engraved on the lid in letters at least 1.5 inches high.

The contractor shall be required to submit for the Engineer's review and approval of product information, shop drawings and submittals on the following components is required prior to installation:

1. Communications manholes and communications pull boxes shall be constructed as shown in the construction drawings.
2. Prior to ordering any material, the Contractor shall submit, for the Engineer's approval, supplier's shop drawings for communications manholes and communications pull boxes.

903.1.B. Construction Methods

Proposed conduit shall NOT be installed in the same water line trench. Communication conduits shall be installed at minimum 3' horizontal clearance from all water and wastewater pipes and appurtenances, and at minimum 24" clearance from all other utilities and drainage systems, except electrical. If communication and electrical are specified to be installed in the same ditch, the communication conduit shall be installed 12" above the electrical conduit, which in turn shall have a minimum 2" concrete cap, painted red. Conduits shall have a minimum of 24" cover overall, and 6" bedding material above the pipe. When crossing other utilities, communication systems shall allow at minimum 12" clearance from other utilities. If such clearance cannot be accomplished, the crossing shall be encased in flowable fill at minimum 3' in each direction. Multiple communication pipes in the same ditch should be installed using pipe supports/spacers specifically manufactured for multiple pipes.

At corners, crossings, and communications pull boxes, additional trenching shall be included as necessary to accomplish routing of the conduit under and across water lines, into and out of communications manholes and communications pull boxes, and around corners. The Conduit shall be placed in the alignment shown on the drawings without the addition of extra bends or fittings except as specifically authorized by the Engineer. Upon completion of installation, each conduit run shall be tested between communications manholes and/or communications pull boxes by pulling a full-sized mandrel through the installed conduit. Conduit runs failing the mandrel test shall be replaced at the Contractor's sole expense.

The fully installed and tested conduit shall include a 1,250 pound test mule tape inside the installed conduit continuous between communications manholes and/or pull boxes. The mule tape shall have at least 10 feet of additional length coiled in place at each communications pull box.

Communications manholes and/or communications pull boxes shall be installed as indicated, with the proposed conduit routed into and out of the installed manholes and/or pull boxes. Oversized communications manholes

and/or communications pull boxes may be required for multiple conduits being routed into and out of the manhole and/or pull box. At specific locations where a conduit run is terminated at a communications manhole or communications pull box, and where a stub location is noted in the construction drawings, the terminal manhole or box shall be constructed to include a conduit stub installed in the manhole or box and continuing in the direction shown for at least 4 feet past the outside edges of the manhole or box, where the stub shall be capped. No additional payment will be allowed for such stubs and caps.

Communications manholes and/or communications pull boxes installed within the roadway shall have the tops adjusted to fit the roadway surface and provide a smooth riding surface. Communications manholes outside the roadway shall be adjusted to have the tops 2 inches above finished grade. Communications pull boxes outside the roadway shall be adjusted to have the tops match finished grade.

For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 Inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer's requirements. The tape shall be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.

903.1.C. Measurement and Payment

Measurement and Payment for **Communication Manhole** will be made per each (EA) for (of any type) installed. Excavation and backfill, adjustment to grade and additional trenching as needed shall be included in the Unit Price Bid for Communication Manhole. Each bid item shall specify the size (width in inches) of the manhole installed.

Measurement and Payment for **Pull Box** will be made per each (EA) for (of any type) installed. Excavation and backfill, adjustment to grade and additional trenching as needed shall be included in the Unit Price Bid for Pull Box. Each bid item shall specify the size (width in inches) of the manhole installed.

Measurement and Payment for **Communication Conduit** shall be measured and paid by the linear foot (LF) for (of any type) installed. Pipe will be measured along the centerline of the pipe for the various sizes and classes of pipe in place, in accordance with these specifications, complete and accepted by the Engineer, including excavation, embedment, and backfill, unless they are included in the bid as a separate pay item.

Payment for each **Communication Manhole**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the for each manhole and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fitting, bends, etc., for oversized communications manholes, including testing for completion of the Work.

Payment for each **Pull Box**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the for each manhole and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fitting, bends, etc., for oversized communications pull boxes, including testing for completion of the Work.

Payment for each **Communication Conduit**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing each linear foot of conduit and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fitting, bends, etc., for extra depth and trench, including testing; mitigation of unstable material, if encountered, trench excavation, and backfill (for all depths) are considered subsidiary to this item unless specifically included as a separate pay item, for completion of the pipe installation as indicated.

903.2 ELECTRICAL

This item shall consist of furnishing and installing conduit for electrical systems, electrical manholes, electrical pull boxes, transformer, illumination, guy wires, and appurtenances as shown on the revised construction drawings. The conduit type and size, manholes, and pull boxes shall be as indicated on the construction drawings.

903.2.A. Electrical Conduits

This item shall consist of furnishing and installing conduit for electrical systems, electrical pull boxes, and appurtenances as shown on the construction drawings. The conduit type and size, the electrical manholes, and electrical pull boxes shall be as indicated on the construction drawings.

903.2.A.1. Materials: All conduit shall be schedule 40 PVC electrical conduit, unless otherwise noted on the construction plans. All conduit shall be connected using waterproof solvent welded joints. All bends shall be made using sweeping elbows with the largest standard bend radius available for the type and size conduit used. For bends with a non-standard degree of curvature (11-¼ deg., 22-½ deg., etc.), the Contractor shall fabricate a bend of the applicable degree of curvature by cutting a standard 90 or 45 degree bend to the appropriate length.

Electrical manholes shall be fully capable of sustaining H20 wheel loads on a continuing basis under constant traffic operations without damage or settlement. Electrical pull boxes shall be capable of sustaining a single H20 wheel load on an occasional basis without damage. Lids and/or tops on manholes and pull boxes shall be capable of being bolted in place. All manholes and communications pull boxes shall have the word: "Electrical" permanently cast or engraved on the lid in letters at least 1.5 inches high.

The contractor shall be required to submit for the Engineer's review and approval of product information, shop drawings and submittals on the following components is required prior to installation:

- a. Communications manholes and communications pull boxes shall be constructed as shown in the construction drawings.
- b. Prior to ordering any material, the Contractor shall submit, for the Engineer's approval, supplier's shop drawings for communications manholes and communications pull boxes.

903.2.A.2. Construction Methods: Proposed conduit shall NOT be installed in the same water line trench. Conduits shall be installed at minimum 3' horizontal clearance from all water and wastewater pipes and appurtenances, and at minimum 24" clearance from all other utilities and drainage systems, except Communication. If communication and electrical are specified to be installed in the same ditch, the communication conduit shall be installed 12" above the electrical conduit. Electrical conduit in turn shall have a minimum 2" concrete cap, painted red. Conduits shall have a minimum of 24" cover overall, and 6" bedding material above the pipe. When crossing other utilities, communication systems shall allow at minimum 12" clearance from other utilities. If such clearance cannot be accomplished, the crossing shall be encased in flowable fill at minimum 3' in each direction. Multiple electrical pipes in the same ditch should be installed using pipe supports/spacers specifically manufactured for multiple pipes. Spacers shall not exceed 8' spacing, and as needed through vertical bends. Testing spacers shall be done via pacing a min. 60-lbs weight at the middle of the span. The clearance from pipe to bottom of trench should not result in less than 4".

Proposed conduit shall be installed as shown on the construction drawings. At corners, crossings, and around pull boxes, additional trenching shall be included as necessary to accomplish routing of the conduit under and across water lines, into and out of communications manholes and communications pull boxes, and around corners. The Conduit shall be placed in the alignment shown on the drawings without the addition of extra bends or fittings except as specifically authorized by the Engineer. Upon completion of installation, each conduit run shall be tested between electrical pull boxes by pulling a full-sized mandrel through the installed conduit. Conduit runs failing the mandrel test shall be replaced at the Contractor's sole expense.

The fully installed and tested conduit shall include a 1,250 pound test mule tape inside the installed conduit continuous between electrical pull boxes. The mule tape shall have at least 10 feet of additional length coiled in place at each electrical pull box and shall be tied or anchored at each end.

Electrical manholes and/or pull boxes shall be installed as indicated, with the proposed conduit routed into and out of the installed manholes and/or pull boxes. Oversized manholes and/or pull boxes may be required for multiple conduits being routed into and out of the manhole and/or pull box. At specific locations where a conduit run is terminated at a communications manhole or communications pull box, and where a stub location is noted in the construction drawings, the terminal manhole or box shall be constructed to include a conduit stub installed in the manhole or box and continuing in the direction shown for at least 4 feet past the outside edges of the manhole or box, where the stub shall be capped. No additional payment will be allowed for such stubs and caps.

Electrical manholes and/or pull boxes installed within the roadway shall have the tops adjusted to fit the roadway surface and provide a smooth riding surface. Manholes outside the roadway shall be adjusted to have the tops 3 inches above finished grade. Pull boxes outside the roadway shall be adjusted to have the tops match finished grade.

For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 Inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer's requirements. The tape shall be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.

903.2.A.1. Measurement and Payment:

Measurement and Payment for **Electrical Manhole** will be made per each (EA) for (of any type) installed. Excavation and backfill, adjustment to grade and additional trenching as needed shall be included in the Unit Price Bid for Electrical Manhole. Each bid item shall specify the size (width in inches) of the manhole installed.

Measurement and Payment for **Pull Box** will be made per each (EA) for (of any type) installed. Excavation and backfill, adjustment to grade and additional trenching as needed shall be included in the Unit Price Bid for Pull Box. Each bid item shall specify the size (width in inches) of the manhole installed.

Measurement and Payment for **Electrical Conduit** shall be measured and paid by the linear foot (LF) for (of any type) installed. Pipe will be measured along the centerline of the pipe for the various sizes and classes of pipe in place, in accordance with these specifications, complete and accepted by the Engineer, including excavation, embedment, and backfill, unless they are included in the bid as a separate pay item.

Payment for each **Electrical Manhole**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the for each manhole and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fitting, bends, etc., for oversized manholes, including testing for completion of the Work.

Payment for each **Electrical Pull Box**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the for each manhole and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fitting, bends, etc., for oversized pull boxes, including testing for completion of the Work.

Payment for each **Electrical Conduit**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing each linear foot of conduit and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or

compacting backfill materials, and all other incidental necessary such as providing fitting, bends, etc., for extra depth and trench, including testing; mitigation of unstable material, if encountered, trench excavation, and backfill (for all depths) are considered subsidiary to this item unless specifically included as a separate pay item, for completion of the pipe installation as indicated.

903.2.B. Transformer Pad

This item shall consist of furnishing and installing a transformer pad, conduit, and appurtenances as shown on the construction drawings. The pad type and size, shall be as indicated on the construction drawings.

903.2.B.1. Materials: Transformer Pads shall be constructed using the materials specified in the details provided. Material for conduit shall be per Item for Electrical Conduits. Concrete shall be supplied per Item for Structural Concrete. The materials and installation of the electrical utilities shall meet or exceed the requirements of the Pedernales Electric Cooperative, Inc. (PEC) at 830-693-5525. CONTRACTOR shall contact the Pedernales Electric Cooperative prior to construction for materials and installation specifications. CONTRACTOR shall also coordinate the Electrical Utility work with the Pedernales Electric Cooperative and allow their representatives access to the work for any inspections that Pedernales Electric Cooperative deems necessary.

903.2.B.2. Construction Methods: Proposed conduit above the concrete no less than 6" which then shall be capped using a plastic cap. No temporary duck-tape will be allowed. If no additional specification is provided in the drawings, then CONTRACTOR shall follow the guidelines of the latest edition for *Underground Developers Specifications* as provided by PEC. The scope of work, as required for the power usage needed for the proposed improvements, shall be sufficient to cover the requirements outlined in the above specification.

Transformer Pad shall NOT be installed above the water line, wastewater, or drainage system. Pad shall be installed at minimum 3' horizontal clearance from all water and wastewater pipes and appurtenances, and at minimum 24" clearance from all other utilities and drainage systems, except Communication.

903.2.B.3. Measurement and Payment:

Measurement and Payment for **Transformer Pad** will be made per each (EA) for (of any type) installed. Excavation and backfill, adjustment to grade and additional trenching as needed shall be included in the Unit Price Bid for Transformer Pad. Each bid item shall specify the size (inches) of the pad installed.

Payment for each **Transformer Pad**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing the for each pad and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing pipes or structures or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fitting, bends, etc., for oversized pads, including testing and coordination with electrical company for completion of the Work.

903.2.C. Guy Wires

This item shall consist of furnishing and installing all guy wire replacements, or temporary relocations of guy wires as required for construction operations as necessary at locations specified directly by the engineer. All poles shall be braced appropriately before removing guy wires. Pole bracing shall remain until the replacement of the guy wire has been completed.

903.2.C.1. Materials: Guy Wires shall be constructed using the materials specified in the details provided. Material for conduit shall be per Item for Electrical Conduits. Concrete shall be supplied per Item for Structural Concrete. The materials and installation of the electrical utilities shall meet or exceed the requirements of the Pedernales Electric Cooperative, Inc. (PEC) at 830-693-5525. CONTRACTOR shall contact the Pedernales Electric Cooperative prior to construction for materials and installation specifications. CONTRACTOR shall also coordinate the Electrical Utility work with the Pedernales Electric Cooperative and allow their representatives access to the work for any inspections that Pedernales Electric Cooperative deems necessary.

The Contractor shall be solely responsible for determining the owner of any guy wires to be relocated, and the Contractor shall be fully responsible for negotiating with the owner of the guy wires regarding scheduling, temporary bracing required, and the determination of whether the Contractor's forces or others shall actually perform the work. The Contractor shall be completely responsible for bearing any expense involved in the required relocation, which is in excess of the expense absorbed by the owner of the guy wire.

903.2.C.2. Construction Methods: If no additional specification is provided in the drawings, then CONTRACTOR shall follow the guidelines of the latest edition for *Underground Developers Specifications* as provided by PEC. The scope of work, as required for the power usage needed for the proposed improvements, shall be sufficient to cover the requirements outlined in the above specification.

Guy Wires shall NOT be installed above the water line, wastewater, or drainage system. Pad shall be installed at minimum 3' horizontal clearance from all water and wastewater pipes and appurtenances, and at minimum 24" clearance from all other utilities and drainage systems.

If any relocations are temporary, as opposed to permanent relocations, the Contractor shall have the option to provide for temporary measures, or temporary bracing to alleviate the need for guy wire relocation, provided that such temporary measures are approved and accepted by the owner of the guy wire. Restoration to the original conditions shall remain the full responsibility of the Contractor.

903.2.C.3. Measurement and Payment: Measurement and Payment for **Guy Wire** will be made per each (EA) for (of any type) installed. Excavation and backfill, adjustment to grade and additional trenching as needed shall be included in the Unit Price Bid for Guy Wire.

If provided in the bid, payment for each **Guy Wire**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, removal of old wire, bracing power pole, furnishing, hauling, and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing poles, structures, or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing anchors, concrete, drilling, etc., for oversized depths and supports, including testing for completion of the Work. If this item is not provided for in the bid, then this item shall be considered subsidiary to the Item for Power Pole, or to other itemized electrical work.

903.2.D. Power Poles

This item shall consist of furnishing all work necessary to permanently or temporarily relocate all existing power poles, disposal, and associated items such as guys wires, concrete, transformers, wires, risers, and any attached meters or other appurtenances that conflict with the proposed improvements, pole replacements, or temporary relocations of power as required for construction operations as necessary at locations specified directly by the engineer. All poles shall be braced appropriately before removing. Pole bracing shall remain until the replacement pole has been completed.

903.2.D.1. Materials: Poles shall be constructed using the materials specified in the details provided. Power poles shall be of same material as the existing power pole. Material for conduit shall be per Item for Electrical Conduits. Concrete shall be supplied per Item for Structural Concrete. The materials and installation of the electrical utilities shall meet or exceed the requirements of the Pedernales Electric Cooperative, Inc. (PEC) at 830-693-5525. CONTRACTOR shall contact the Pedernales Electric Cooperative prior to construction for materials and installation specifications. CONTRACTOR shall also coordinate the Electrical Utility work with the Pedernales Electric Cooperative and allow their representatives access to the work for any inspections that Pedernales Electric Cooperative deems necessary.

The Contractor shall be solely responsible for determining the owner of any pole to be relocated, and the Contractor shall be fully responsible for negotiating with the owner of the utility regarding scheduling, temporary bracing required, and the determination of whether the Contractor's forces or others shall actually perform the

work. The Contractor shall be completely responsible for bearing any expense involved in the required relocation, if any in excess of the expense absorbed by the owner of the power pole.

903.2.D.2. Construction Methods: If no additional specification is provided in the drawings, then CONTRACTOR shall follow the guidelines of the latest edition for *Underground Developers Specifications* as provided by PEC. The scope of work, as required for the power usage needed for the proposed improvements, shall be sufficient to cover the requirements outlined in the above specification. Furthermore, all work shall be coordinated with the Engineer and the utility provider, prior to disturbing any existing poles or appurtenances.

Poles shall NOT be installed above the water line, wastewater, or drainage system. Pole shall be installed at minimum 5' horizontal clearance from all water and wastewater pipes and appurtenances, and at minimum 36" clearance from all other utilities and drainage systems. Restoration to the original conditions shall remain the full responsibility of the Contractor.

All demolition and disposal of existing power poles and appurtenances shall be performed in compliance with the requirements of the appropriate utility provider, Owner, TCEQ and any other entity that has jurisdiction. This includes disposal of any materials considered to be hazardous waste at an approved disposal site. Alternatively, the removed material and poles shall become the property of the Contractor, who shall then take full responsibility for complying with all applicable TCEQ regulations.

All removal and disposal methods shall comply with the Item 203 for Removal and Disposal Methods and Item 215 for Power Pole removal and Disposal.

903.2.D.3. Measurement and Payment: Measurement and Payment for **Power Pole Relocation** will be made per each (EA) for (of any type) installed. Excavation and backfill, adjustment to grade and additional trenching as needed shall be included in the Unit Price Bid for Power Pole.

Payment for each **Power Pole Relocation**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, removal of old wire, bracing power pole, furnishing, hauling, and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing poles, structures, or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing anchors, concrete, drilling, connecting to and installing guy wires, etc., for oversized depths and supports, including testing for completion of the Work.

903.2.E. Illumination

This item shall consist of furnishing all work necessary to permanently install or relocate illumination or light fixtures poles and foundation, disposal, and associated items such as wires, concrete, risers, and any attached meters or other appurtenances that conflict with the proposed improvements, replacements, or temporary relocations of power of the light pole as required for construction operations as necessary at locations specified directly by the engineer. All poles shall be braced appropriately before removing, relocating, or installing new.

The items and methods addressed in this Special Specification shall conform to TxDOT Item 610 except as otherwise detailed in this Special Specification or in the plans.

903.2.E.1. Materials: Luminaires assemblies shall be of the type shown in the Construction Drawings. All hardware, ballasts, and appurtenances shall be included and shall be sufficient to provide a complete and functioning lighting system as shown on the Construction Drawings. Unless otherwise shown on the Construction Drawings, each luminaire shall be fitted with an individual photoelectric control set to turn on at dusk and off at dawn. Light poles shall be as shown in the Construction Drawings. All poles shall be of the same length and of sufficient height to provide the pole height for the attached luminaires as indicated in the Construction Drawings. All items shall be furnished and installed as specified in TxDOT Item 610 and as further specified in DMS-11010 as referenced therein. All fixtures shall be LED type, and dark sky compliant by projecting downward.

The contractor shall be required to submit for the Engineer's review and approval of product information, shop drawings and submittals on the following components is required prior to installation:

1. Manufacture's brand, type and material, with coloring specification, fixture type, amount of lumens, power consumption.
2. Prior to ordering any material, the Contractor shall submit, for the Engineer's approval, supplier's shop drawings for pole, foundation spec if not provided in the drawings, shop drawings for fixture.
3. Shop drawing should show item type, model number, and part number for each individual part for reordering, manufacturer phone number and address.
4. The Contractor shall provide separate submittals of revised wire and conduit runs to conform to final placement of service poles and transformers for the Engineer's review and approval.

Owner reserves the right to request luminaires as such that has been installed previously in the vicinity by the Owner, or a different type to better fit the Owners vision for the area, or to comply with the latest laws and ordinances, at no additional cost to Owner.

Material for conduit shall be per Item for Electrical Conduits. Concrete shall be supplied per Item for Structural Concrete. The Owner may at certain locations have an Agreement with the electric provider to install certain types of fixtures and appropriate poles that can be assembled with those fixtures. The materials and installation of the electrical utilities shall meet or exceed the requirements of the Pedernales Electric Cooperative, Inc. (PEC) at 830-693-5525. CONTRACTOR shall contact the Pedernales Electric Cooperative prior to construction for materials and installation specifications. CONTRACTOR shall also coordinate the Electrical Utility work with the Pedernales Electric Cooperative and allow their representatives access to the work for any inspections that Pedernales Electric Cooperative deems necessary.

The Contractor shall be solely responsible for determining the owner of any pole to be relocated, and the Contractor shall be fully responsible for negotiating with the owner of the utility regarding scheduling, temporary bracing required, and the determination of whether the Contractor's forces or others shall actually perform the work. The Contractor shall be completely responsible for bearing any expense involved in the required relocation, if any in excess of the expense absorbed by the owner of the power pole.

903.2.E.2. Construction Methods: If no additional specification is provided in the drawings, then CONTRACTOR shall follow the guidelines of the latest edition for *Underground Developers Specifications* as provided by PEC. The scope of work, as required for the power usage needed for the proposed improvements, shall be sufficient to cover the requirements outlined in the above specification. Furthermore, all work shall be coordinated with the Engineer and the utility provider, prior to disturbing any existing poles or appurtenances.

Poles shall NOT be installed above the water line, wastewater, or drainage system. Pole shall be installed at minimum 5' horizontal clearance from all water and wastewater pipes and appurtenances, and at minimum 36" clearance from all other utilities and drainage systems. Restoration to the original conditions shall remain the full responsibility of the Contractor.

The Contractor shall have a licensed electrician check all wire sizes and installation. The Contractor shall have all wiring and electrical components furnished and installed to meet current National Electrical Code specifications and requirements. Unless otherwise shown on the Construction Drawings, all wire runs from the service pole to the light poles shall be installed in buried conduit, schedule 40 PVC with a minimum diameter as shown on the plans. Transformers and service poles will be furnished by the electric utility and will be installed in the general locations shown in the plans. The Contractor shall furnish and install all required boxes, conduit risers, breakers, and any other required hardware, wiring, and electrical components necessary to complete the installation of the required wire runs from the service poles to the Illumination Assemblies.

Each specific Illumination Assembly shall be installed at the location shown and with an adjoining pull box as shown in the plans. However, the wire runs shown on the plans are schematic in nature and the installed locations of the service poles are likely to vary based on the electric utility's final transformer locations. It shall be the Contractor's sole responsibility to modify the conduit installation as required to provide service for each wire run

from the service poles as installed. All such modifications shall be subject to the approval of the Engineer. No additional payment will be allowed for the required field modifications.

903.2.E.2.a Inspection and Testing: Before shipping the equipment, the Manufacturer shall perform shop tests. These tests shall include at a minimum a visual inspection of all equipment, and a complete assembly. Illumination Testing shall be required subsequent to installation of all Illumination Assemblies, Pole Foundations, Wiring, Conduit, Pull Boxes, Service Pole Attachments, and appurtenances necessary to produce a fully functioning Illumination system, as designed. The testing shall consist of turning on all lighting elements for a continuous period of no less than 48 hours. After this 48 hour minimum testing period, any portion of the Illumination system that appears to be damaged or does not function as designed shall be repaired or replaced as necessary. Retesting of the Illumination system shall be required following each series of repairs or replacement of materials. The Engineer shall have the final decision in all cases as to the adequacy of the installation.

903.2.E.2.b. Configuration: Illumination Configuration shall be required after all Illumination Testing is complete and approved. Illumination Configuration shall consist of performing all activities necessary to meet the operational requirements of the fully functioning Illumination system as outlined in the construction documents.

Upon completion of all electrical installations, the Contractor shall provide as-built drawings showing all wire and conduit runs and all installed pull boxes, service poles, and Illumination Assemblies. These illumination as-built drawings shall be combined with other as-built drawings that may be required by other sections of these specifications.

903.2.E.3. Measurement and Payment: Measurement and Payment for **Luminaire or Light Pole** will be made per each (EA) for (of any type) installed. Excavation and backfill, adjustment to grade and additional trenching as needed shall be included in the Unit Price Bid.

Payment for each **Luminaire or Light Pole**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, bracing the pole, Illumination Assemblies, Pole Foundations, wiring, furnishing, hauling, and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing conduits, structures, or systems; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing anchors, concrete, drilling, connecting to and installing guy wires if needed, testing, installing adjacent pull boxes, service pole attachments, startup, configuration and as-built drawings, etc., for oversized depths and supports, including testing for completion of a functioning Luminaire.

904 FENCING AND WALLS

This item shall consist of furnishing all materials for constructing fences, gates, walls, gracing, removal and disposal or reconstruction of fencing, wall, and all associated appurtenances, connections, including all applicable work such as excavating, bedding, jointing, backfilling, materials, tests, etc. The appurtenances shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer and shall include all joints or connections to new or existing structures, fences, or other items as indicated on drawings or standard details, etc. as may be required to complete the work in accordance with specifications and standard published practices of the trade associations for the material specified and to the lines and grades indicated. This item shall consist of pumping, bailing, drainage and Trench Safety Systems for trench walls when indicated.

Fencing and walls at locations not shown for replacement or reconstruction that is damaged during construction shall be restored to the equivalent of existing conditions subject to approval by owner at the contractor's sole expense, no payment will be made for such repairs or restorations.

904.1 SECURITY FENCE

This item shall consist of furnishing and installing of a chain link security fence complete in place. The Contractor shall guarantee the fence against faulty or inadequate design, improper assembly or erection, and defective

workmanship, materials, or other failures. The Contractor shall also furnish a written warranty agreeing to furnish and install, at his own expense, any part of the fence proving to be defective within 12-months from the date of final acceptance by the Owner.

904.1.A. Materials

The installation of any approved substitution is the Contractor's responsibility. Any changes required for the installation of any approved substitution must be made to the satisfaction of the Owner and without additional cost to the owner.

904.1.A.1. Fencing Gate: New fencing and gate shall consist of cedar fencing with a fabric height of 6 foot and an overall height of 7 feet from the bottom of the fabric to the top of the barbed wire. The fence shall have a top and an intermediate brace rail, and three strands of barbed wire mounted on a 45 degree single extension arm. The upper strand shall be approximately 12 inches out from the fence and 12 inches above the top of the fabric. The main gate shall be 16 feet wide with two 8 feet wide swing-in frames. The personnel gate shall be 3 feet wide. Posts shall be set in concrete. In order to improve aesthetic appearance of the fence, the chain link mesh may be coated with vinyl or wooden privacy fencing may be attached to the outside of the chain link mesh.

904.1.A.2. Chain Link Fence: All materials and hardware for 6 foot tall fence shall be galvanized according to Chain Link Fence Manufacturers Institute. Fence components shall comply with the following:

- a. Fabric: Cedar fencing
- b. Posts: Extra strong steel pipe, all posts attached to concrete structures shall be SCH-40 galvanized steel pipe.
- c. Line Posts: 2-3/8 in. OD pipe, 3.12 lb. per ft.
- d. Terminal Posts: 2-3/8" OD pipe, 3.12 lb. per ft. (End, Corner & Pull)
- e. Gate Post: 2-3/8 in. OD pipe, 3.12 lb./ft.
- f. Gate Frames Steel pipe, 2-3/8 in.
- g. Gate Drop Rod & Appurtenances: 1-5/8 in. OD pipe
- h. Top & Intermediate Brace Rail: 1-5/8" OD pipe, 1.82 lb. per ft.
- i. Rail Couplings: Sleeve type, 6 inches long.
- j. Post Tops: Malleable iron with pressed steel extension arms, with hole for top rail, designed to prevent entry of moisture into tubular posts.
- k. Barbed Wire: Galvanized, ASTM A 121, Class 2 two 12-1/2 gauge steel wires with 4 point barbs.
- l. Stretcher Bars: Steel 3/16 inch by 3/4 inch, or equivalent area.
- m. Fabric Ties: Galvanized wires.
- n. Tension Wire: Galvanized coated coil spring wire, 7 gauge
- o. Setting Cement: Domestic Portland Cement with regular aggregate mixed to form concrete at 3000 PSI at 28 days

904.1.A.3. Residential Gate Materials: The 3-foot single swing gate shall be constructed of the same materials as the fence. The 3-foot gate shall have intermediate members as required for rigid construction and shall be free from sag or twist. The gates shall come complete with frames, hinges, braced, and pad lockable. The hinges shall not twist or turn under the action of the gate. The gate shall be installed so that it may not be removed without disassembling the hardware. The hardware attachment bolts shall be peened so that removal will be difficult.

The gate posts shall be 2-3/8 inches OD. When installed, the gates shall be of the same height as the fence and hinged to swing 180 degrees from open to close.

904.1.A.4. Mowing Strip: Mowing strip shall be formed from Domestic Portland cement with regular aggregate. It shall be eighteen (18) inches wide and a minimum of four (4) inches thick with two (2) inches above

ground level. Two (2) rows of number three (3) bars of steel shall be evenly spaced along the full length of the mow strip, and a number three(3) bar of steel shall be cross-tied every four (4) feet. Expansion joints shall be installed every twenty (20) feet. Fence posts shall be installed in center of mow strip.

904.1.B. Construction Methods

The Contractor shall prepare the excavation for the correct elevation after grading has been properly executed. The fence and gates shall be set according to the drawings. All work and materials shall be in full accordance with the latest rules and regulations of the Owner and/or local governing authority.

The Contractor, shall make a thorough examination of the site to familiarize himself with the nature and extent of the work to be encountered. The Contractor shall field verify all measurements. No extra compensation will be allowed for any work made necessary by unusual conditions or obstacles encountered during the progress of the work which are readily apparent upon visiting the site. The Contractor shall be responsible for procuring all available plans and information concerning underground utilities which might be encountered. Damage to these facilities due to the Contractor's negligence shall be repaired by qualified workmen at the Contractor's expense.

904.1.B.1. Existing Conditions: The Contractor shall acquaint himself with all site conditions prior to beginning any work. The Contractor is responsible for determining the presence of any buried utilities in addition to the ones shown on the drawings. If any utilities or other work not shown on the plans be found during excavations, the Contractor shall notify the Engineer as to the required course of action. The Contractor shall take necessary precautions to protect the site conditions. Should damage be incurred, the contractor shall repair the damage to its original condition at his own expense.

904.1.B.2. Permits and Fees: The Contractor is required to obtain all permits and pay all required fees to any governmental agency having jurisdiction over this project. The Contractor shall also arrange for any inspections required by local agencies and ordinances during the course of the project.

904.1.B.3. Fence Installation: The installed fence shall conform to the alignment and grade. All posts shall be plumb and spaced at a maximum 10-feet apart. The fence shall be installed to maintain not more than 2-inches of clearance below the bottom of the fence fabric. Unless provided for otherwise, line posts shall be embedded at least 30" into concrete foundation; gate and terminal posts at least 36".

If bedrock is encountered, post excavation shall be continued to the 36 inch depth or 26 inch into the rock, whichever is less. Concrete foundations shall be circular in horizontal section, not less than 12 inches in diameter for line posts, and with a diameter not less than the post OD plus 12 inches for terminal and gate posts, except that foundations in bedrock shall be a minimum of 6 inches larger than the outside dimension of the post. Foundations shall extend 2" above the ground surface and shall be crowned approximately two inches. Concrete for foundations shall be cured for at least 72 hours before further work is done on the post.

Top and intermediate rails, and bottom tension wires shall be installed before the fabric. Top and intermediate rails shall be securely connected to gate and terminal posts. Tension wires shall be attached to each post and securely anchored at terminal and gate posts. A terminal post shall be provided at each change in slope. Fabric shall be attached to the top and bottom rails at 24-inch centers and to the line posts at 15-inch centers. Barbed wire shall be fastened to each extension arm by internal clips or external fabric ties.

Stretcher bars shall be provided at each gate, terminal, and pull post. Each stretcher bar shall be threaded through the fabric and anchored to the post at 15 inch centers by positive mechanical means. Each gate, terminal, and pull post shall be braced by a horizontal pipe brace and an adjustable truss(es) extending to an adjacent line post. Center posts shall be braced in both directions. Fabric shall be stretched taut and anchored so that a pull of 150 pounds at the middle of the panel will not lift the bottom of the fabric more than 6 inches.

904.1.B.4. Final Acceptance: Upon final acceptance, the Owner will assume responsibility for maintenance of the work. Final acceptance does not relieve the Contractor of the warranty obligations. The

Contractor shall remove all excavated material and trash from the site after each working day. Any trash or material left on site at the end of each day, or at the end of the project, may be disposed of by Owner at the Contractor's expense.

904.1.B.5. Testing and Inspection: All identified deficiencies shall be corrected by the Contractor prior to the acceptance of the project by the Owner. Fence and gates should not move if pulled by hand or leaned against.

904.1.C. Measurement and Payment

Measurement and Payment for **Security Fence** shall be measured and paid by the linear foot (LF) for (of any type) installed. Fence will be measured along the centerline of the fence for the various sizes and classes of fence in place, in accordance with these specifications, complete and accepted by the Engineer, including excavation, embedment, and backfill, unless they are included in the bid as a separate pay item.

Payment for each **Security Fence**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing each linear foot of fence and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing structures or systems including gates and corner anchors; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fittings, bends, supports, etc., for extra depth and trench, including testing; mitigation of unstable material, if encountered, trench excavation, and backfill (for all depths) are considered subsidiary to this item unless specifically included as a separate pay item, for completion of the pipe installation as indicated.

904.2 MISCELLANEOUS FENCE

This item shall consist of removal and/or furnishing and installing a smooth fence, barbed wire fence, safety fence, complete in place. The Contractor shall guarantee the fence against faulty or inadequate design, improper assembly or erection, and defective workmanship, materials, or other failures. The Contractor shall also furnish a written warranty agreeing to furnish and install, at his own expense, any part of the fence proving to be defective within 12-months from the date of final acceptance by the Owner.

904.2.A. Materials

The installation of any approved substitution is the Contractor's responsibility. Any changes required for the installation of any approved substitution must be made to the satisfaction of the Owner and without additional cost to the owner. In addition to standard details and design documents, the removed fence or new fence shall comply with the following requirements:

1. Brick Columns: All existing brick columns, fencing and gates shall be reconstructed at the proposed right of way, unless otherwise noted. The contractor shall install new fencing to the equivalent of existing conditions subject to approval by owner.
2. Smooth Wire Fence: All smooth wire fencing in the proposed right of way shall be removed and new fencing shall be constructed at the proposed right of way, unless otherwise noted. The number of strands of wire shall be as indicated in the Unit Price Schedule.
3. Barbed Wire Fence: All barbed wire fencing in the proposed right of way shall be removed and new fencing shall be constructed at the proposed right of way, unless otherwise noted. The number of strands of wire shall be as indicated in the Unit Price Schedule.
4. Miscellaneous Fence: All fence indicated shall be called out in the construction documents by station number and shall be reconstructed in kind.
5. Pedestrian Safety Fence: All fence shall be plastic net standard construction safety fence and shall be bright orange in color. All Pedestrian Safety Fence shall be constructed in locations as shown on the plans and shall be firmly supported in place by steel t-posts driven into the ground to provide a stable support. All Pedestrian Safety Fence shall be maintained in place through the duration of the project and removed upon completion of the project. All Pedestrian Safety Fence materials shall be the property of the Contractor.

6. Installation of H-Braces, Reconnection and Re-stretching of Existing Fence: All installations shall be performed as indicated in the construction documents.
7. Removal and Disposal of Existing Fence: All removal and disposal shall be performed as indicated in the construction documents. For chain link fence, provide terminal ends as appropriate for all locations where fencing has been removed.

All fencing to be removed shall require coordination with the property owner. Special provisions, such as temporary fencing throughout the project, shall be necessary, unless the contractor provides written permission from all adjoining landowners. No separate pay item shall be provided for coordination or special provisions necessary to remove or reconstruct the specified fence.

904.2.A.1. Fencing Gate: Fence gates shall consist of galvanized panel gates to the size and material specified. All Fence Gate construction shall conform to the type specified and appropriate detail.

904.2.A.2. Cattle Panels: Cattle Panels shall consist of a minimum of 4 gauge galvanized wire, with a minimum height of 5 feet, unless otherwise shown in the construction drawings. All Cattle Panel construction shall conform to the Contract Documents

904.2.A.3. Fence Water Gaps: Fence Water Gaps shall consist of minimum 2 ¾ gauge galvanized wire, with a minimum height of 4 feet, unless otherwise shown in the construction drawings. All Fence Water Gap construction shall conform to the Contract Documents.

904.2.A.4. Mowing Strip: Mowing strip if indicated, shall be done per Item 904.1 for Security Fence.

904.2.B. Construction Methods

The construction methods shall comply with all the requirements per Item 904.1 for Security Fence.

904.2.C. Measurement and Payment

Measurement and Payment for **Miscellaneous Fence, Cattle Panels, Water Gaps, and Fence Gates** shall be measured and paid by the linear foot (LF) for (of any type) installed. Fence will be measured along the centerline of the fence for the various sizes and classes of fence in place, in accordance with these specifications, complete and accepted by the Engineer, including excavation, embedment, and backfill, unless they are included in the bid as a separate pay item.

Payment for each **Miscellaneous Fence, Cattle Panels, Water Gaps, and Fence Gates**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing each linear foot of fence and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing structures or systems including gates and corner anchors, braces and stretching; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fittings, bends, supports, etc., for extra depth and trench, including testing; mitigation of unstable material, if encountered, trench excavation, and backfill (for all depths) are considered subsidiary to this item unless specifically included as a separate pay item, for completion of the pipe installation as indicated.

If provided in the construction documents the Measurement of **Fence Gate** shall be made each (EA) of each type installed. If not provided for in the construction documents then this item shall be considered subsidiary to general fencing construction. Payment for each type shall be made as indicated above or item complete in place including all incidentals and appurtenances.

904.3 RETAINING WALL

This Item shall govern for the furnishing and installing of modular and concrete block retaining walls as shown on the plans and as specified in the specifications. Prior to fabrication, the Contractor shall submit to the Owner seven (7) sets of shop drawings and two (2) sets of design calculations. These drawings shall reflect all

information needed to fabricate and erect the walls including the base of wall elevations; the shape and dimensions of wall elements; the size, number and details of the reinforcing steel; the number, size, type, and details of the soil reinforcing system and anchorage; and any additional details pertaining to coping, railing, drainage or base slabs as required by the contract plans. Base of wall elevations may vary from footing elevations shown on the plans. However, the base of wall elevations shall be such as to allow for transverse and longitudinal drainage structures shown on the plans. Unless otherwise shown on the plans, one-foot minimum cover shall be provided from the bottom of the lowest facing element to finish grade. Construction drawings and design calculations shall bear the seal of a Registered Professional Engineer.

904.3.A. Modular Retaining Walls

This Item shall govern for the furnishing and installing of modular retaining walls as shown on the plans and as specified in the specifications.

904.3.A.1. Materials: All materials and all construction methods utilized shall be as shown on the plans and in the Specifications. Contractor shall furnish to OWNER manufacturer product list and sampling images and typical usages. Wall material and bracing shall be appropriate for wall height per the calculation submitted by the manufacturer indicating adequate support for the wall height as specified in the drawings.

Wall should have 1' min. pea gravel or crushed rock material behind the wall with perforated drain pipe encased in geofabric for appropriate drainage. Backfill material shall comply with Item 904.3.B for Concrete Block Walls.

904.3.A.2. Construction Methods : All applicable construction methods shall comply with Item 904.3.B for Concrete Block Walls and as recommended by the manufacturer.

904.3.A.3. Measurement and Payment: Measurement shall be measured and paid by the linear foot (LF) for of any type and height installed. If wall are constructed in series, then each wall shall be measured separately. If steps are constructed of the same material across from the wall, and the steps are no longer than the 150% of the height of the wall, such steps shall be considered subsidiary to wall construction, and the wall will be measured across from the steps. Wall will be measured along the centerline for the various sizes and classes in place, in accordance with these specifications, complete and accepted by the Engineer, including excavation, embedment, and backfill, unless they are included in the bid as a separate pay item.

Payment for each **Modular Retaining Wall**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing each linear foot of wall and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing structures or systems including gates and corner keys or bends, steps, braces and stretching; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fittings, bends, supports, etc., for extra depth and trench, including testing; mitigation of unstable material, if encountered, trench excavation, and backfill (for all depths) are considered subsidiary to this item unless specifically included as a separate pay item, for completion of the structure installation as indicated.

904.3.B. Concrete Block Retaining Walls

This Item shall govern for the construction of Concrete Block Retaining Walls in accordance with these specifications and with the lines, grades and dimensions shown on the plans. When optional or alternate design details are shown on the plans, the Contractor will have the option of constructing any of the types of retaining wall shown. The Contractor will be required to use the same facing design within an area of continuous retaining walls. The Contractor's attention is directed to the fact that retaining wall options shown on the plans may be proprietary.

Prior to fabrication, the Contractor shall submit to the Owner two (2) sets of shop drawings and two (2) sets of design calculations. These drawings shall reflect all information needed to fabricate and erect the walls including the base of wall elevations; the shape and dimensions of wall elements; the size, number and details of the

reinforcing steel; the number, size, type, and details of the soil reinforcing system and anchorage; and any additional details pertaining to coping, railing, drainage or base slabs as required by the contract plans. Base of wall elevations may vary from footing elevations shown on the plans. However, the base of wall elevations shall be such as to allow for transverse and longitudinal drainage structures shown on the plans. Unless otherwise shown on the plans, one-foot minimum cover shall be provided from the bottom of the lowest facing element to finish grade. Construction drawings and design calculations shall bear the seal of a Registered Professional Engineer.

904.3.B.1. Materials: The concrete block units shall comply with the requirements of ASTM C90, "Load-Bearing Concrete Masonry Units" when sampled and tested in accordance with ASTM C140, "Sampling and Testing Concrete Masonry Units", except that the minimum compressive strength shall be 3000 psi, and the maximum water absorption shall be limited to 7 percent. Aggregates used in the manufacture of concrete block units shall conform to ASTM Specification C-33 for normal weight concrete aggregate (no expanded shale or light weight aggregates) except that the grading requirements shall not necessarily apply. Concrete for base slabs or coping, when required, shall be TxDOT Class "A". Any admixtures required or permitted shall meet the requirements of TxDOT Item 437, "Concrete Admixtures". Unless otherwise noted on the plans, reinforcing steel may be Grade 40, meeting the requirements of TxDOT Item 440, "Reinforcing Steel". Any filter-fabric material required shall conform to TxDOT Specification D-9-6200, "Filter Fabric".

Any soil reinforcements required shall be of the type specified on the approved construction drawings and design calculations. Manufacturer's certification of compliance with the design values will be required.

Backfill Material

- a. Granular backfill required within the limits of and one foot behind the facing units shall be free from organic or otherwise deleterious material, and shall conform to the following gradation limits as determined by TxDOT Test Method Tex-110-E.

Sieve Size	Percent Passing
3/4 inches	100
3/8 inches	0-25

- b. Granular backfill required within the limits of the soil reinforcing system shall be free from organic or otherwise deleterious material and shall conform to the following gradation limits as determined by TxDOT Test Method Tex-110-E.

Sieve Size	Percent Passing
3/4 inches	100
No. 200	0-15

904.3.B.2. Construction Methods: Excavation shall be in accordance with the requirements of TxDOT Item 110, and in conformity with the limits and construction stages shown on the plans. The foundation for the structure shall be graded as required and shall be approved by the Owner before erection is started. Prior to wall construction, the foundation shall be compacted for a width equal to the structure volume with a smooth wheel vibratory roller. Any foundation soils found to be unsuitable shall be removed and replaced. The precast concrete block units shall be installed in accordance with the manufacturer's recommendations as shown on the approved shop plans. Special care shall be taken in setting the bottom course of units to true line and grade.

At each reinforcement level, backfill shall be leveled before placing the reinforcement. As shown on the plans, earth reinforcements shall be placed normal to the face of the wall. Each layer of reinforcement shall be pulled taut and pinned to remove any slack prior to placement of backfill. At no time will tracked equipment be allowed to operate directly on the earth reinforcements. Any operation resulting in damage to or displacement of earth reinforcements shall be immediately discontinued. Backfill shall be compacted to the maximum practical density as determined by the Owner.

Backfill and embankment behind the wall shall be placed and compacted in accordance with the applicable requirement of TxDOT Item 132. When erecting a wall, placement of backfill behind the wall shall closely follow erection of successive courses of units. At no time shall the difference in elevation between the backfill and the top of the last erected course exceed three feet. Underdrain, if required, shall be placed in accordance with the Contract Documents and in accordance with applicable specifications.

The concrete block walls shall be erected within a horizontal and vertical tolerance of 1 1/2 inches when measured along a 10-foot straight edge. The overall vertical tolerance of the wall shall not exceed one (1) inch per 10 feet of wall height.

904.3.B.2.a. Testing and Inspection: The Contractor shall display for approval typical samples of block units, indicating the color, texture and finish. The block units shall be cast in steel forms and in a manner that will assure the production of uniform units. The transporting, placement and compaction of concrete shall be by methods that will prevent the segregation of the concrete materials and the displacement of the reinforcement steel from its proper position in the form. Concrete shall be carefully placed in the forms and vibrated sufficient to produce a surface free from imperfections such as honeycomb, segregation, cracking or checking. Care shall be taken during storage, transporting, and handling of all units to prevent cracking or damage. Units damaged by improper storing, transporting, or handling shall be replaced or repaired to the satisfaction of the Owner. The quality of materials, the process of manufacture, and the finished units may be subject to inspection by the Owner prior to the shipment. Precast units shall be subject to rejection on account of failure to conform to any of the specification requirements. Individual units may be rejected because of any of the following:

- (1) Tolerances for Individual Units: The length of individual units shall be within 1/8 inch of the specified dimension. The width of all units shall be within 1/8 inch of the approved specified dimension. When a broken or fractured face is required, the length of individual units shall be measured from the back of the unit to the point of contact of the splitting device.
- (2) Formed Surfaces: The sides of the units which bear against other units shall be constructed so that the finished units will meet the tolerances specified in "Tolerances for Individual Units" and so that the units may be stripped without damage to the concrete. Honeycombed or open surfaces shall be done per Owners approval.

904.3.B.3. Measurement and Payment: Measurement shall be measured and paid by the linear foot (LF) for of any type and height installed. If wall are constructed in series, then each wall shall be measured separately. If steps are constructed of the same material across from the wall, and the steps are no longer than the 150% of the height of the wall, such steps shall be considered subsidiary to wall construction, and the wall will be measured across from the steps. Wall will be measured along the centerline for the various sizes and classes in place, in accordance with these specifications, complete and accepted by the Engineer, including excavation, embedment, and backfill, unless they are included in the bid as a separate pay item.

Payment for each **Concrete Block Retaining Wall**, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, placing each linear foot of wall and all incidental and subsidiary materials and works; preparing, shaping, reinforcing, dewatering, shoring, placing and preparing bedding, for connecting to new or existing structures or systems including gates and corner keys or bends, steps, braces and stretching; for hauling, moving, placing or compacting backfill materials, and all other incidental necessary such as providing fittings, bends, supports, etc., for extra depth and trench, including testing; mitigation of unstable material, if encountered, trench excavation, and backfill (for all depths) are considered subsidiary to this item unless specifically included as a separate pay item, for completion of the structure installation as indicated.

905 CONCRETE FOR STRUCTURES

The requirements of this item shall govern for all concrete for structures or miscellaneous construction. Concrete shall be considered of satisfactory quality and made of materials acceptable to the job and these

specifications, in the proportions approved by the OWNER; and mixed, placed, finished and cured in accordance with the requirements of these specifications and any special provisions.

905.1 MATERIALS

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.

905.1.A. Aggregates

Aggregates for Portland cement concrete shall conform to the requirements contained in this Item and shall be approved by the OWNER prior to use. Aggregates shall be of such character that it shall be possible to produce workable concrete within the limits contained in this specification.

This item shall comply with all the requirements for Item 407 for Concrete Pavement.

905.1.B. Portland Cement

Portland cement shall be in accordance with Item 405.2 for Portland Cement Treatment. Only one brand of cement shall be used in any one (1) structure, except by written permission of the 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.

905.1.C. Admixtures

Unless otherwise provided in the plans or special provisions, approved types of chemical admixtures to minimize segregation, to improve workability or to reduce the amount of mixing water may be used in the rate of dosage specified by the OWNER and in accordance with the manufacturer's recommendations.

Admixtures item shall comply with all the requirements for Item 407 for Concrete Pavement.

905.1.D. Water

Water shall comply with all the requirements for Item 407 for Concrete Pavement.

905.1.E. Formwork

Formwork shall comply with all the requirements for Item 407 for Concrete Pavement.

905.1.F. Reinforcing

Concrete reinforcement is the metal (rods or fabric) imbedded in concrete in such a manner that the reinforcement and concrete act together in resisting forces. This item shall comply with all the requirements for Item 407 for Concrete Pavement.

905.1.G. 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.

Joints shall comply with all the requirements for Item 407 for Concrete Pavement.

905.1.H. Concrete Properties

Concrete shall be composed of cementitious materials, fine aggregate, coarse aggregate, mineral filler and/or admixture if used and water, mixed in the proportions designated by the approved Mix Design and in the manner set forth in this specification. On the basis of job and laboratory investigations of the proposed materials, the

Contractor will fix proportions by weight of water, coarse aggregate, fine aggregate, cementitious materials, admixture and mineral filler where required, in order to produce concrete of the specified strength and workability for the actual delivery time and site conditions to be encountered.

Concrete shall be proportioned- as detailed in the approved mix design. 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.

It shall be the responsibility of the Contractor to furnish the mix design, using a Coarse Aggregate Factor acceptable to the City, for the class of concrete specified. The mix shall be designed by a certified testing laboratory to conform with the requirements contained herein and in accordance with ASTM C1077. The Contractor shall perform, at his own expense, the work required to substantiate the design, and testing of concrete strength. Complete concrete design data shall be submitted to the Engineer for approval.

905.1.H.1. Concrete Classes: The concrete shall be uniform and workable and the minimum cement content, maximum water content, for the various classes of mixes shall conform to the following table 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:

Table 905.1.H.1.a. Concrete Classes

Class of Concrete¹	28 Day Min. Compressive Strength² (psi)	Max. Water/ Cementitious Ratio	Max. Coarse Aggregate Size⁴	Appropriate Usage⁴
B	2,000	0.6	2-7	Small roadside signs, and anchors
C ⁵	3,600	0.45	1-6 ⁷	Drilled shafts, bridge substructure, bridge railing & Approach, Drainage, traffic barrier
D	1,500	0.6	2-7	Riprap
E	3,000	0.5	2-5	Seal Concrete
F ⁵	Note 5	0.45	2-5	Railroad and Bridge Structures
S ⁵	4,000	0.45	2-5	Bridge slabs
DC ⁵	5,500	0.4	6	Dense concrete overlay
CO ⁵	4,600	0.4	6	Concrete Overlay
LMC ⁵	4,000	0.4	6-8	Latex-modified concrete overlay
SS ⁵	Note 6	0.45	4.6	Slurry displacement shafts, underwater drilled shafts

1. All exposed horizontal concrete shall have entrained - air.
2. Minimum Strength Required by OWNER [Compressive or Flexural]
3. ASTM C78 (Third-Point); Reduce by 10% when Type II Cement is Used
4. Smaller nominal maximum size aggregate may be used if strength requirement is satisfied
5. Structural concrete classes, See plans or Design report.
6. Cementitious material content shall be minimum 658-pcy of concrete.
7. Grade 1 aggregate shall not be allowed unless specifically directed and steel bars shall have a minimum 4-in clear spacing. Grade 1 will not be allowed in drilled shafts.

905.1.H.2. Slump: Slump requirements for pavement and related concrete shall be as specified in Table 407.1.H.2.a. Slump Requirements. Slump shall comply with all the requirements for Item 407 for Concrete Pavement.

905.1.I. Submittals

Submittals shall comply with all the requirements for Item 407 for Concrete Pavement.

905.2 EQUIPMENT

All equipment shall comply with all the requirements for Item 407 for Concrete Pavement.

905.3 CONSTRUCTION METHODS

Construction Methods shall comply with all the requirements for Item 407 for Concrete Pavement.

905.4 MEASUREMENT AND PAYMENT

When specifically included on the bid form as a pay item, concrete placed under this Section shall be measured complete in place by physically measuring the completed concrete structure after removal of forms and all required finishing has been completed. Length and width (or depth) shall be measured, and the constructed volume of the placed concrete shall be computed in square yards (SY). Separate provisions may be made in the bid documents and drawings allowing for measurement of concrete placement in cubic yards (CY), which will account for the volume of concrete placed. Other provisions may be made to measure the concrete in linear feet (LF) through the length of the structure. Such length approximates an average cross section of the structure. If such provision is made, and within the linear footage of the structure there is a deviation in dimension, such deviation shall be considered subsidiary to the length measurement and overall quantity of the structure. If none of the above measurement apply the concrete placed shall be measure per each (EA) of each structure poured or per lump sum (LS) of all such structures in place. When not specifically included on the bid form as a pay item, there shall be no direct measurement of installed concrete, and all installed concrete not included in a specific bid item shall be paid as a subsidiary item to other bid items in the contract.

Concrete for Structures, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid as noted above which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, hauling and handling all concrete ingredients, including all freight and royalty involved; for placing and adjusting forms, including supporting material or preparing track grade; for mixing, placing, finishing, sawing, cleaning and sealing joints and curing all concrete; for furnishing and installing all reinforcing steel; for furnishing all materials for sealing joints and placing longitudinal, expansion and weakened plane joints, including all steel dowel caps and load transmission devices required and wire and devices for placing, holding and supporting steel bars, load transmission devices and joint filler material in proper position, for coating steel bars, all other materials and methods, equipment, tools, testing, labor, and incidentals necessary to complete the work.

906 GABIONS AND REVET MATTRESSES

The work to be performed under this specification shall include furnishing, assembling, filling, and tying rock-filled wire mesh compartmented gabions and revet mattresses in accordance with the lines, grades, and dimensions shown on the Drawings or otherwise established in the field by the Engineer or designated representative. The type of construction (i.e. twisted woven mesh, welded mesh or both) and wire sizes [i.e. 13.5 gage (2.2 mm), 12 gage (2.7 mm) or 10 gage (3.4 mm)] shall be as defined in the Drawings or otherwise established by the Engineer or designated representative. This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

906.1 MATERIALS

Gabions and revet mattresses shall be constructed of galvanized steel wire with polyvinylchloride (PVC) flexible coating. The gabions and revet mattresses shall be of the construction and sizes specified in the Drawings and shall meet the specifications presented herein. Unless otherwise specified in the Drawings or approved by the Engineer or designated representative, the gabions and revet mattresses may be constructed of either double twist woven mesh or welded wire mesh. Gabions shall be furnished in the specified dimensions within a tolerance of ± 5 percent. Revet mattresses shall be furnished in the specified dimensions within a tolerance of 5 percent for

the length and width and (10 percent for the height. For each individual gabion or revet mattress, the same mesh style shall be used for the base, front, ends, back, diaphragms and lid panels. Each gabion or revet mattress shall be manufactured and divided into cells of equal length, no greater than 3 feet (0.9 meter), by diaphragm panels.

906.1.A. Wire

Gabion wire shall be galvanized steel, Class 3 or A coating, soft temper conforming to ASTM A 641, and shall specifically meet the requirements given below for gabions (12 gage wire) and/or revet mattresses (13.5 wire gage) as called for in the Drawings. PVC coating of the wire may be fuse-bonded or extruded onto the wire. Galvanization of welded wire shall be performed either before or after welding.

Table 906.1.A.1. Wire Mesh Requirements

Characteristic	Gabions	Revet Mattresses
Wire Gage	12 gage	13.5 gage
Maximum Tensile Strength (ASTM 641)	70,000 psi	75,000 psi
Nominal Wire Diameter (ASTM A 641)	0.106 inch	0.0866 inch
Minimum Diameter (ASTM A 641, Table Below)	0.102 inch	0.0826 inch
Galvanizing, Zinc (ASTM A 641, Table Below)	0.80 oz/ft ²	0.70 oz/ft ²

906.1.B. Gabion Mesh

Woven mesh shall be of a uniform non-raveling, double twist hexagonal pattern nominally of dimensions 3.25 inches by 4.5 inches. Selvedge wire shall be 10 gage (nominal diameter of 3.4 mm).

Mesh opening shall be nominally 3 inches by 3 inches. Strength of welds shall meet the following requirements when tested in accordance with section 13.4 of ASTM A-974:

Table 906.1.B.1. Minimum Weld Strength Requirements

Type of Structure	Wire Size Gage	Minimum Average Weld Shear Strength
Gabions	12	472 lbf
Revet Mattress	13.5	292 lbf

Twisted wire mesh gabions shall be manufactured in conformance with ASTM A-975, while welded wire mesh gabions shall be manufactured in conformance with ASTM A-974.

All wire used in fabrication of the gabions, revet mattresses and wiring operations during construction shall, after zinc coating, have a fuse-bonded or extruded coating of PVC. The coating shall be gray in color. The thickness shall be nominally 0.020 inch (0.5 mm), and shall not be less than 0.015 inch (0.38 mm) in thickness. It shall be capable of resisting deleterious effects of natural weather exposure, and immersion in salt water. For PVC-coated welded wire fabric panel, cutting of the panels shall not be allowed closer than 1/4 inch (1/8 inch (6 mm (3.18 mm) after fabrication in order to prevent exposure near the welds. All coatings shall comply with the following specifications: ASTM A-975, ASTM Test Method B-117, ASTM D-792, ASTM A-974, ASTM Practice D-1499 and G-23, ASTM D-746, ASTM D-1242, and ASTM D-638

906.1.C. Stone Requirements

906.1.C.1. Gabion Stone: Stone fill shall be durable and of suitable quality to ensure permanence in the structure. The stone used to fill the gabion baskets shall be a clean, sound, and durable rock meeting the following requirements. It shall have a wearing loss less than 35 percent when the stone is tested with the Los Angeles Abrasion Machine in accordance with ASTM Test Method C535 (TxDOT Test Method Tex-410A). The loss of material experienced during five cycles of magnesium sulfate exposure conducted in accordance with TxDOT Test Method Tex411A for Rock Riprap shall not exceed 18 percent. The stone shall be well graded to produce a dense fill, angular in texture, while meeting the following gradation requirements:

Table 906.1.C.1. Gabion Stone Gradation Requirements

Sieve Size	% Passing
8"	100
4"	0-5
3"	0

The minimum unit weight (unit mass) of a rock filled gabion shall be 120 pcf. Verification of unit weight (mass) shall be performed when ordered by the Engineer, by constructing a test gabion with materials supplied for construction with the same effort and method intended for production gabions.

906.1.C.2. Revet Mattress Stone: The stone used to fill the revet mattresses shall be as specified for gabions except that it shall have a maximum dimension of 5 inches (125mm) and a minimum dimension of 3 inches (75 mm). The majority of the stone shall be in the 3 to 4 inch (75 to 100 mm) range; cubical or rounded in shape. A tolerance of 5% shall be allowed on the upper and lower dimensions of the rock.

906.1.C.3. Ties: Lacing wire and connecting wire shall be 13.5 gage [0.087 inch (2.20 mm)] PVC coated galvanized steel, Class 3, soft temper, conforming to ASTM A-641. During testing, any separation of 2 inches (50 mm) or more between connecting wires shall be considered as a failure.

Spiral binders shall consist of 0.106 inch (2.7 mm) PVC coated wire for the gabion and 0.087 inch (2.2 mm) PVC coated wire for the revet mattresses. Spiral binders shall have a 3.0 inch (75 mm) maximum separation between continuous successive loops (3 inch or 75mm pitch). The binder shall be made of galvanized steel, Class 3, soft temper, conforming to ASTM A-641.

Alternate fasteners, acceptable for use by the intended gabion basket manufacturer, may be submitted to the Engineer for consideration and approval prior to construction. The fasteners may consist of split ring or interlocking fasteners. Alternate fasteners systems shall produce a joint that meets the requirements of ASTM A-975.

906.1.D. Fastener System

The Contractor shall provide a complete description of the fastener system, including the number of fasteners required for all vertical and horizontal connections for single and multiple basket joining, as well as the number and size wires the fastener is capable of properly joining. The Contractor shall provide a description of a properly installed fastener, including test reports, drawings and/or photographs. Properly formed fasteners shall meet the requirements of ASTM A-974 for welded wire mesh or ASTM A-975 for twisted woven mesh.

Each interlocking fastener shall be locked and closed. 165 Underground Piped Utilities Each overlapping ring fastener shall be closed and the free ends shall overlap an average of 1 inch (25 mm). Spiral binders shall be screwed into position such that they pass through each mesh opening along the joint. In order to prevent unraveling, both ends of the spiral shall be crimped back around itself. Wire fasteners shall not be used to join more wires, or larger wires, than tested and approved for the application.

The minimum strength of the joined panels shall be as specified in Section 7.3 of ASTM A-974 for Welded wire panels or Section 7.3 of ASTM A-975 for twisted woven mesh.

Aggregate bedding, geotextiles or other materials shall conform to the requirements established on the Drawings. The Contractor shall submit for all materials proposed for use to the Engineer for review and approval one week prior to construction.

906.2 CONSTRUCTION METHODS

Twisted wire mesh Gabon's and revote mattresses shall be supplied in the forms allowed in ASTM A-975, while welded wire mesh Gabon's and revote mattresses shall be supplied in a form allowed in ASTM A-974. The Gabon/revote mattress manufacturer/supplier will be required to have a qualified representative on site at the start of gabion/revet mattress construction. The Contractor shall submit work experience documentation of the representative for review/approval by the Engineer or designated representative. The representative shall be available for consultation as needed throughout the gabion construction. Gabions and revet mattresses shall be constructed to the lines and grades shown on the Drawings. Individual or groups of gabions or revet mattresses, which deviate from line and grade, shall, at the direction of the Engineer or designated representative, be removed and replaced at no cost to the owner. Gabions or revet mattresses, which are constructed with bulges, and/or under-filled, loosely filled, or otherwise lacking a neat and compact appearance shall, at the direction of the Engineer or designated representative, be repaired/replaced at no cost to the owner. Under-filling of gabion/revet mattress corners to facilitate insertion of spirals shall not be permitted.

906.2.A. Foundation Preparation

The foundation shall be excavated to the extent shown on the Drawings or as directed by the Engineer or designated representative. All loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. The depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to 166 Underground Piped Utilities a density at least equal to that of the adjacent foundation. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free draining materials.

Any buried debris protruding from the foundation that will impede the proper installation and detrimentally impact the final appearance of the gabion, shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to gabion or revet mattress placement, the prepared foundation surface shall be inspected and approved by the Engineer and no material shall be placed thereon until that area has been approved. Placement of filter material and/or filter fabric shall be as shown on the Drawings or directed by the Engineer.

906.2.B. Basket Assembly

No work shall take place using PVC coated materials unless both the ambient air temperature and the temperature of the PVC materials are at least 15°F (8°C) above the brittleness temperature of the PVC materials. Assembly of gabions and revet mattresses shall consist of shaping and tying each individual basket. Baskets shall be assembled by connecting all untied edges including diaphragms with lacing wire, spirals or approved fasteners. The connections for the completed assemblies shall conform to the requirements of Section 7 of ASTM specifications A-974 (welded wire) and Section 7.3 and Table 2 of A-975 (double twisted). Assembly of baskets, connection of baskets together and lid closures shall be accomplished in accordance with one of the following approved procedures:

Lacing Wire: Using lacing wire of appropriate length, secure one end of the wire onto the basket corner by looping and twisting the lacing wire together. Proceed along the joint by tying with double loops every other mesh opening at intervals not more than 6 inches (150 mm) apart, while pulling the basket elements tightly together. Secure the other end of the lacing wire again by looping and twisting the wire around itself.

Spiral Binders: Spiral binders shall be screwed into position such that they pass through each mesh opening along the joint. To prevent unraveling, each end of the spiral binder shall be crimped back against itself.

Alternate Fasteners: Interlocking fasteners meeting the minimum acceptance criteria above, shall be installed with, as a minimum, one interlocking fastener in every other opening. Ring fasteners meeting the minimum acceptance criteria of these specifications shall be installed with, as a minimum, one split ring fastener in every opening, having a minimum 1 inch (25 mm) total overlap and securing only the number and diameter of wires for which tested. Placing of gabions and revet mattresses shall consist of installing baskets to the lines and grades shown on the Drawings. Gabions and revet mattresses shall be securely fastened to each adjoining unit along the vertical and top reinforced edges of all contact surfaces. Overlying rows of baskets shall be staggered appropriately. Empty sections stacked on a filled line of gabions and revet mattresses shall be securely fastened to the bottom unit along the front, back and ends. Prior to the placement of rock, the baskets used in the front vertical exposed faces of retaining walls shall be aligned. To facilitate alignment, tension may be applied to empty units at the direction of the Engineer or designated representative.

906.2.C. Basket Filling

The gabions and revet mattresses may be filled by machine, in maximum lifts of 12 inches (300 mm). The machine work shall be supplemented with handwork to avoid bulges and provide a compact mass with a minimum of voids. Care will be exercised so as not to damage the gabion/revet mattress elements or wire coating by limiting height of drop during filling to 3.0 feet (0.9 meter) for Gabions and 1.5 feet (0.5 meter) for revet mattresses. Undue deformation or bulging of the mesh shall be corrected prior to further stone filling. Where specified on the Drawings, select large stone shall be hand placed on vertical outside faces to achieve a desired neat appearance. During placement, the depth of stone in any cell shall not exceed the depth in an adjoining cell by more than one foot (300 mm). Stone smaller than the mesh opening found against vertical faces shall be removed. Two connecting wires in each direction for end units and two parallel connecting wires perpendicular to the exposed face for exposed face units shall be installed at every 12 inch (300 mm) lift. The connecting wires shall loop around two mesh openings, and the ends of wires shall be securely twisted with a minimum of three twists after looping. Prefabricated connecting wire may be used in lieu of connecting wire. Connecting wires associated with 18inch (450 mm) gabions shall be installed when and as specified on the Drawings or as recommended by the gabion/revet mattress manufacturer.

The gabion or revet mattress unit shall be overfilled by 1-1/2 to 2 inches (37.5 to 50 mm) and the lid shall be bent and stretched until it meets the perimeter edges of the front and end panels. The stretching shall be accomplished using an approved lid closing tool in order to prevent damage to the PVC coating. Crow bars or similar single point leverage devices will not be allowed. The lid shall then be securely tied with lacing wire, spirals or approved fasteners to the fronts, ends and diaphragms. Excessive deformation of the lid panel to facilitate closing of a bulging gabion or revet mattress will not be permitted.

All backfill shall be placed and compacted in sequence with the filling of the baskets; however, care shall be exercised in compacting the fill behind a single row of baskets since excessive compaction effort can displace the gabions/revet mattresses from the desired alignment. Gabion or revet mattress units may be cut or shaped to fit odd length or odd shaped areas. They shall be cut at least 6" to 8" (150 mm to 200 mm) larger than the opening to allow sufficient material for overlap and lacing. All edges or faces formed in this manner shall be adjusted to present a finished and pleasing appearance. At all times, care shall be taken to turn all loose and projecting ends of wire into the gabion units to prevent injury.

Wire of proper grade and quality, when fabricated and installed in the manner herein required, shall result in a strong, serviceable mesh-type product having substantially uniform openings. It shall be fabricated and finished in a workmanlike manner, as determined by visual inspection, and shall conform to this specification.

906.3 MEASUREMENT AND PAYMENT

Measurement for **Gabion Baskets, Walls, and Mattresses**, shall be measured per cubic foot (CY) for (of any type) installed. Length, height, and width (or depth) shall be measured, and the constructed volume of the system shall be computed.

Payment for Gabion Baskets, Walls, and Mattresses, shall be measured as specified above and paid for at the contract unit price bid as noted above which price shall be full compensation for shaping and fine grading, including furnishing and applying all water required, items needed as noted above; for furnishing, loading and unloading, storing, hauling and handling all materials, including all freight and royalty involved; for placing and adjusting forms, including supporting material or preparing grade; ties and supports, anchors, for mixing, placing, finishing; for furnishing and installing all steel; bedding material, geotextile if required, for furnishing all materials, load transmission devices, for coating steel bars, all other materials and methods, equipment, tools, testing, labor, and incidentals necessary to complete the work for a finished system in place.