

K.C. ENGINEERING, INC. STANDARD SPECIFICATIONS (3RD EDITION)

NOTICE TO BIDDERS

The K.C. ENGINEERING, INC. 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:

K.C. ENGINEERING, INC.



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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.

000.1 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.

000.2 Contract Documents

The term Contract Documents refers to the complete set of documents produced for a given project, including but not limited to: the Construction Contract, Project Manual, Unit Price Schedule, General Notes and General Requirements, Standard Specifications (including any third party specifications that may be referenced), Construction Drawings, and Standard Details. These documents may be combined into one or more bound documents or sets, the total of all sets and documents being collectively referred to as: Contract Documents. It is the Contractor's sole responsibility to read, understand, and comply with all requirements, Specifications, Special Specifications and Special Provisions no matter where such Special Specifications and Special Provisions may be located within the Construction Documents.

000.3 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.

000.4 Interpretation of Specifications

The Specifications are intended to constitute instructions to the Contractor related to materials, methods, and operational requirements necessary to accomplish the Contractor's obligations under the Contract. Throughout the Contract Documents, all declarative, imperative statements and phrases shall be interpreted as constituting specific instructions to the Contractor, unless specifically stated otherwise.

000.5 Owner, Engineer, Inspector

The construction contract is between the Owner of the Project and the Contractor. In many instances, the Owner will be assisted during construction management by the Engineer and / or an Inspector. Throughout the Contract Documents, references to the Engineer, and / or Inspector indicate actions that may be taken or may be required on behalf of the Owner insofar as the Engineer and / or Inspector are acting on assignment to represent the interests and authority of the Owner.

000.6 Standard Specifications

In addition to *K.C. Engineering, Inc.'s Standard Specifications*, the complete set of specifications to be used includes the Texas Department of Transportation's (TxDOT) *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges*, adopted by TxDOT on June 1, 2004, **excluding Items 1 through 9** of those specifications. The Contractor shall be required to obtain and refer to a copy of the *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges* as required for the duration of the project. References to specific items from the *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges* will be made as: TxDOT Item #### (where #### is replaced by the actual Item number). In limited instances, there may be references to Item ####, which shall be interpreted as the applicable TxDOT Item.

The complete set of specifications for each project also includes any Special Provisions to the *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges*, as well as Special Provisions to these specifications, all of which will be referenced as SP ###. Special Specifications that have been prepared specifically for each project are also a part of the complete set of specifications, and will be referenced as SS ###.

All other specifications referenced in these *K.C. Engineering, Inc.'s Standard Specifications* will be referenced as: Section ###. For instance, this specification itself will be referenced as Section 000.

000.7 Standard Details

K.C. Engineering, Inc.'s Standard Details, 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.

000.8 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.

END SECTION

005.1 Summary

This section defines methods of determining quantities for payment purposes, measurement requirements, methods of determining payment, and methods of requests and claims for additional compensation.

005.2 Quantities

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.

005.3 Payment

- A. The method of payment shall be **as noted on the Unit Price Schedule** and / or elsewhere in the Contract Documents and shall be Lump Sum, Plans Quantity, or Unit Price. Progress payments and partial payments shall be determined as designated in this Section.
 - 1. Lump Sum: For contracts designated for payment by Lump Sum, the Contractor shall be paid the total bid price tabulated on the Unit Price Schedule.
 - 2. Plans Quantity: For contracts designated for payment by Plans Quantity, the Contractor shall be paid the sum of the unit price for each item on the Unit Price Schedule multiplied by the quantities shown in the Unit Price Schedule for all items actually installed.
 - 3. Unit Price: For contracts designated for payment as Unit Price, the Contractor shall be paid the sum of the unit price for each item on the Unit Price Schedule multiplied by the quantities that are actually measured in the field following installation.
- B. Regardless of the overall method of payment (Lump Sum, Plans Quantity, or Unit Price) designated by the contract, individual items may be designated for payment as Lump Sum for that individual item, and shall be noted as such on the Unit Price Schedule.
- C. Payment includes: Full compensation for required supervision, labor, products, tools, equipment, plant, transportation, services and appurtenances; erection, application or installation of an item of the work, and including Contractor's overhead and profit. Payment for any item includes full payment for any and all items referenced in that Section or subsidiary items.
- D. Total compensation for required work shall be as shown on the Unit Price Schedule. Claims for payment of work not specifically covered in the list of unit prices contained in the Unit Price Schedule will not be accepted.
- E. Progress payments will be based on the Engineer's monthly estimates using observations and evaluations of quantities incorporated in the work as of the date of each Application for Payment. Payment of each monthly estimate shall be determined based on the contract less any withholdings or deductions in accordance with the contract. Progress payments may be withheld for failure to comply with the contract.
- F. Payment Provisions for Subcontractors: The Contractor shall pay the subcontractor for work performed within 10 days after receiving payment for the work performed by the subcontractor. The Contractor shall pay any retainage due to the subcontractor within 10 days of release by the Owner of any retainage associated with the subcontractor's work. (The inspection and approval

of the subcontractor's work does not eliminate any of the Contractor's responsibilities for any of the work.)

The Owner may pursue actions against the Contractor, including withholding of estimates and suspending the work, for noncompliance with the subcontract requirements of this Section upon written notice with sufficient details showing the subcontractor has complied with contractual obligations as described in this Section.

These requirements apply to all tiers of subcontractors.

- G. Payment for Material on Hand (MOH): If payment for MOH is desired, request compensation for the invoice cost of acceptable nonperishable materials that have not been used in the work before the request, and that have been delivered to the work location or are in acceptable storage places. Nonperishable materials are those that do not have a shelf life or whose characteristics do not materially change when exposed to the elements. Include only materials that have been sampled, tested, approved, or certified, and are ready for incorporation into the work. Only materials which are completely constructed or fabricated on the Contractor's order for a specific Contract and are so marked and on which an approved test report has been issued are eligible.

Payment for MOH may include the following types of Items: concrete traffic barrier, precast concrete box culverts, concrete piling, reinforced concrete pipe, and illumination poles. Any repairs required after fabricated materials have been approved for storage shall require approval of the Engineer before being made and shall be made at the Contractor's expense. Include only those materials that have an invoice cost of at least \$1,000 in the request for MOH payment. If the request is acceptable, the Engineer will include payment for MOH in a progress payment. Payment for MOH does not constitute acceptance of the materials. Payment will not exceed the actual cost of the material as established by invoice, or the total cost for the associated Item less reasonable placement costs, whichever is less. Materials for which the Contractor does not have a paid invoice within 60 days will not be eligible for payment and will be removed from the estimate. Payment may be limited to a portion of the invoice cost or unit price if shown elsewhere in the Contract.

Payment for precast products fabricated or constructed by the Contractor for which invoices or freight bills are not available may be made based on statements of actual cost. If the Owner determines noncompliance with any of the requirements of this provision, the Owner may exclude payment for any or all MOH for the duration of the Contract.

Maintain all records relating to MOH payment until final acceptance. Provide these records to the Engineer upon request.

- H. Final Payment: When the Contract has been completed, all work has been approved, final acceptance has been made, and Contractor submittals have been received, the Engineer will prepare a final estimate for payment showing the total quantity of work completed and the money owed the Contractor. The final payment will reflect the entire sum due, less any sums previously paid.

005.4 Changes in the Work

The Engineer reserves the right to make changes in the work including addition, reduction, or elimination of quantities and alterations needed to complete the Contract. Perform the work as altered. These changes will not invalidate the Contract nor release the Surety.

If the changes in quantities or the alterations do not significantly change the character of the work under the Contract, the altered work will be paid for at the unit price listed on the Unit Price Schedule. **By submitting the Unit Price Schedule associated with the contract, the Contractor expressly agrees to accept revised compensation for such changes in the work based on the unit prices submitted.**

If the changes in quantities or the alterations significantly change the character of the work, the Contract will be amended by a change order. If no unit prices exist, this will be considered extra work and the Contract will be amended by a change order. Provide cost justification as requested, in an acceptable format. Payment will not be made for anticipated profits on work that is eliminated.

The Engineer and Contractor must agree upon the scope of work and the basis of payment for any change order before beginning the work. If there is no agreement, the Engineer may order the work to proceed as directed in the following paragraph: "Force Account," or by making an interim adjustment to the Contract. In the case of an adjustment, the Engineer will consider modifying the compensation after the work is performed.

A significant change in the character of the work occurs when:

- The character of the work for any Item as altered differs materially in kind or nature from that in the Contract
or
- A major item of work varies by more than 25% from the original Contract quantity. (The 25% variance is not applicable to non-site-specific Contracts.)

When the quantity of work to be done under any major item of the Contract is more than 125% of the original quantity stated in the Contract, then either party to the Contract may request an adjustment to the unit price on the portion of the work that is above 125%. When the quantity of work to be done under any major item of the Contract is less than 75% of the original quantity stated in the Contract, then either party to the Contract may request an adjustment to the unit price. If the changes require additional working days to complete the Contract, Contract working days will be adjusted as prescribed under: "Operational Requirements."

005.5 Force Account

The Engineer may provide for payment for extra work under "Changes in the Work," on the force account basis, which includes compensation for the use of small tools, overhead expense, and profit. The Engineer will execute a change order to establish labor and equipment rates and material costs to determine an estimated cost for the proposed work. The Owner reserves the right to withhold payment for low production or lack of progress. Payment for extra work directed on a force account basis will be as follows:

- A. Labor: Compensation will be made for payroll rates for each hour that the labor and foremen or others approved by the Engineer are actually engaged in the work. In no case will the rate of wages be less than the minimum shown in the Contract for a particular category. An additional 25% of the above sum will be paid for overhead, superintendence, profit, and small tools.
- B. Insurance and Taxes: An additional 55% of the labor cost, excluding the 25% compensation provided under "Labor," above, will be paid as compensation for all insurance and taxes including the cost of premiums on public liability and workers compensation insurance, Social Security, and unemployment insurance taxes.

- C. Materials: Compensation will be made for materials associated with the work based on actual delivered invoice costs, less any discount. An additional 25% of this sum will be paid as compensation for overhead and profit.
- D. Equipment: Payment will be made for the established equipment hourly rates for each hour that the equipment is involved in the work. An additional 15% will be paid as compensation for overhead and profit not included in the rates. Transportation cost for mobilizing equipment will be included if the equipment is mobilized from an off-site location. If a rate has not been established for a particular piece of equipment in the Rental Rate Blue Book, the Engineer will allow a reasonable hourly rate, as agreed upon in writing before work is begun. This price will include operating costs.
1. Contractor-Owned Equipment: For Contractor-owned machinery, trucks, power tools, or other equipment necessary for use on force account work, use the Rental Rate Blue Book as modified by the following to establish hourly rates. Use the rates in effect for each section of the Rental Rate Blue Book at the time of use.

Compute the hourly rates as follows:

$$H = \frac{M \times R1 \times R2}{176} + OP$$

where:

H = Hourly Rate
M = Monthly Rate
R1 = Rate Adjustment Factor
R2 = Regional Adjustment Factor
OP = Operating Costs.

Payment for equipment will be made for the actual hours used in the work. Payment will not be made for time lost for equipment breakdowns, time spent to repair equipment, or time after equipment is no longer needed. If equipment is used intermittently while dedicated solely to the force account work, payment will be made for the duration the equipment is assigned to the work but no more than 8 hours per day.

2. Equipment Not Owned by the Contractor: If equipment is rented exclusively for force account work from a third party not owned by the Contractor, payment will be made at the invoice daily rental rate for each day the equipment is needed for the work. The Owner reserves the right to limit the daily rate to comparable Rental Rate Blue Book rates. When the invoice specifies that the rental rate does not include fuel, lubricants, repairs, and servicing, the Rental Rate Blue Book hourly operating cost for each hour the equipment is operated will be added.
- E. Subcontracting. Additional compensation will be made for extra work performed by subcontractors under "Changes in the Work," on the force account basis or based on actual invoice costs. An additional 5% compensation will be paid on subcontracted work for administrative cost and profit.

- F. Law Enforcement. For off-duty law enforcement, an additional 5% of the invoice cost for labor and equipment will be paid for administrative costs, superintendence, and profit.
- G. Bond Cost. An additional 1% of the total labor, material, equipment, and subcontracted compensation, including the additional compensation percentages provided by Sections A through F above, will be paid for the increase in bond cost due to the force account work.
- H. Cost Records: Maintain daily records of extra work completed on the force account basis. Provide copies of these records daily, signed by the Contractor's representative, for verification by the Owner. Submit a request for payment for extra work performed on the force account basis, including copies of all applicable invoices, along with other normal submittals for payment.

005.6 Differing Site Conditions

During the bidding process, **the Contractor is required to visit the site and make a complete assessment of the site conditions.** The Contractor's required site assessment includes, but is not limited to: taking soil borings and samples; evaluating existing storm water drainage, traffic conditions, issues that may arise regarding private property access through the construction site, Contractor's access to the site, and any local or neighborhood requirements that may apply. By failing to make the required site assessments, including the requirement to take soil borings and samples, the Contractor fully accepts the responsibility for all existing site conditions.

No claim for differing site conditions, including subsurface or latent physical conditions, may be made by the Contractor if such conditions could have been reasonably determined by the Contractor during his required site assessment.

Under unusual circumstances, differing subsurface or latent physical conditions may be encountered at the site. The two types of differing site conditions are defined as:

- Those that differ materially from those indicated in the Contract.

and

- Unknown physical conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the Contract.

Notify the Engineer in writing when differing site conditions are encountered. The Engineer will notify the Contractor when the Engineer discovers differing site conditions. Unless directed otherwise, suspend work on the affected items and leave the site undisturbed. The Engineer will investigate the conditions and determine whether differing site conditions exist. If the differing site conditions cause an increase or decrease in the cost or number of working days specified for the performance of the Contract, the Engineer will make adjustments, excluding the loss of anticipated profits, in accordance with the Contract. Additional compensation will be made only if the required written notice has been provided.

005.7 Requests and Claims for Additional Compensation

The Contractor shall notify the Engineer in writing of any intent to request additional compensation once there is knowledge of the basis for the request. An assessment of damages is not required to be part of this notice but is desirable. The intent of the written notice requirement is to provide the Engineer an opportunity to evaluate the request and to keep an accurate account of the actual costs that may arise and to provide additional design or instructions in order to minimize impacts and costs.

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. Submit the request 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.

- A. Delay Claims: The intent of paying for delay damages is to reimburse the Contractor for actual expenses arising out of a compensable impact. No profit or force account markups, other than labor burden, will be allowed. If the Contractor requests compensation for delay damages and the delay is determined to be compensable, then standby equipment costs and project overhead compensation will be based on the duration of the compensable delay and will be limited as follows:
 - 1. Standby Equipment Costs: Standby costs will not be allowed during periods when the equipment would have otherwise been idle. No more than 8 hr. of standby will be paid during a 24-hr. day, nor more than 40 hr. per week, nor more than 176 hr. per month. Standby will be paid at 50% of the rental rates found in the Rental Rate Blue Book for Construction Equipment and calculated by dividing the monthly rate by 176 and multiplying by the regional adjustment factor and the rate adjustment factor. Operating costs will not be allowed.
 - 2. Project Overhead: Project overhead will be determined from actual costs that the Contractor will be required to document. Project overhead is defined as the administrative and supervisory expenses incurred at the work locations.
 - 3. Home Office Overhead: The Owner will not compensate the Contractor for home office overhead.
- B. Dispute or Claims Procedure. The Contractor shall work with the Engineer to resolve all issues. If the issue cannot be resolved within the time frame established by the Owner, the Contractor may submit a contract claim to be handled in accordance with the Owner's contract claim procedure. It is the Contractor's responsibility to prove or justify all claims and requests in a timely manner.

005.8 Measurement

- A. The Engineer will measure all completed work using United States standard measures, unless otherwise specified. All measured and / or calculated quantities will be in the units designated on the Unit Price Schedule.
- B. Measurement methods delineated in individual Sections are intended to complement the criteria of this Section. In the event of conflict, the requirements of the individual Sections govern.

- C. When measurements are required for the purpose of preparing as-built drawings or completion records, the Contractor shall be responsible for taking the required measurements and shall do so under the supervision of the Engineer. When measurements are required for payment purposes under a Unit Price Contract, the Engineer shall take the required measurements, and the Contractor shall assist the Engineer as required.
- D. The Contractor shall provide equipment, tools, workers, and survey personnel as necessary to perform the required measurements. The cost of providing such equipment, tools, workers, and survey personnel shall be subsidiary to the pertinent item.
- E. Linear Measurement: Measure by linear dimension, at the item centerline or mean chord of the installed item. All longitudinal measurements shall be taken along the actual surface of the item, and not taken horizontally. For all transverse measurements for base courses, surface courses, and pavements, the dimensions to be used in calculating quantities shall be the neat dimensions and will not exceed those shown in the plans, unless otherwise specified.
- F. Measurement by Area: Measure length and width for installed items, complete in place. Use the methods prescribed above for linear measurement; calculate area from the measurements taken.
- G. Measurement by Volume: Measure area as prescribed above for installed items, complete in place. Measure depth in the direction perpendicular to the linear measurements taken; calculate volume from the measurements taken. For volume measurement of transported materials, use approved hauling vehicles (each of which must have a unique identification number) with information furnished to the Engineer as necessary to verify the volume capacity of each vehicle. Load the vehicle and level the load to the approved capacity. The Engineer may require volume verification by weight measurement.
- H. Measurement by Weight: Transport materials measured for payment by weight or truck measure in approved hauling vehicles. Furnish certified measurements, tare weights, and legal gross weight calculations for all haul units. Affix a permanent, legible number on each vehicle to correspond to the certified information. Furnish certified weights of loaded haul units transporting material if requested. The material shall be measured at the point of delivery. For measurement by the ton, in the field, provide measurements in accordance with TxDOT Item 520, except for those items where ton measurements are obtained by standard tables as specified elsewhere.
- I. Plans Quantity Measurement: Plans quantities may or may not represent the exact quantity of work performed or material moved, handled, or placed during the execution of the Contract, and items paid by plans quantities shall not be measured for payment in the field; however, the Engineer reserves the right to measure installed quantities to verify minimum contract requirements. The estimated quantities are designated as final payment quantities, unless revised by the governing specifications of the pertinent item.

If the quantity measured, as prescribed above, varies by more than 5% (or as stipulated in the governing specifications for the pertinent item) from the total estimated quantity for an individual item originally shown in the contract, an adjustment may be made to the quantity of authorized work done for payment purposes. The party to the Contract requesting the adjustment will provide field measurements and calculations showing the revised quantity. When approved, this revised quantity will constitute the final quantity for which payment will be made. Payment for revised quantities will be made at the unit price bid for that item except as specified elsewhere under: "Changes in the Work".

When quantities are revised by a change in design approved by the Engineer, by change order, or to correct an error on the plans, the plans quantity will be increased or decreased by the amount involved in the change, and the 5% variance will apply to the new plans quantity. If the total Contract quantity multiplied by the unit bid price for an individual item is less than \$250 and the item is not originally a plans quantity item, then the item may be paid as a plans quantity item if the Engineer and Contractor agree in writing to fix the final quantity as a plans quantity item.

005.9 Nonconformance of Work

- A. Remove and replace the work, or portions of the work, not conforming to the Contract Documents.
- B. If, in the opinion of the Engineer, it is not practical to remove and replace the work, the Engineer will direct one of the following remedies:
 - 1. The nonconforming work will remain as is, but the unit price will be adjusted to a lower price at the discretion of the Engineer.
 - 2. The nonconforming work will be modified as authorized by the Engineer, and the unit price will be adjusted to a lower price at the discretion of the Engineer, if the modified work is deemed to be less suitable than originally specified.
- C. Individual Sections may modify these options or may identify a specific formula or percentage price reduction.
- D. The authority of the Engineer to assess the nonconforming work and identify payment adjustment is final.

005.10 Nonpayment

- A. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable to Engineer.
 - 2. Products determined as nonconforming before or after placement.
 - 3. Products placed beyond the lines and levels of the required work.
 - 4. Products remaining on hand after completion of the work, unless specified to remain.
 - 5. Loading, hauling and disposing of rejected products.

005.11 Alternate Bid Items

Items of work identified in the Plans and / or in the Unit Price Schedule as: **Alternate Bid Items** shall be bid by the Contractor, but such items may be included in the final contract or excluded at the Owner's discretion.

005.12 Additional Bid Items

Items of work identified in the Unit Price Schedule as **Additional Work Items** shall be bid by the Contractor and included in the contract to be furnished, installed, and paid on a Unit Price basis if and only if any or all of these items are requested in writing by the Owner. Otherwise, no payment shall be made for any unused

portions of these Additional Work Items. The Contractor's unit bid price for these Additional Work Items shall be used primarily as a basis for negotiated change orders throughout the duration of the Project.

END SECTION

010.1 Milestones and Phases

The contract includes requirements for allowable times for substantial and final completion for the project. The Contractor is required to plan, schedule, and perform the work under this agreement such that the contract deadlines are met.

010.2 Jobsite Supervision

The Contractor shall designate a competent, English-speaking Superintendent (who is employed by the Contractor) who shall be available at all times to receive instructions from the Engineer and to act for the Contractor. The Superintendent shall be experienced in the work being performed and be capable of reading and understanding the Contract Documents. The Engineer may suspend work if a Superintendent is not available or does not meet the above criteria; however, working day charges will not be suspended.

010.3 Cooperation with the Engineer, Utilities, Other Contractors, Railroads

The Contractor shall be required to cooperate with the Engineer in every way possible, and to respond promptly to instructions from the Engineer.

The Contractor shall locate and protect all existing utilities and use established safety practices when working near utilities. All damages to existing utilities (without regard to whether such utilities are shown on the construction drawings) shall be completely repaired to the Owner's satisfaction at the contractor's sole expense. The location, type, and extent of such repairs shall be included on the project as-built drawings. Consult with the appropriate utility coordinators and supervisors before beginning work. The Contractor shall 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(s) when utility adjustments are required.

The Contractor shall 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 interruptions 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.

The Contractor shall be required to cooperate and coordinate with other Contractors working within the project limits or adjacent to the project limits.

The Contractor shall plan and prosecute portions of the work involving a railway to avoid interference with or hindrance to the railroad company.

010.4 Protection of Adjacent Property and General Public

The Contractor shall be required to protect adjacent property from damage. If any damage results from an act or omission on the part of or on behalf of the Contractor, the Contractor shall take corrective action to restore the damaged property to a condition similar or equal to that existing before the damage was done.

In addition, the contractor shall be required to make any provisions necessary to protect the general public. The general public shall include all persons, as well as their property, that can reasonably be injured or damaged at a construction site, or as a result of construction activities. The Contractor shall be completely and solely responsible for all damages to the general public that result from the Contractor's operations.

010.5 Livestock

This item shall consist of providing all materials, labor, and other incidentals required to protect all livestock on properties adjacent to the limits of construction, as well as all third parties that may be damaged by livestock. The Contractor shall be fully responsible for taking any precautions for protecting and containing all livestock adjacent to the project. In the event that actions or omissions by the Contractor lead to the injury or demise of any livestock adjacent to the project, or damages to any third party due to the lack of containment of livestock, the Contractor shall assume full responsibility for making the affected party whole.

The Contractor shall be required to **immediately** repair any damages to fences that contain or may contain livestock. The Contractor shall be required to maintain all gates in the same configuration as set by the owner or livestock operator – that is: gates that are open shall be left open; gates that are closed shall remain closed. When crossing through gates that are closed, the Contractor shall be **required to immediately** close the gate after passing through; it is unacceptable to leave gates open temporarily while working in the area.

If the Contractor fails to comply with any portion of this section, the Engineer or Owner may order all work stopped until the noncompliant conditions are fully corrected, and all damages and/or expenses incurred by third parties have been fully paid or settled. There shall be no suspension of time for any such work stoppages. The Owner may, at the Owner's option, make any repairs or changes necessary to remedy damages to fences or gates and withhold the costs for such repairs or changes from funds due to the Contractor.

010.6 Sequence of Construction

- A. The Contract Documents may contain Erosion Control Plans, Storm Water Pollution Prevention Plans, details, and requirements that have been prepared by the Owner or Engineer, however, it is the Contractor's sole responsibility to file, at the Contractor's expense, the *Notice of Intent for Storm Water Discharges* (NOI) Associated with Construction Activity under TPDES General Permit TXR150000 with the Texas Commission on Environmental Quality a minimum of 7 days prior to beginning construction. The required form may be obtained online at:

<http://www.tceq.state.tx.us/assets/public/permitting/waterquality/forms/10382.pdf>

In addition, prior to commencing construction activities, it is the Contractor's sole responsibility to fill out, post, and maintain the appropriate Construction Site Notice on site at a readily visible location as required by *TPDES General Permit TXR150000*. The required forms for small and large construction activities, as defined in *TPDES General Permit TXR150000*, may be obtained online at:

www.tceq.state.tx.us/assets/public/permitting/waterquality/attachments/stormwater/txr15smallsite.pdf

www.tceq.state.tx.us/assets/public/permitting/waterquality/attachments/stormwater/txr15largepri.pdf

- B. The Contractor shall provide ingress and egress to all existing businesses and property owners along the proposed project at all times. The Contractor shall be required to construct the project in phases as required to provide the required access. Additionally, the Contractor shall schedule his operations to minimize conflict between construction operations and operations of local businesses.

- C. The Contractor is required to install all temporary erosion protection devices before beginning work on any section of the project. To the extent that erosion protection is specific to isolated sections of the project, the Contractor may, with the Owner's approval, elect to install and maintain temporary erosion protection in sections as appropriate, provided all construction operations and disturbed areas are fully protected at all times.
- D. The Contractor is required to maintain traffic flow through the project at all times and shall comply with construction phasing and temporary traffic control drawings and details included in the Contract Documents.
- E. The Contractor is required to maintain drainage of storm water flow through the project at all times and shall install temporary drainage facilities as required to meet this requirement.
- F. Unless otherwise noted in the Construction Documents, the Contractor shall not interfere with or restrict service in existing utility systems (underground, surface, or overhead) throughout the project.
- G. Utility Locations: The Contractor shall be required to make full use of, and comply with, the Texas One-Call system. The Contractor shall locate all existing underground utilities and mark the locations in the field, along with the alignment of the proposed facilities. All such utility and alignment location shall be performed in advance of any excavation.
- H. Construction Schedule: The Contractor shall include in his preliminary progress schedule, milestones for completion of each of the bid items listed in the contract. The preliminary progress schedule shall adhere to the requirements of the General Conditions.
- I. It is the Contractor's sole responsibility to file, at the Contractor's expense, the *Notice of Termination (NOT) for Authorizations under TPDES General Permit TXR150000* with the Texas Commission on Environmental Quality. The required form may be obtained online at:

<http://www.tceq.state.tx.us/assets/public/permitting/waterquality/forms/20023.pdf>

010.7 As-built Drawings

The Contractor shall keep up-to-date as-built drawings by redlining completed installations on the Construction Drawings for all items that have been installed to different sizes, lines, and or grades than shown on the original Construction Drawings. For all horizontal and vertical points of intersection and all other significant points (as determined by the Engineer) of all installed underground facilities, the CONTRACTOR shall, at his expense, have all such horizontal and vertical points of intersection for the top of the installed underground facility located by a Registered Professional Land Surveyor (RPLS) licensed to practice in the State of Texas prior to performing backfilling/embankment, unless otherwise approved by the Engineer. For sections of underground facility alignments that do not contain horizontal and vertical points of intersection, the top of the installed underground facility shall be located by an RPLS at maximum intervals of 300 feet as measured along the centerline of the underground facility, unless otherwise specified by the Engineer. The as-built drawings shall include the surveyor's collected information, all in the same horizontal and vertical datum as used for the construction control for the project.

In addition, the Contractor shall include in the as-built drawings any other information specifically required for individual items as described in the body of these specifications.

The Contractor shall record all such required information by redline on the as-built drawings without regard to the nature of the information, whether required by other sections of the specifications or plans, or whether a change was instituted by the Engineer, by the Contractor, or necessitated by field conditions.

The as-built drawings shall include ALL sheets with as-built revisions as described in this section. In addition, a copy of the Title Sheet of the plans must be included with the as-built drawings. On the back of the Title Sheet, the Contractor's representative shall include a signed printed or typed statement to the effect that he certifies as the Contractor's Agent that the attached as-built drawings correctly reflect all variances from the

original drawings. The statement shall include the date signed along with the printed name and signature of the Contractor's representative.

Upon completion of the project, the Contractor shall submit the completed as-built drawings to the Engineer for his use. Submittal of the complete signed and dated redline set of as-built drawings shall be a condition precedent to substantial completion of the project.

010.8 Charges

Any failure by the Contractor to adhere to schedules, milestones or sequence of construction as presented in these Operational Requirements, will constitute reason for charges by the Owner for Liquidated Damages against the Contractor as set forth in the Agreement, unless specifically authorized in writing by the Engineer by a Change Order.

010.9 Close-out of Project

Upon final completion, the Contractor will notify the Engineer of the Project's readiness for a final inspection. The Engineer will require 10 days in which to complete the final inspection and forward any comments to the Contractor regarding, in his judgment, incomplete or unsatisfactory items. Upon the Contractor's completing said additional items, and presenting the Engineer with affidavits of required Warranties in the Operational Conditions, the Engineer shall make a recommendation to the Owner for acceptance of the Project and final payment to be paid in accordance with paragraph 14.13 of the General Conditions.

010.10 Field Engineering and Lines and Grades

The CONTRACTOR shall be required to have all construction control points (horizontal and vertical) staked and permanently located as shown in the construction plans. The CONTRACTOR shall, at his expense, have all construction control and construction staking operations performed by a Registered Professional Land Surveyor (RPLS) licensed to practice in the State of Texas. The Contractor shall be required to provide all construction staking throughout the project including the initial establishment of centerline and benchmarks on the ground. The CONTRACTOR, through his RPLS shall permanently mark with paint the alignment or location of any proposed underground facilities where they are within 15 feet horizontally of any surface facilities or underground utilities, such as poles, fences, gates, walls, and underground utility or telecommunications lines. Immediately upon completion of marking the proposed alignment, the CONTRACTOR shall submit clear and legible copies of all field notes to the Engineer for review and approval. The CONTRACTOR shall verify through his RPLS that **ALL** proposed improvements are located within the right of way. No construction or installation of improvements shall be performed outside of the right of way without explicit written approval from the Engineer. In addition, the CONTRACTOR shall provide field notes including horizontal and vertical information for all improvements as required under Section 10.7 of the specifications with each pay application. Approval of each pay application shall be contingent upon this requirement.

The Engineer will have the authority to stop all work and withhold recommendations of payment to the Contractor at any time adequate control is not in existence on the site. The decision of the Engineer is final.

010.11 Sanitary Facilities

The Contractor shall provide sanitary facilities during the construction period. The Contractor will be responsible for the cleanliness of the facility and responsible for any and all repairs of the facility during the Contractor's use period, up to the condition of the facility at the startup of construction activities.

010.12 Construction Yard

The Owner may provide to Contractor a site suitable for a construction yard during the construction period provided adequate space is available for use. The Contractor shall fence the site temporarily during the use period. The construction yard shall be restored to a pre-construction condition or scheduled improvement thereof completed prior to final payment. The Contractor shall provide his own Storm Water Pollution Prevention Plan (SWPPP) and submit his own Notice of Intent (NOI) and Notice of Termination (NOT) to the TCEQ for the construction yard. Access to the site shall be gated at all times. Access shall be as negotiated with the Owner during the pre-construction period.

010.13 Abatement and Mitigation of Excessive or Unnecessary Noise.

Minimize noise throughout all phases of the Contract. Exercise particular and special efforts to avoid the creation of unnecessary noise impact on adjacent noise sensitive receptors in the placement of non-mobile equipment such as air compressors, generators, pumps, etc. Place mobile and stationary equipment to cause the least disruption of normal adjacent activities.

All equipment associated with the work must be equipped with components to suppress excessive noise and these components must be maintained in their original operating condition considering normal depreciation. Noise-attenuation devices installed by the manufacturer such as mufflers, engine covers, insulation, etc. must not be removed nor rendered ineffectual nor be permitted to remain off the equipment while the equipment is in use.

010.14 Preservation of Cultural and Natural Resources and the Environment

If the Contractor initiates changes to the Contract and the Owner approves the changes, the Contractor is responsible for obtaining clearances and coordinating with the appropriate regulatory agencies.

- A. Cultural Resources. Cease all work immediately if a site, building, or location of historical, archeological, educational, or scientific interest is discovered within the right of way. The site, building, or location will be investigated and evaluated by the Owner.
- B. Work in Waters of the United States. For work in the right of way, the Owner will obtain any required Section 404 permits from the U.S. Army Corps of Engineers before work begins. Adhere to all agreements, mitigation plans, and standard best management practices required by the permit. When Contractor-initiated changes in the construction method changes the impacts to waters of the U.S., the Contractor shall obtain new or revised Section 404 permits.
- C. Work in Navigable Waters of the United States. For work in the right of way, the Owner will obtain any required Section 9 permits from the U.S. Coast Guard before work begins. Adhere to the stipulations of the permits and associated best management practices. When Contractor-initiated changes in the construction method changes the impacts to navigable waters of the U.S., the Contractor shall obtain new or revised Section 9 permits.
- D. Work Over the Environmentally Sensitive Features. Make every reasonable effort to minimize the degradation of water quality resulting from impacts relating to work over the environmentally sensitive features, as determined by the local governing authority. Use best management practices and perform work in accordance with Contract requirements.
- E. Project-Specific Locations. For all project-specific locations (PSLs) on or off the right of way (material sources, waste sites, parking areas, storage areas, field offices, staging areas, haul roads, etc.), signing the Contract certifies compliance with all applicable laws, rules, and regulations pertaining to the preservation of cultural resources, natural resources, and the

environment as issued by the following or other agencies:

- The local governing authority,
- Occupational Safety and Health Administration,
- Texas Commission on Environmental Quality,
- Texas Department of Transportation,
- Texas Historical Commission,
- Texas Parks and Wildlife Department,
- Texas Railroad Commission,
- U.S. Army Corps of Engineers,
- U.S. Department of Energy
- U.S. Department of Transportation,
- U.S. Environmental Protection Agency,
- U.S. Federal Emergency Management Agency, and
- U.S. Fish and Wildlife Service.

All subcontractors must also comply with applicable environmental laws, rules, regulations, and requirements in the Contract. Maintain documentation of certification activities including environmental consultant reports, Contractor documentation on certification decisions and contacts, and correspondence with the resource agencies. Provide documentation upon request.

Obtain written approval from the Engineer for all Contractor owned facilities in the right of way not specifically addressed in the plans. Prepare an SWP3 for all Contractor facilities, such as asphalt or concrete plants located within public right of way. Comply with all TCEQ permit requirements for portable facilities, such as concrete batch plants, rock crushers, asphalt plants, etc. Address all environmental issues, such as Section 404 permits, wetland delineation, endangered species consultation requirements, or archeological and historic site impacts. Obtain all permits and clearances in advance.

010.15 Prosecution and Progress

A. Prosecution of Work: Before starting work, 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 day charges. Unless otherwise shown in the Contract, begin work within 20 calendar days after issuance of the Notice to Proceed. Prosecute the work continuously to completion within the working days specified. Unless otherwise shown on the plans, work may be prosecuted in concurrent phases if no changes are required in the traffic control plan or if a revised traffic control plan is approved. Notify the Engineer at least 24 hr. before beginning work or before beginning any new operation. Do not start new operations to the detriment of work already begun. Minimize interference to traffic.

B. Progress Schedules: Schedules are subject to review and acceptance. Before starting work on a construction Contract, prepare and submit a progress schedule based on the sequence of work and traffic control plan shown in the Contract. At a minimum, prepare the progress schedule as a bar chart. Include all planned work activities and sequences and show Contract completion within the number of working days specified. Incorporate major material procurements, known utility relocations, and other activities that may affect the completion of the Contract in the progress schedule. Show a beginning date, ending date, and duration in number of working days for each activity. Do not use activities exceeding 20 working days, except for agreed upon activities. Show an estimated production rate per working day for each work activity.

Submit an updated progress schedule monthly, unless otherwise shown in the Contract or as directed.

Update the progress schedule by adding actual progress made during the previous update period, including approved changes to the sequence of work and the traffic control plan. If an updated progress schedule indicates the Contract will not be completed within the number of working days specified, notify the Engineer in writing whether the Contractor will revise the progress schedule to meet the number of working days specified or exceed the number of working days specified.

Notify the Engineer in writing of proposed major changes in the progress schedule. Major changes are those that may affect compliance with the Contract requirements or that change the critical path or controlling Item of work. The Engineer reserves the right to reject these proposed changes.

No direct compensation will be made for fulfilling these requirements, as this work is considered subsidiary to the Items of the Contract.

C. Computation of Contract Time for Completion: Working day charges will begin on the date provided in the Notice to Proceed or on the thirtieth day after execution of the contract, whichever is earlier. Working day charges will continue in accordance with the Contract. The Engineer may consider increasing the number of working days under extraordinary circumstances.

1. Working Day Charges: Working days will be charged in accordance with Section 010.14.C.1d, "Standard Workweek," as defined below, unless otherwise shown on the plans. The Engineer may consider increasing the number of working days under extraordinary circumstances. Working days will be computed and charged in accordance with one of the following, as shown in the Contract:
 - a. Five-Day Workweek: Working days will be charged Monday through Friday, excluding national holidays, regardless of weather conditions or material availability. The Contractor has the option of working on Saturdays. Provide sufficient advance notice to the Engineer when scheduling work on Saturdays. Work on Sundays and national holidays will not be permitted without written permission of the Engineer. If work requiring an Inspector to be present is performed on a Saturday, Sunday, or national holiday, and weather and other conditions permit the performance of work for 7 hr. between 7:00 A.M. and 6:00 P.M., a working day will be charged.
 - b. Six-Day Workweek: Working days will be charged Monday through Saturday, excluding national holidays, regardless of weather conditions or material availability. Work on Sundays and national holidays will not be permitted without written permission of the Engineer. If work requiring an Inspector to be present is performed on a Sunday or a national holiday, and weather or other conditions permit the performance of work for 7 hr. between 7:00 A.M. and 6:00 P.M., a working day will be charged.
 - c. Seven-Day Workweek: Working days will be charged Monday through Sunday, excluding national holidays, regardless of weather conditions or material availability. Work on national holidays will not be permitted without written permission of the Engineer. If work is performed on any of these holidays requiring an Inspector to be present, and weather or other conditions permit the performance of work for 7 hr. between 7:00 A.M. and 6:00 P.M., a working day will be charged.
 - d. Standard Workweek: Working days will be charged Monday through Friday, excluding national or state holidays, if weather or other conditions permit the performance of the principal unit of work underway, as determined by the Engineer, for a continuous period of at least 7 hr. between 7:00 A.M. and 6:00 P.M., unless otherwise shown in the Contract. The Contractor has the option of working on Saturdays or state holidays. Provide sufficient advance notice to the

Engineer when scheduling work on Saturdays. Work on Sundays and national holidays will not be permitted without written permission of the Engineer. If work requiring an Inspector to be present is performed on a Saturday, Sunday, or holiday, and weather or other conditions permit the performance of work for 7 hr. between 7:00 A.M. and 6:00 P.M., a working day will be charged.

- e. Calendar Day: Working days will be charged Sunday through Saturday, including all holidays, regardless of weather conditions, material availability, or other conditions not under the control of the Contractor.
 - f. Other: Working days will be charged as shown on the plans.
2. Restricted Work Hours: Restrictions on Contractor work hours and the related definition for working day charges are as prescribed in this Article unless otherwise shown on the plans.
3. Nighttime Work. 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.
- a. Five-, Six-, and Seven-Day Workweeks: Nighttime work that extends past midnight will be assigned to the following day for the purposes of approval for allowing work on Sundays or national holidays.
 - b. Standard Workweek.
 - i. Nighttime Work Only: When nighttime work is allowed or required and daytime work is not allowed, working day charges will be made when weather and other conditions permit the performance of the principal unit of work underway, as determined by the Engineer, for a continuous period of at least 7 hr. for the nighttime period, as defined in Section 10.14.C.3, unless otherwise shown in the Contract.
 - ii. Nighttime Work and Daytime Work Requiring Inspector: When nighttime work is performed or required and daytime work is allowed, working day charges will be made when weather and other conditions permit the performance of the principal unit of work underway, as determined by the Engineer, for a continuous period of at least 7 hr. for the nighttime period, as defined in Section 10.14.C.3, or for a continuous period of at least 7 hr. for the alternative daytime period unless otherwise shown in the Contract. Only 1 day will be charged for each 24-hr. time period. When the Engineer agrees to restrict work hours to the nighttime period only, working day charges will be in accordance with Section 10.14.C.3.b.i.
4. Time Statements. The Owner will furnish the Contractor a monthly time statement. The Contractor shall review the monthly time statement for correctness and report protests in writing, no later than 30 calendar days after receipt of the time statement, providing a detailed explanation for each day protested. Not filing a protest within 30 calendar days will indicate acceptance of the working day charges and future consideration of that statement will not be permitted.

D. Temporary Suspension of Work or Working Day Charges. The Engineer may suspend the work, wholly or in part, and will provide notice and reasons for the suspension in writing. Suspend and resume work only as directed in writing.

When part of the work is suspended, the Engineer may suspend working day charges only when conditions not under the control of the Contractor prohibit the performance of critical activities. When all of the work is suspended for reasons not under the control of the Contractor, the Engineer will suspend working day charges.

E. Failure to Complete Work on Time. The time established for the completion of the work is an essential element of the Contract. If the Contractor fails to complete the work within the number of working days specified, working days will continue to be charged. Failure to complete the Contract, or a separate work order when specified in the Contract, within the number of working days specified, including any approved additional working days, will result in liquidated damages for each working day charged over the number of working days specified in the Contract. The dollar amount specified in the Contract will be deducted from any money due or to become due the Contractor for each working day the Contract or work order remains incomplete. This amount will be assessed not as a penalty, but as liquidated damages. The amount assessed for non-site-specific Contracts will be based on the estimated amount for each work order unless otherwise shown in the Contract.

F. Abandonment of Work or Default of Contract. The Engineer may declare the Contractor to be in default of the Contract if the Contractor:

- fails to begin the work within the number of days specified,
- fails to prosecute the work to assure completion within the number of days specified,
- fails to perform the work in accordance with the Contract requirements,
- neglects or refuses to remove and replace rejected materials or unacceptable work,
- discontinues the prosecution of the work without the Engineer's approval,
- makes an unauthorized assignment,
- fails to resume work that has been discontinued within a reasonable number of days after notice to do so,
- is uncooperative, disruptive or threatening, or
- fails to conduct the work in an acceptable manner.

If any of these conditions occur, the Engineer will give notice in writing to the Contractor and the Surety of the intent to declare the Contractor in default. If the Contractor does not proceed as directed within 10 days after the notice, the Owner may upon written notice declare the Contractor to be in default of the Contract. The Owner will also provide written notice of default to the Surety. Working day charges will continue until completion of the Contract. The Contractor may also be subject to sanctions under the Texas Administrative Code.

The Owner will determine the method used for the completion of the remaining work as follows:

- **Contracts without Performance Bonds:** The Owner will determine the most expeditious and efficient way to complete the work, and recover damages from the Contractor.
- **Contracts with Performance Bonds:** The Owner will, without violating the Contract, demand that the Contractor's Surety complete the remaining work in accordance with the terms of the original Contract. A completing Contractor will be considered a subcontractor of the Surety. The Owner reserves the right to approve or reject proposed subcontractors. Work may resume after the Owner receives and approves certificates of insurance as required by the Contract Documents. Certificates of insurance may be issued in the name of the completing Contractor. The Surety is responsible for making every effort to expedite the resumption of work and completion of the Contract. The Owner may complete the work using any or all materials at the work locations that it deems suitable and acceptable. Any costs incurred by the Owner for the completion of the work under the Contract will be the responsibility of the Surety.

From the time of notification of the default until work resumes (either by the Surety or the Owner), the Owner will maintain traffic control devices and will do any other work it deems necessary, unless otherwise agreed upon by the Owner and the Surety. All costs associated with this work will be deducted from money due to the Surety. The Owner will hold all money earned but not disbursed by the date of default. Upon resumption of the work after the default, all payments will be made to the Surety. All costs and charges incurred by the Owner as a result of the default, including the cost of completing the work under

the Contract, costs of maintaining traffic control devices, costs for other work deemed necessary, and any applicable liquidated damages or disincentives will be deducted from money due the Contractor for completed work. If these costs exceed the sum that would have been payable under the Contract, the Surety will be liable and pay the Owner the balance of these costs in excess of the Contract price.

In case the costs incurred by the Owner are less than the amount that would have been payable under the Contract if the work had been completed by the Contractor, the Owner will be entitled to retain the difference.

J. Termination of Contract. The Owner may terminate the Contract in whole or in part whenever:

- the Contractor is prevented from proceeding with the work as a direct result of an executive order of the President of the United States or the Governor of the State;
- the Contractor is prevented from proceeding with the work due to a national emergency, or when the work to be performed under the Contract is stopped, directly or indirectly, because of the freezing or diversion of materials, equipment or labor as the result of an order or a proclamation of the President of the United States;
- the Contractor is prevented from proceeding with the work due to an order of any federal authority;
- the Contractor is prevented from proceeding with the work by reason of a preliminary, special, or permanent restraining court order where the issuance of the restraining order is primarily caused by acts or omissions of persons or agencies other than the Contractor; or
- the Owner determines that termination of the Contract is in the best interest of the State or the public. This includes but is not limited to the discovery of significant hazardous material problems, right of way acquisition problems, or utility conflicts that would cause substantial delays or expense to the Contract.

H. Procedures and Submittals: The Engineer will provide written notice to the Contractor of termination specifying the extent of the termination and the effective date. Upon notice, immediately proceed in accordance with the following:

- stop work as specified in the notice;
- place no further subcontracts or orders for materials, services, or facilities, except as necessary to complete a critical portion of the Contract, as approved by the Engineer;
- terminate all subcontracts to the extent they relate to the work terminated;
- complete performance of the work not terminated;
- settle all outstanding liabilities and termination settlement proposals resulting from the termination for public convenience of the Contract;
- create an inventory report, including all acceptable materials and products obtained for the Contract that have not been incorporated in the work that was terminated (include in the inventory report a description, quantity, location, source, cost, and payment status for each of the acceptable materials and products); and
- take any action necessary, or that the Engineer may direct, for the protection and preservation of the materials and products related to the Contract that are in the possession of the Contractor and in which the Owner has or may acquire an interest.

I. Settlement Provisions: Within 60 calendar days of the date of the notice of termination, submit a final termination settlement proposal, unless otherwise approved. The Engineer will prepare a change order that reduces the affected quantities of work and adds acceptable costs for termination. No claim for loss of anticipated profits will be considered. The Owner will pay reasonable and verifiable termination costs including:

- all work completed at the unit bid price and partial payment for incomplete work;

- the percentage of "Mobilization," equivalent to the percentage of work complete or actual cost that can be supported by cost records, whichever is greater;
- expenses necessary for the preparation of termination settlement proposals and support data;
- the termination and settlement of subcontracts;
- storage, transportation, restocking, and other costs incurred necessary for the preservation, protection, or disposition of the termination inventory; and
- other expenses acceptable to the Owner.

At the written request of the Engineer, immediately remove from the work locations any employee or representative of the Contractor or a subcontractor who, in the opinion of the Engineer, does not perform work in a proper and skillful manner or who is disrespectful, intemperate, disorderly, uncooperative, or otherwise objectionable. Do not reinstate these individuals without the written consent of the Engineer. The Engineer may suspend the work without suspending working day charges until the Contractor complies with these requests.

010.16 Measurement

All work prescribed in this Specification Item shall be included in one or more of the following items. Sequence of Construction and Field Engineering shall each be measured per Lump Sum or per Station as listed on the Unit Price Schedule. If measured by Station, the measurement shall be along the project baseline listed in the Unit Price Schedule. No extra measurement shall be made for driveways or intersecting streets, unless specific Pay Items are included for such driveways or intersecting streets.

Mobilization shall be measured as Lump Sum.

010.16.1 Sequence of Construction: This pay item shall be full compensation for all items required under Section 010.6, Sequence of Construction, of these Operational Requirements. Measurement shall be for completed work per Station, using stations as shown on the construction drawings, or as a percentage of the Lump Sum as determined by the Engineer. Payment under this item shall be full compensation for all construction scheduling, construction phasing, coordination, submittals, and all other items and incidentals required by Section 010.6.

010.16.2 Field Engineering: This pay item shall be full compensation for all tasks prescribed under Section 010.10, Field Engineering of Lines and Grades, of these Operational Requirements. Work under this Item shall be measured as completed work per Station using stations as shown on the construction drawings, or as a percentage of the Lump Sum as determined by the Engineer. Payment under this item shall be full compensation for all labor, materials, and incidentals required by Section 010.10.

010.16.3 Mobilization: For all other items required in these Operational Requirements or elsewhere in the contract documents, specifications, and / or construction drawings and not specifically referenced by a pay item, the contractor shall be compensated in full under payment for **Mobilization**. This item shall be paid as a lump sum with partial payments as follows:

75% of the lump sum amount to be paid on acceptable completion of all items due and submittal of all documentation required from the Contractor before beginning of construction operations.

The remaining 25% of the lump sum amount to be paid with the first partial payment after construction operations actually begin.

- 010.16.4** **As-built Drawings:** This pay item shall be full compensation for all tasks prescribed under Section 010.7, As-built Drawings, of these Operational Requirements. Work under this Item shall be measured as completed work per Lump Sum. Payment under this item shall be full compensation for all labor, materials, and incidentals required by Section 010.7.
- 010.16.5** **Livestock:** This pay item shall be full compensation for complying with all requirements established under Section 010.5 and shall be measured on a lump sum basis.

010.17 Payment:

Payment for the items described above shall include all labor, materials, supervision, equipment, supervision, and all other incidentals required to perform the required services for the entire project, regardless of the means of measurement or the project baseline upon which the measurements are based. The items described above shall be paid under one or more of the following items:

010.17.1	Sequence of Construction	Per Station or Lump Sum
010.17.2	Field Engineering	Per Station or Lump Sum
010.17.3	Mobilization	Per Lump Sum
010.17.4	As-built Drawings	Per Lump Sum
010.17.5	Livestock	Per Lump Sum

END SECTION

101.1 Description

This item shall include labor and other incidentals required to locate, demolish, salvage and dispose of all items and utilities as specified by the Engineer in the construction plans. Salvage shall include delivery to the Owner of all existing fire hydrants, valves, culverts, and road signs removed within the project limits, and other materials, labor and other incidentals required to complete the work, as specified by the Engineer.

101.2 Construction Methods

Locate and remove all items and materials from locations indicated in the plans. The contractor shall be responsible for all damage to items that are to remain in place. The contractor shall take full responsibility for coordination and disposal of demolished items or materials specified in the construction plans.

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

Remove, salvage and deliver to the Owner all existing fire hydrants, valves, culverts and road signs within project limits.

101.3 Measurement

Locating, demolishing, salvage, delivery and disposing of electrical poles, electrical lines, telephone lines, overhead utilities, underground utilities, fire hydrants, valves, culverts road signs and other appurtenances will be measured by Lump Sum.

Coordination for removal of existing utilities, with the appropriate utility providers, shall be considered subsidiary to the payment of this item.

101.4 Payment

Demolition, salvage and disposal, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Demolition, Salvage and Disposal" 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.

Payment, when included as a contract pay item will be made under:

101.4.1	Demolition, Salvage and Disposal	Lump Sum
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END SECTION

102.1 Description

This item shall consist of removing and disposing of all trees, stumps, brush, roots, shrubs, vegetation, logs, rubbish and other objectionable material.

102.2 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.

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:

1. In areas to receive 6 inches or more embankment, a minimum of 12 inches below natural ground.
2. In areas to receive embankment less than 6 inches and areas to be excavated, 18 inches below elevation of the embankment, structure or excavation.
3. 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.

102.3 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.

102.4 Measurement

"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.

102.5 Payment

This item will be considered subsidiary to Section 200, 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, will be made under one of the following:

102.4.1	Clearing and Grubbing	Per Acre
102.4.2	Clearing and Grubbing	Per Station
102.4.3	Clearing and Grubbing	Lump Sum
102.4.4	Selective Clearing and Grubbing	Per Acre
102.4.5	Selective Clearing and Grubbing	Per Station
102.4.6	Selective Clearing and Grubbing	Lump Sum

END SECTION

103.1 Description

This item shall consist of scarifying, blading and removing the top 3" 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.

103.2 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 3" 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.

103.3 Measurement

All Surface Stripping will be measured per 100 foot station regardless of the width of the right of way.

103.4 Payment

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.

Payment, when included as a contract pay item will be made under:

103.4.1	Surface Stripping	Per Station	{3" deep or as otherwise called out}
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END SECTION

104.1 Description

This item shall consist of removal and disposal all existing roadway construction within the project limits, and other materials, labor and other incidentals required to complete the work, as specified by the Engineer.

104.2 Construction Methods

Remove 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.

After removal of all existing asphalt and stabilized material from the existing roadbed, the Contractor shall scarify and mix the remaining roadbed with soil and blade to produce a smooth uniform appearance. Fill, cut, and shape the designated sections of the removed roadway to blend into the surrounding terrain. Cover disturbed areas with topsoil after shaping operations to facilitate establishment of vegetation.

104.3 Measurement

Removal of existing roadway will be measured per square yard complete in place.

104.4 Payment

Removal of existing roadway, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Remove Existing Roadway" which price shall be full compensation for all work herein specified, including the removal of all existing roadway materials, and furnishing of all materials, topsoil, borrow, equipment, tools and labor and incidentals necessary to complete the work.

Payment, when included as a contract pay item will be made under:

104.4.1	Remove Existing Roadway	Per Square Yard
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END SECTION

105.1 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.

105.2 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.

105.3 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.

105.4 Measurement

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

105.5 Payment

The work performed and material furnished as prescribed by this item and measured as provided above will be paid per lump sum. 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.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under the following item:

105.5.1	Mailbox Removal & Reconstruction	Lump Sum
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END SECTION

106.1 Description

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 inches of the subgrade, or other depths as may be called out in the plans or the bid form, including the removal and disposal of concrete curbing as identified by the Engineer.

106.2 Construction Methods

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. Remove additional material, as necessary, to ensure that the final thickness of select material and final surface is in accordance with the design thickness. The subgrade shall be scarified and shaped in conformity with the typical sections and the lines and grades indicated or as established by the Engineer by the removal of existing material. 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. All holes, ruts and depressions shall be filled with approved material. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of the work. Scarify at least 6 inches of the cut soil subgrade, and re-compact to at least 95% of the maximum dry density determined using Texas Department of Transportation (TxDOT) Test Method TEX-114-E. Maintain water contents wet of optimum, but within a range that will allow the specified percentage of compaction.

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 220 Embankment" requirements.

The surface of the subgrade along with any necessary fill material shall be finished to the lines and grades as established and be in conformity with the typical sections indicated. Any deviation in excess of 1/2 inch cross section and in a length of 10 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and compacting by sprinkling and rolling.

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 100 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.

All suitable material removed may be utilized elsewhere on the site with the approval of the Engineer. Subgrade materials on which structures shall be placed shall be compacted by approved mechanical tamping equipment to a density as determined by the Engineer. Subgrade materials on which planting or turf will be established shall also be compacted to density as determined by the Engineer. Observation by the Engineer for density will be made as soon as possible after compacting operations are completed. If the material fails to meet approval of the Engineer, it shall be reworked as necessary to obtain the density required prior to placing any subsequent materials.

106.3 Measurement

All acceptable subgrade preparation will be measured by the square yard regardless of the required depth of preparation.

106.4 Payment

Subgrade preparation, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Subgrade Preparation" 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.

Payment, when included as a contract pay item will be made under:

106.4.1	Subgrade Preparation	Per Square Yard	{6" deep or as otherwise called out}
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END SECTION

107.1 Description

This item shall govern removal of all Roadway Signs, installation of all temporary roadway signs, and reconstruction of all permanent roadway signs and appurtenances as indicated in the construction plans.

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

107.2 Materials

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

107.3 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 roadway signs comply with requirements in the contract documents.

107.4 Measurement

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 included as a single item.

107.5 Payment

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.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under the following item:

107.5.1 Roadway Sign Removal and Reconstruction per Each

END SECTION

200.1 Description

This item shall consist of excavating and properly utilizing or otherwise satisfactorily disposing of all excavated materials, of whatever character, within the limits of the work and the constructing, compacting, shaping and finishing of all earthwork in the designated areas indicated in accordance with specification requirements herein outlined and in conformity with the required lines, grades and typical cross sections indicated or as directed by the Engineer. When not otherwise included or in the Contract Documents, this item shall include the work described in TxDOT Items 100 through 106.

Geotechnical engineering requirements contained on the construction plans shall govern for this item. Where descriptions below may be in conflict, the requirements stated on the plans shall govern.

200.2 Classification

All excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed.

200.3 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 required. Construction equipment shall not be operated within the drip line of trees, unless otherwise 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.

All excavation shall be performed as specified herein and shall conform to the establishing alignment, grades and cross sections. Suitable excavated materials shall be utilized, insofar as practical, in constructing required embankments. The construction of all embankments shall conform to Section 220. No material shall be stockpiled within the banks of a waterway or floodplain.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor and it shall become his sole responsibility to dispose of this material off the limits of the right of way in an environmentally sound manner at a permitted disposal site.

All blasting shall conform to Section 1500. In all cases, blasting shall comply with applicable Federal, State, and Local laws, ordinance, and other applicable requirements.

Adequate dewatering and drainage of excavation shall be maintained throughout the time required to complete the work.

200.4 Measurement

Excavation may be paid by quantities actually measured in place, or may be paid as a plans quantity item. Regardless of the method of payment, in the absence of design changes, absolutely no claims for changes in excavation quantities will be accepted unless the contractor has provided measurements based on cross sections as required for excavation paid as measured in place and as described in the following paragraph. Absolutely all claims for adjustments to excavation quantities must be submitted before any excavation actually begins. The absence of such claims filed in a timely manner will constitute the contractor's acceptance of excavation quantities as shown on the plans.

For excavation 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 excavation. 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 excavation. The manner, location, and level of detail of the cross sections shall be as approved by the Engineer. The contractor shall calculate the total excavation volume and submit both sets of cross sections and the calculations to the Engineer for review and approval.

For excavation 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 Engineer.

200.5 Payment

This item will be paid the item listed below for at the contract unit price bid for "Excavation," when included in the bid, which price shall be full compensation for all work herein specified: including dewatering and drainage, unless otherwise indicated and the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work.

200.5.1	Excavation	Per Cubic Yard
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END SECTION

210.1 Description

This item shall consist of required excavation, removal and proper utilization of materials secured from sources obtained by the Contractor and approved by the Engineer. Compaction of embankments constructed from borrow as provided herein shall conform to the method of Density Control in Section 220.

Borrow will be resorted to only when indicated or directed by the Engineer and then only from approved sources.

210.2 Materials

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

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

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.

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.

210.3 Construction Methods

Prior to commencing this work, all erosion control and environmental measures required shall be in place. All suitable materials removed from excavations shall be used, insofar as practicable in the formation of embankments conforming to Section 220 or otherwise be utilized as indicated or as directed by the Engineer and the completed work shall conform to the established alignment, grades and cross section. 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.

210.4 Measurement

Borrow and topsoil may be paid by quantities actually measured in place, or may be paid as a plans quantity item. For quantities 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 excavation. 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 work under this Section. The manner, location, and level of detail of the cross sections shall be as approved by the Engineer. The contractor shall calculate the total quantities and submit both sets of cross sections and the calculations to the Engineer for review and approval.

For quantities paid as plans quantity items, 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 Engineer.

210.5 Payment

When included in the bid, payment will be made under one the following items, which price shall be full compensation for all work herein specified: including dewatering, drainage, hauling, spreading, and grading, and shall include the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work unless otherwise indicated.

210.5.1	Borrow - Class A	Per Cubic Yard
210.5.2	Borrow – Class B	Per Cubic Yard
210.5.3	Topsoil	Per Cubic Yard

END SECTION

220.1 Description

This item shall consist of the placing and compacting of suitable materials obtained from approved sources for utilization in the construction of street or channel embankments, berms, levees, dikes and structures.

220.2 Construction Methods

(1) General

Prior to placing any embankment, all trees protection, tree wells and erosion control devices shall be in place and all TxDOT Items No. 100 through 106 and all Section 102 operations shall have been completed on the areas over which the embankment is to be placed. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable material and thoroughly tamped by approved methods before commencing embankment construction. The surface of the ground, including plowed loosened ground or surface roughened by small washes, shall be restored to approximately its original slope and the ground surface thus prepared shall be compacted by sprinkling and rolling.

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.

Unless otherwise indicated, the surface of the ground of all unpaved areas, other than rock which are to receive embankment, shall be loosened by scarifying or plowing to a depth of not less than 8 inches. The loosened material shall be recompacted with the new embankment as hereinafter specified.

The surface of hillsides to receive embankment shall be loosened by scarifying or plowing to a depth of not less than 8 inches and benches cut before embankment materials are placed. The embankment shall then be placed in layers, as hereinafter specified, beginning at the low side in partial width layers and increasing the widths as the embankment is raised. The material which has been loosened shall be recompacted simultaneously with the embankment material placed at the same elevation.

Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than 8 inches and the embankment built up in successive layers, as hereinafter specified, to the level of the old roadbed before its height is increased. Then, if indicated, the top of the old roadbed shall be scarified and recompacted with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible layer depth.

Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in the embankment.

All embankment 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, revegetation procedures must commence immediately to minimize the soil loss and air pollution.

(2) Earth Embankments

Earth embankments shall be defined as embankments composed primarily of soil material other than rock. For earth embankments in excess of two feet in depth that are located beneath pavement, the upper two feet shall meet the material requirements under Section 210 for Class B Borrow, with the underlying material meeting the requirements established below.

Except as otherwise indicated, earth embankments shall be constructed in successive 6 inch layers, loose measure, for the full width of the individual cross section and in such length as are best suited to the sprinkling and compaction methods utilized.

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.

Each layer of embankment shall be uniform as to material, density and moisture content before beginning compaction. Where layers of unlike materials abut each other, each layer shall be feathered on a slope of 1:20 or the material shall be so mixed as to prevent abrupt changes in the soil. No material placed in the embankment by dumping in a pile or windrows shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, discing or similar methods to the end that a uniform material of uniform density is secured in each layer.

Water required for sprinkling to bring the material to the moisture content necessary for optimum compaction shall be evenly applied and it shall be the responsibility of the Contractor to secure uniform moisture content throughout the layer by such methods as may be necessary.

All earth cuts, whether full width or partial width cuts in the side of a hill, which are not required to be excavated below subgrade elevation shall be scarified to a uniform depth of at least 8 inches below grade and the material shall be mixed and reshaped by blading and then sprinkled and rolled in accordance with the requirements outlined above for earth embankments and to the same density as that required for the adjacent embankment.

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 overcompacting high PI expansive clays.

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.

(3) Rock Embankments

Rock embankments shall be defined as those composed principally of rock and shall be constructed of accepted material from approved sources. Rock embankments shall not be placed immediately adjacent to structures.

Except as otherwise indicated, rock embankments shall be constructed in successive layers for the full width of the cross section and of 12 inches or less in depth. When, in the opinion of the Engineer, the rock sizes necessitate a greater depth of layer than specified, the layer depth may be increased as necessary, but in no case shall the depth of layer exceed 2 feet.

Each layer shall be constructed by starting at one end and dumping the rock on top of the layer being constructed then pushing the material ahead with a bulldozer in such a manner that the larger rock will be placed on the ground or preceding embankment layer and the interstices between the larger stones filled with small stones and spalls by the operation and from the placing of succeeding loads of material.

The maximum dimension of any rock used in embankment shall be 4 inches or less. 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.

Each layer shall be compacted to the required density as outlined for "Earth Embankments," above, except in those layers where rock will make density testing difficult, the Engineer may accept the layer by visual inspection or proof rolling conforming to TxDOT Item 216.

Unless otherwise indicated, the upper 3 feet of the embankment shall contain no stones larger than 4 inches in their greatest dimension and shall be composed of material so graded that the density and uniformity of the surface layer may be tested for proper compaction when compared with the maximum density determined by TxDOT Test Method Tex-113/114-E. Oversized material shall be broken up or removed.

After each layer of earth embankment 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 moisture or density specified, the course shall be reworked as necessary to obtain the specified compaction and moisture content.

(4) At Culverts and Bridges

Embankments adjacent to culverts and bridges which cannot be compacted by use of the blading and rolling equipment used in compacting the adjoining sections of embankment shall be compacted in the manner approved by the Engineer.

Embankment placed around spill through type abutments shall be constructed in 6 inch loose layers of uniform suitable material placed in such manner as to maintain approximately the same elevation on each side of the abutment and all materials shall be mixed, wetted and compacted as specified above.

Embankment material placed adjacent to any portion of any structure or above the top of any culvert or similar structure shall be free of any appreciable amount of gravel or stone particles and thoroughly compacted by mechanical compaction equipment.

220.3 Measurement

When included as a pay item, embankment may be paid by quantities actually measured in place, or may be paid as a plans quantity item. For embankment 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 embankment. 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 embankment. The manner, location, and level of detail of the cross sections shall be as approved by the Engineer. The contractor shall calculate the total embankment volume and submit both sets of cross sections and the calculations to the Engineer for review and approval.

For embankment 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 Engineer.

220.4 Payment

This item is usually subsidiary to excavation and/or borrow and is not paid for separately. However, when included in the contract as a separate pay item, it shall be paid for at the contract unit price bid for "Embankment," compacted in place, which price shall be full compensation for all work herein specified, including the furnishing of all materials (except "Borrow" when paid as a separate bid item), processing (as required to meet Class B Borrow requirements), compacting, equipment, tools, labor, water for sprinkling, proof rolling and incidentals necessary to complete the work.

Payment, when included in the contract, will be made under the following item:

220.4.1	Embankment	Per Cubic Yard
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END SECTION

230.1 General

All excavation, trenching and backfilling for utility lines and appurtenant structures shall conform to the requirements of this specification and Contract Documents. The Engineer shall have the right to limit the amount of trench opened in advance or left open after pipe lying. Within this Section, any reference to pipe shall be construed to mean any facility being buried in the trench referenced by this Section.

230.2 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.

230.3 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.

230.4 Methods of Excavation

Excavation may be performed with any type of trenching or excavating equipment which is capable of cutting properly aligned trenches in whatever materials are encountered. All excavation shall be by open cut unless specifically required to be bored. Blasting will be permitted only when or where specifically approved by the 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.

230.5 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.

230.6 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.

230.7 Use of Washed Gravel

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

230.8 Existing Structures

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

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

230.9 Excavation

(A) Procedure:

Excavate as indicated or specified line and grade.

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.

(B) 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.

(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 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.

When sheeting 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.

(D) Pipe Zone:

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.

230.10 Bedding

Bedding shall be 6" thick 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.

Bedding Material for pipe diameters larger than 8 in. shall consist of Class I material per ASTM D2321 - 08 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications," ASTM International, West Conshohocken, PA, 2003, DOI: 10.1520/C0033-03, www.astm.org. with 100% passing the 3/4" Sieve, no more than 15% passing the #4 sieve, no more than 25% passing the 3/8" sieve, and less than 12% passing the #200 sieve. For pipe with diameters less than 8" the maximum particle size shall be 10% of the pipe diameter.

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.

230.11 Embedment Material

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.

230.12 Backfill

Backfill shall be of three types: Select Backfill and Common Backfill.

(A) **Select Backfill in Streets and Drives**

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 three (3) inches. Not more than twenty-five (25) percent shall be clay or clay lumps.

(1) 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.

(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.

230.13 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 section 240 – 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 of a minimum 2” of HMAC Type D in conformance with Item 410 – 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.

230.14 Measurement

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. 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.

230.15 Payment

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.

230.15.1 Trench, {width, depth, and applicable detail as called for in bid form} Per Linear Foot

END SECTION

240.1 Description

This item shall consist of a crushed stone foundation course for surfacing, pavement or other base courses, furnished and installed on a prepared surface. The "Flexible Base" 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 Engineer.

240.2 Material

The material shall be crushed argillaceous limestone meeting the requirements hereinafter specified and shall consist of durable crushed stone and screened to the required particle size. The material shall be from approved sources.

Testing of flexible 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)

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.

The material shall be well graded and when properly tested, shall meet the following requirements:

Sieve Size	Percent Retained
2 ½ inch	0
1¾ inch	0 - 10
No. 4	45 - 75
No. 40	60 - 85
Maximum Liquid Limit	35
Maximum Plasticity Index	12
Maximum Wet Ball Mill	50
Maximum increase in passing No. from Wet Ball Mill Test	45 20 percent

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.

240.3 Stockpiling, Storage and Management

(1) Managing Aggregates

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 rehandling. 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.

240.4 Construction Methods

(1) Preparation of Subgrade

"Flexible Base" shall not be placed until the Contractor has verified through density testing that the subgrade has been prepared and compacted in conformity with Section 106, "Subgrade Preparation", to the typical sections, lines and grades as indicated. Any deviation shall be corrected and proof rolled prior to placement of aggregate. Existing base shall be scarified and recompacted at a minimum of 2 inches of depth prior to application of the first course of base.

Blue tops shall be set by the Contractor for subgrade on centerline, quarter points, curb lines or edge of pavement where curb is omitted, at intervals not exceeding 50 feet.

(2) First Course

Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section. The thickness of each base course shall not exceed 6 inches, loose measure and will be equal increments of the total depth. 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 approved vehicles and it shall be the responsibility of the Contractor that the required amount of specified material shall be delivered. Material deposited upon the subgrade shall be spread and shaped the same day unless otherwise approved by the Engineer. In the event inclement weather or other unforeseen circumstances render impractical spreading of the material during the first 24 hour period, the material shall be spread as soon as conditions allow. The material shall be sprinkled, if required, and shall then be bladed, dragged and shaped to conform to typical sections as indicated. All areas and "nests" of segregated course or fine material shall be corrected or removed and replaced with well-graded material. If additional binder is considered desirable or necessary after the material is spread and shaped, it shall be furnished and applied as required. Such binder material shall be carefully and evenly incorporated with the material in place by scarifying, harrowing, brooming or by other approved methods.

The course shall be sprinkled as required to bring it to optimum moisture content and compacted to the extent necessary to provide not less than the percent density hereafter specified under "Density." In no case shall the base be worked at more than 2 percent above or below optimum moisture. 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. Throughout this entire operation the shape of the base course shall be maintained by blading and the surface, upon completion, shall be smooth and in conformity with the typical section indicated and to the established lines and grades. In that area on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section and in length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material,

reshaping and recompacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling. 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 recompacted and refinished at the sole expense of the Contractor.

(3) 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. 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.

240.5 Measurement

When included as a pay item, flexible base may be paid by quantities actually measured in place, or may be paid as a plans quantity item. 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 Engineer. The contractor shall calculate the total flexible base volume and submit both sets of cross sections and the calculations to the Engineer for review and approval.

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 Engineer.

240.6 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit prices bid or the pay adjusted unit price for "Flexible Base," compacted in place, which price shall be full compensation for all work herein specified, including the furnishing of all materials, compacting, equipment, tools, labor, water for sprinkling, proof rolling and incidentals necessary to complete the work.

Payment, when included in the contract, will be made under the following item:

240.6.1	Flexible Base, {thickness as called for in Unit Price Schedule}	Per Cubic Yard
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END SECTION

250.1 Description

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.

250.2 Materials

- (1) Geotextile Fabric - as approved by Engineer.
- (2) Clean native rock, size as indicated in the Contract Documents - as approved by Engineer.

250.3 Construction

All Rock Riprap construction shall conform to the Contract Documents.

250.4 Measurement

All Rock Riprap will be measured per square yard complete in place.

250.5 Payment

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.

Payment, when included as a contract pay item will be made under:

250.5.1	Rock Riprap	Per Square Yard
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END SECTION

300.1 Description

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

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

300.2 Submittals

Prior to beginning construction, for each class of concrete to be used, the Contractor shall submit to the Engineer for approval the following items:

- 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.
- 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.
- 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.

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.

300.3 Materials

- (A) 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.

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

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

- (B) Mixing Water

Water for use with cement shall be clean and free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances and meeting the requirements of ASTM C94. Water from doubtful sources shall not be used until tested and approved.

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

(C) Coarse Aggregate

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

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

When tested in accordance with Tex-401-A, the coarse aggregate shall conform to the following grading requirements:

Coarse Aggregate Gradation Chart

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.

(D) Fine Aggregate

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

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

When tested in accordance with Tex-401-A, the fine aggregate shall conform to the following grading requirements.

Fine Aggregate Gradation Chart (Grade 1)

Sieve Size	Percent Passing
3/8 in.	100
No. 4	95–100
No. 8	80–100
No. 16	50–85
No. 30	25–65
No. 50	10–35 ¹
No. 100	0–10
No. 200	0–3 ²

1. 6–35 when sand equivalent value is greater than 85.
2. 0–6 for manufactured sand.

(E) Concrete Admixtures

- (1) Water Reducing Agent shall conform to ASTM C-494 Type A, and shall have a dosage as recommended by the manufacturer. Admix shall be Pozzolith by Master Builders Co.; WRDA by W.R. Grace; PSI by Gifford Hill & Company or approved equal.
- (2) Set Retarding Agent: When, in the opinion of the Engineer, the ambient or concrete temperature requires the use of a set retarding admixture, such admix shall conform to ASTM C-494, Type D. Admixtures shall be PSI-R by Gifford Hill; Daratard by W.R. Grace, or approved equal.
- (3) Air Entaining Admixture shall be used where specified or directed to improve workability and increase resistance to freeze and thawing, and scaling. The admix shall comply with ASTM C 260 and shall be used in accordance with manufacturer's recommendations. Products shall be Air-Tite by Gifford Hill; Daravair by W.R. Grace; MB-VR by Master Builders, or approved equal.

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

(F) Curing and Sealing Compound

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

(G) Bonding Agent

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

(H) Fiber

- (1) Add steel or polypropylene fibers only when called for on the plans or approved by the Engineer:

- (2) Polypropylene Fiber:
 - a). Ratio: 1.5 pounds of fiber per cubic yard of concrete.
 - b). 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.
 - c). Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.
- (3) Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A820.
 - a). Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
 - b). 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.
- (I) Formwork Materials
 - (1) Lumber and Plywood: 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.
 - (2) Formwork for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 3/4-inch minimum thickness, preferably oiled at the mill.
 - (3) Chamfer Strips and Similar Moldings: 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.
 - (4) Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties.

- (5) 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.
- (J) Production Methods
- Use either ready-mixed concrete conforming to requirements of ASTM C94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C685.
- (K) Reinforcing Steel
- (1) Bar Steel: All bar reinforcement shall be open hearth new billet steel of structural, intermediate, or hard grade. New billet steel shall conform to the requirements of the latest Standard Specification for Billet-Steel Concrete Reinforcement Bars, ASTM Designation 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.
- (2) Wire Fabric: Wire for fabric reinforcement shall be cold-drawn from rods hot rolled from open hearth billets. Wire shall conform to the requirements of the latest Standard Specification for Drawn Wire for Concrete Reinforcement, ASTM Designation A-185 or A884.
- (3) Wire: ASTM A82. Use 16½ gauge minimum for tie wire, unless otherwise indicated.
- (L) Premolded Expansion Joint Filler shall conform to the requirements of ASTM Designation D-994 or other as approved by City Engineer.
- (M) 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.

300.4 Batching and Mixing

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

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

300.5 Consistency

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

- (A) The mortar will cling to the coarse aggregate.
- (B) The aggregate will not segregate in the concrete when it is transported to the place of deposit.
- (C) The concrete and mortar will show no free water when removed from the mixer.
- (D) The surface of the finished concrete will be free from a surface film of "laitance".

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

300.6 Classifications and Proportions

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.

- (A) 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.:

Concrete Classes

Class of Concrete	Design Strength, Min. 28-day f'_c (psi)	Maximum W/C Ratio ¹	Coarse Aggregate Grades ^{2,3}	General Usage ⁴
A	3,000	0.60	1-4, 8	Inlets, manholes, curb, gutter, curb & gutter, conc. retards, sidewalks, driveways, backup walls, anchors
B	2,000	0.60	2-7	Riprap, small roadside signs, and anchors
C _s	3,600	0.45	1-6	Drilled shafts, bridge substructure, bridge railing, culverts except top slab of direct traffic culverts, headwalls, wing walls, approach slabs, concrete traffic barrier (cast-in-place)
D	1,500	0.60	2-7	Riprap
E	3,000	0.50	2-5	Seal concrete
F _s	Note 6	0.45	2-5	Railroad structures; occasionally for bridge piers, columns, or bents
H _s	Note 6	0.45	3-6	Prestressed concrete beams, boxes, piling, and concrete traffic barrier (precast)

S ₅	4,000	0.45	2-5	Bridge slabs, top slabs of direct traffic culverts
P	See TxDOT Item 360	0.45	2-3	Concrete pavement
DC ₅	5,500	0.40	6	Dense conc. overlay
CO ₅	4,600	0.40	6	Conc. overlay
LMC ₅	4,000	0.40	6-8	Latex-modified concrete overlay
SS ₅	Note 7	0.45	4-6	Slurry displacement shafts, underwater drilled shafts
K ₅	Note 6	0.45	Note 6	Note 6
HES	Note 6	0.45	Note 6	Note 6

1. Maximum water-cement or water-cementitious ratio by weight.
2. Unless otherwise permitted, do not use Grade 1 coarse aggregate except in massive foundations with 4-in. minimum clear spacing between reinforcing steel bars. Do not use Grade 1 aggregate in drilled shafts.
3. Unless otherwise approved, use Grade 8 aggregate in extruded curbs.
4. For information only.
5. Structural concrete classes.
6. As shown on the plans or specified.
7. Cementitious material content shall be minimum 658 lb/cy of concrete.

(B) 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 (es) 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.

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

(C) Generally concrete slump shall be maintained to the minimum slump which allows placement and finishing. Slump should be maintained within the limits in the following table unless otherwise specified by the engineer and approved by the city.

Concrete Designation	Recommended Design and Placement 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 ¹	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

300.7 Quality of Concrete

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

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

300.8 General Construction Requirement for Concrete Structures

- (A) 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.
- (B) Forms and false work to be used in the construction of the various units of a structure shall be in accordance with all governing safety requirements and shall be the responsibility of the Contractor.
- (C) Approval by the Engineer of construction methods, equipment, or form and false work plans will not relieve the Contractor of responsibility for the safety or correctness of methods used, adequacy of equipment, or from carrying out the work in full accordance with the contract.

300.9 Concrete Delivery

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

The transit mixer shall be of an approved revolving drum or revolving blade type so constructed as to produce a thoroughly mixed concrete with a uniform distribution of the materials throughout the mass and shall be equipped with a discharge mechanism which will insure the discharging of the mixed concrete without segregation.

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

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

300.10 Concrete 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.

300.11 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 a type that are encased in paper or other materials to allow the removal of the complete tie, leaving a hole through the concrete structure, will not be permitted. Metal ties shall be held in place by devices attached to walls. Each device shall be capable of developing the strength of the tie.

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

300.12 Placing Concrete

(A) General

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.

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, 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.

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.

(B) Foundation and Footings

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

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

When footings can be placed in dry foundation pits without the use of cofferdams or caissons, forms may be omitted, if desired by the Contractor and approved by the Engineer, and the entire excavation filled with concrete to the elevation of the top of the footing.

(C) Weather Conditions for Placement

No concrete shall be placed when the atmospheric temperature is at or below forty (40) degrees F (taken in the shade away from artificial heat) unless permission is

given or in cases where the temperature drops below forty (40) degrees F after the concreting operations have been started.

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

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

Concrete shall not be placed when it's temperature is greater than ninety-five (95) degrees 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.

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

300.13 Finishing

- (A) Slabs, Valve Vault, Tops, Etc.

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

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

Tamping and screeding operations shall be continued until the concrete is properly consolidated and the surface voids are eliminated. The surface shall then be brought to a smooth true alignment by means of longitudinal screeding, floating, 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 plastic, the surface shall be straight edged by the use of a standard ten (10) foot metal straightedge. Deviations in excess of permissible variations shall be corrected. The final surface finish of the slab shall be done after the initial straight edging and corrective adjusting, if required, is completed, as specified hereinafter.

(B) Formed Surfaces

Immediately after forms are removed, the formed surfaces shall be finished as follows:

- (1) Any honeycomb areas shall be chipped out to firm concrete and thoroughly cleaned of chips and particles of broken concrete. A bonding agent shall then be applied to the entire surface of the cavity, and the cavity packed with a relatively dry mortar of the same sand-cement ratio as the concrete mix used in the structure. The mortar shall be thoroughly compacted to insure complete filling of the cavity and the surface struck off to match the surrounding concrete.
- (2) Exterior surfaces that will be more than one (1) foot below grade will require no further finish.
- (3) Exterior surfaces to be exposed to view and to a point one (1) foot below finish grade, and interior exposed surfaces, shall be finished as follows:

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

(C) Floor and Slab Finishes

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

(1) Sidewalks

The sidewalk shall be floated with a steel trowel to provide a smooth, burnished surface. After floating and before the finish has set, the surfaces shall be lightly brushed with a fine brush to remove the surface.

(2) Concrete Valleys, Driveways, Vault Tops and Floors, Etc.

After the initial treatment specified in "A" above, and after the surface has become firm, the surface shall be given a single floating with a wood float to provide a uniform surface.

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

300.14 Curing Concrete

Immediately after finishing, all upper non-formed surfaces shall be covered with a continuous, uniform, water impermeable coating. Immediately after removal of the side and end forms of non-

exposed surfaces, and after required finishing of exposed surfaces, the formed surfaces of all concrete shall receive a like coating. The solution shall be applied under pressure with a spray nozzle in such a manner as to cover the entire exposed surface thoroughly and completely with a uniform film.

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

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

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

300.15 Measurement

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, width, and height (or depth) shall be measured, and the constructed volume of the placed concrete shall be computed in cubic yards. 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, when included on the bid form as a pay item, shall be measured per square yard complete in place per type and to the depth specified in the Contract Documents.

300.16 Payment

When specifically included on the bid form as a pay item, concrete placed under this Section shall be paid under the specific item below for each class of concrete listed on the bid form. For all concrete not specifically listed as a pay item on the bid form, payment shall be subsidiary 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 all work herein specified, including the furnishing of reinforcing steel as specified in the Contract Documents, all other materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment, when included as a contract pay item will be made under:

300.16.1	Concrete, Class {as listed on the bid form}	Per Cubic Yard
300.16.2	Concrete Pavement	Per Square Yard

END SECTION

305.1 Description

The requirements of this item shall govern for supplying and installing cement stabilized sand for backfill, bedding, and free formed structures.

305.2 Submittals

Prior to beginning construction, the Contractor shall submit to the Engineer for approval a proposed design mix and test data for sand / cement mixture.

At the time of delivery, the Contractor shall submit to the Engineer the supplier's batch ticket indicating cement content per cubic yard or per ton of product, batch date and time and weight of load at time of delivery.

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.

305.3 Materials

- (A) Cement shall conform to ASTM C 150 Type I. All cement shall be sampled and tested in accordance with the current Standard Methods of Sampling and Testing Portland Cement of the ASTM Designation C-183, C-184, C-188, C-190 and C-191.
- (B) Sand shall be clean durable sand complying with the following:
 - 1. Meet ASTM D 2487 and shall be classified as SW, SP, SC, or SM by the Unified Soils Classification System.
 - 2. Deleterious materials shall not exceed the following:
 - a. Clay lumps – ASTM C 142, less than 0.5 percent.
 - b. Lightweight pieces – ASTM C 123, less than 5.0 percent.
 - c. Organic impurities – ASTM C 40, color no darker than the standard color.
 - d. Plasticity index – ASTM D 4318, of 4 or less.
- (C) Water shall meet the requirements of ASTM 94.

305.4 Mix Design and Mixing

Use a sand / cement mixture containing a minimum of 2 sacks of cement per cubic yard (1-1/2 sacks of cement per ton) unless specified otherwise on the construction plans. Design the sand / cement mixture to produce a minimum unconfined compressive strength of 200 psi in 48 hours when compacted to 95 percent maximum standard dry density in accordance with ASTM D 558. Perform molding, curing, and compression testing in accordance with ASTM D 1633 – Method A.

Add the required amount of water and mix it thoroughly in a pugmill-type mixer. Stamp the batch ticket at the plant with the time of loading.

Material not placed and compacted within 4 hours after mixing will be considered nonconforming.

305.5 Placement

Place the sand / cement mixture for free formed structures in 8-inch-thick loose layers and compact to not less than 95 percent maximum standard dry density (ASTM D 698) unless otherwise specified. The moisture content during compaction shall be on the dry side of optimum, but sufficient for hydration.

Perform and complete compaction of sand / cement mixture within 4 hours after addition of water to mix at the plant.

Do not place or compact sand / cement mixture in standing or free water.

305.6 Measurement

When specifically included on the Unit Price Schedule as a pay item per cubic yard, cement stabilized sand placed under this Section shall be measured complete in place by physically measuring the length, width, and height (or depth), and the constructed volume of the placed material shall be computed in cubic yards.

Alternatively, when specifically included on the Unit Price Schedule as a pay item per ton, cement stabilized sand placed under this Section shall be measured complete in place per ton based on approved weight tickets submitted at the time of installation.

305.7 Payment

When specifically included on the bid form as a pay item, cement stabilized sand placed under this Section shall be paid under one or more of the specific items below. For all cement stabilized sand not specifically listed as a pay item on the bid form, payment shall be subsidiary to other bid items in the contract.

305.7.1 Cement Stabilized Sand Per Cubic Yard

305.7.2 Cement Stabilized Sand Per Ton

END SECTION

310.1 Description

Break, remove, and salvage or dispose of existing concrete.

310.2 Construction

Remove existing concrete from locations shown on the plans. Avoid damaging concrete that will remain in place. 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.

310.3 Measurement

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 dowelled 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.

310.4 Payment

This item will be considered subsidiary to Section 200, and / or Section 220, unless included as a separate pay item in the contract. 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.

310.4.1	Removing Concrete	Per Square Yard
310.4.2	Removing Concrete	Per Linear Foot

END SECTION

320.1 Description

This item shall govern for the furnishing and placing of all longitudinal, contraction and expansion joint material in concrete work as herein specified in the various items of these specifications as indicated by the Engineer.

320.2 Material

(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.

(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.

(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.

(4) Joint Sealer (Concrete Pavement)

This material shall be a one-part low modulus silicone especially designed to cure at ambient temperatures by reacting with moisture in the air and shall have the following properties:

As Supplied

Color	Gray
Flow, MIL-2-8802D Sec. 4.8.4	0.2 maximum
Working Time, minutes	10
Tack-Free Time at 77 F±2 F Min. MIL-2-8802D Sec.4.8.7	60
Cure time, at 77 F (25 C), days	7-14
Full Adhesion, days	14-21

As Cured-after 7 days at 77 F (25 C) and 40% RH

Elongation, percent minimum	1200
Durometer Hardness, Shore A, points ASTM 2240	15
Joint Movement Capability, percent	+100/-50
Tensile Strength, maximum elongation, psi	100
Peel strength, psi	25

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 incompressibles. The material shall not crack or break when exposed to low temperature.

(5) 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.

320.3 Construction Methods

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 No. 3 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.

320.4 Measurement and Payment

No additional compensation will be made for materials, equipment or labor required by this item, but shall be considered subsidiary to the various items included in the contract.

END SECTION

330.1 Description

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.

330.2 Materials

(1) Concrete

Concrete shall conform to Class A Concrete as indicated in Section 300 "Concrete."

(2) Reinforcing Steel

Reinforcing steel shall conform to TxDOT Item 440, "Reinforcing Steel."

(3) Expansion Joint Materials

Expansion joint materials shall conform to Section 320, "Concrete Joint Materials."

330.3 Construction Methods

Subgrade for curb and gutter shall be excavated and prepared to required depth and width including a minimum of 6 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.

Forms shall be of metal or well-seasoned wood. 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.

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.

Expansion joint material, $\frac{3}{4}$ inch in thickness, shall be provided at intervals not to exceed 40 feet and shall extend the full width and depth of the concrete. Weakened plane joints shall be made $\frac{3}{4}$ inch deep at 10-foot intervals. All joint headers shall be braced perpendicular and at right angles to the curb.

Two round smooth dowel bars, $\frac{1}{2}$ 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.

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 $\frac{1}{2}$ inch nor less than $\frac{1}{4}$ 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.

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.

330.4 Measurement

Accepted work as prescribed by this item will be measured by the linear foot of concrete curb and gutter, complete in place.

330.5 Payment

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.

330.5.1	Concrete Curb and Gutter {Type as called out in the Unit Price Schedule}	Per Linear Foot
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330.5.2	Concrete Curb {Type as called out in the Unit Price Schedule}	Per Linear Foot
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END SECTION

331.1 Description

This item shall include the construction of all Concrete Valley Gutter construction within public right-of-way, and all of the materials, labor, and other incidentals required to complete the work at a location specified by the Engineer.

331.2 Materials

All materials shall comply with Section 300 and TxDOT Item 440.

331.3 Construction

All Concrete Valley Gutter construction shall conform to the details included in the Contract Documents.

331.4 Measurement

All Concrete Valley Gutters will be measured per square yard complete in place.

331.5 Payment

Concrete Valley Gutter, if included in the bid, shall be measured as specified, 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 will be made under:

331.5.1	Concrete Valley Gutter	Per Square Yard
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END SECTION

400.1 General

This item includes sidewalk, concrete driveway approaches, and valley gutter construction within public right-of-way. It does not include sidewalk and driveway construction beyond the right-of-way property line. All sidewalks, drive approaches, and valley gutters shall conform to the standard plans and details appended to these Standard Specifications.

400.3 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 300, "Concrete".
- (B) Flexible Base Material shall conform to the requirements of Item 240, "Flexible Base".

400.4 Excavation, Fill, and Grading

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.

400.5 Concrete Valley Gutters, Sidewalks, and Concrete Driveway Approaches

Construction of concrete valley gutters, sidewalks, and concrete driveway approaches shall conform to the following requirements. Concrete shall be Class A as specified under Item 300, "Concrete", of these Standard Specifications. No concrete shall be placed until the forms have been checked and approved by the City Inspector. Dimensions and conformation shall comply with the 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.

- (A) Concrete 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.

(B) Sidewalks and Concrete Driveway Approach

Sidewalks 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, 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 300, "Concrete", of these specifications. The edges shall be tooled with a one-quarter (1/4) inch radius edging tool, and walks shall also be tooled transversely at five (5) foot intervals. This pattern shall be continued through the concrete driveway approach apron. Curing compound shall be applied to the surface immediately after finishing is completed.

400.6 Measurement

All Concrete Valley Gutters, Sidewalks, and Concrete Driveway Approach will be measured per square yard complete in place.

400.7 Payment

Concrete Valley Gutter, Sidewalks, 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.

Payment, when included as a contract pay item will be made under:

400.7.1	Concrete Valley Gutter	Per Square Yard
400.7.2	Sidewalks	Per Square Yard
400.7.3	Concrete Driveway Approach	Per Square Yard

END SECTION

401.1 Description

This item shall include the saw-cut, removal and reconstruction of all pavements, and all of the materials, labor, and other incidentals required to complete the work at location specified by the Engineer.

401.2 Materials

All materials shall match the existing materials present before the start of construction. All materials shall comply with requirements set forth elsewhere in the contract documents.

401.3 Construction

All pavements shall be saw-cut to a depth of 3" and shall include cutting of reinforcing steel if applicable. The area to be saw-cut shall consist of only the area necessary to adequately construct the project as specified by the Engineer in the construction documents. Any pavement, outside the area specified by the Engineer that is damaged during construction shall be the removed and reconstructed at the contractor's sole expense.

Removing material shall consist of removing only the amount of material necessary to adequately construct the project as specified by the engineer.

Reconstruction shall be done in accordance with applicable sections as shown in the contract documents and in these Specifications. All reconstruction shall match conditions prior to the start of construction.

Density testing of select backfill at approximately 100 foot intervals per 8 inch lift, or at the engineer's discretion, shall be required for backfilling trenches in existing roadways. 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.

401.4 Measurement

The saw-cut of existing pavements will be measured per linear foot.

The removal of existing pavements will be measured per square yard.

The reconstruction of pavements will be measured per square yard complete in place.

The removal of existing curb ramps will be measured per each.

The reconstruction of curb ramps will be measured per each complete in place.

401.5 Payment

Saw-Cut, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Saw-Cut" 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.

Pavement Removal, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Pavement Removal" which price shall be full compensation for all work herein specified, including the furnishing of all excavation, equipment, tools and labor and incidentals necessary to complete the work.

Pavement Reconstruction, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Pavement Reconstruction" 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.

Curb Ramp Removal, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Curb Ramp Removal" 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.

Curb Ramp Reconstruction, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Curb Ramp Reconstruction" 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.

Payment, when included as a contract pay item will be made under one of the following:

401.5.1	Saw-Cut	Per Linear Foot
401.5.2	Pavement Removal	Per Square Yard
401.5.3	Pavement Reconstruction	Per Square Yard
401.5.4	Curb Ramp Removal	Per Each
401.5.5	Curb Ramp Reconstruction	Per Each

END SECTION

410.1 Description

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.

410.2 Materials

(1) General

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.

(2) 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

(3) Asphalts, Oils, and Emulsions

Asphaltic Material shall be provided in accordance with TxDOT Item 300 as shown on the plans.

410.3 Paving Mixtures

(1) Mixture Design

Mixture Design shall be performed in accordance with TxDOT Item 340 to satisfy Materials and Type specified on the plans.

(2) Types

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.

(3) Sampling and Testing

The Engineer 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 Engineer.

The Engineer 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 Engineer. 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 Engineer 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 Engineer, of in place asphalt concrete will be at the cost of the Contractor.

(4) Construction

Design, produce, store, transport, place, and compact the specified paving mixture in accordance with the requirements of TxDOT Item 340.

410.4 Equipment

Provide required or necessary equipment in accordance with TxDOT Item 320, "Equipment for Asphalt Concrete Pavement."

(1) 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".

(2) Compacting

Lay-Down Operations shall be performed in accordance with the requirements TxDOT Item 340.

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 Engineer 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:

$$\text{Percent in place Density} = \frac{GA}{GT} \times 100$$

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 Engineer 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.

(3) 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 Engineer for riding surface, finish and appearance.

410.8 Measurement

Asphaltic concrete pavement will be measured by the square yard of the specified total thickness of the type actually used in the completed and accepted work in accordance with the plans and specifications.

410.9 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" 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 No. 410, "Hot Mix Asphaltic Concrete Pavement."

The prime coat, or tack coat, when required, will not be measured or paid for directly but shall be considered subsidiary to "Hot Mix Asphaltic Concrete 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 under one of the following items:

- 410.10 Hot Mix Type C {thickness as called out in the Unit Price Schedule} Per Square Yard**
- 410.11 Hot Mix Type D {thickness as called out in the Unit Price Schedule} Per Square Yard**
- 410.12 Hot Mix Type C Per Ton**
- 410.13 Hot Mix Type D Per Ton**

END SECTION

420.1 Description

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. 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 Engineer, are not suitable.

420.2 Materials

Aggregate:

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 not more than 1 percent (1%) by weight of organic matter (other than native bitumen), clays, loam or pebbles coated therewith and shall contain not 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:

Grade 4	Retained on $\frac{5}{8}$ " sieves	0
	Retained on $\frac{1}{2}$ " sieves	0-5
	Retained on $\frac{3}{8}$ " sieves	20-40
	Retained on #4 sieves	95-100
	Retained on #8 sieves	98-100

Application Rate - Min. 1 cy cover 90 sy, max. 1 cy cover 110 sy, 1-110.

Asphaltic Materials:

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.

420.3 Construction Methods

420.3.1 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 Engineer, 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 Engineer shall be furnished an accurate and satisfactory record of such calibration. After beginning work, should the yield of the asphaltic material appear to be in error, the distributor shall be recalibrated in a manner satisfactory to the Engineer 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 Engineer in writing. The aggregate 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 of the first course until the second course is applied.

The entire surface shall then be broomed, bladed or raked as required by the Engineer 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 Engineer, 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 Engineer, its use shall be discontinued.

Rollers shall be maintained in good repair and operating condition and shall be approved by the Engineer.

420.3.2 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.

420.4 Measurement

All acceptable Chip Seal or Two Course Surface Treatment will be measured by the square yard for actually completed and accepted work in accordance with the plans and specifications.

420.5 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit prices 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 with no addition in payment.

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.

Payment, when included as a contract pay item will be made under one or more of the following items:

420.5.1	Chip Seal	Per Square Yard
420.5.2	Two Course Surface Treatment	Per Square Yard

END SECTION

430.1 Description

This item shall consist of the saw-cut, removal and reconstruction of all driveways, and all of the materials labor, and other incidentals required to complete the work at a location specified by the Engineer.

430.2 Materials

All materials shall match the existing materials present before the start of construction. All materials shall comply with requirements set forth elsewhere in these Specifications.

430.3 Removal & Reconstruction

- Typical driveway removal & reconstruction consists of removing only the amount of material necessary to adequately construct the project as specified by the engineer. All driveways shall be reconstructed to match the conditions and materials before the start of construction, unless otherwise called out in the construction plans.
- Asphalt driveway removal & reconstruction consists of removing only the amount of material necessary to adequately construct the project as specified by the engineer. Reconstruction shall be done in accordance with applicable items in these Specifications. All reconstruction shall match conditions prior to the start of construction, unless otherwise called out in the construction plans.

430.4 Measurement

Driveway removal and reconstruction shall be measured per square yard or shall be measured per each as indicated in the Unit Price Schedule.

430.5 Payment

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.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under one of the following items.:

430.5.1	Driveway Removal & Reconstruction	Per Square Yard
430.5.2	Driveway Removal & Reconstruction	Per Each

END SECTION

440.1 Description

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.

440.2 Construction Methods

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

440.3 Measurement

All Temporary Access Road will be measured per square yard complete in place.

440.4 Payment

Temporary Access Road, if included in the bid, shall be measured as specified above and 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.

Payment, when included as a contract pay item will be made under:

440.4.1	Temporary Access Road	Per Square Yard
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END SECTION

445.1 Description

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.

445.2 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.

445.3 Measurement

All Temporary Roadway will be measured per square yard 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 included in the per square yard measurement.

445.4 Payment

Temporary Roadway, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Temporary Roadway" 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.

Payment, when included as a contract pay item will be made under:

445.4.1	Temporary Roadway	Per Square Yard
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END SECTION

500.1 Description

This item shall consist of furnishing and installing all pipe and appurtenances for constructing pipe mains, laterals, stubs, service connections, services leads, meter assemblies, valves, fittings, and all other materials including applicable work such as unclassified excavating, bedding, jointing, backfilling, materials, tests, etc. 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 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.

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.

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.

500.2 Materials

(1) Pipe

Pipe and fittings shall conform to Section 800 "Pipe."

(2) Valves

(a) Gate Valves (up to 3 inches in diameter)

Meeting 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: Milwaukee Valve Co. Gate 105 (or equal).

- (b) Gate Valves (4 inches through 16 inches in diameter)

Meeting or exceeding applicable requirements of ANSI/AWWA C 509 "Resilient Seated Gate Valves for Water and Sewerage Systems" standard. 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: (1) Mueller, (2) American Flow Control, and (3) Clow (No alternates allowed).

- (c) Pressure Reducing Valve

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).

- (d) Backflow Preventer (Double Check Valve Assembly)

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 headloss at rated flow. Approved manufacturer: Cla-Val Co. (or approved equal).

- (e) Flush Valve

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).

- (f) Air / Vacuum Release Valves

Globe type, screwed connection, 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: Apco (or approved equal).

- (1) 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.

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.

Valves shall be rated for at least 150 psi {maximum} normal service pressure.

(2) Material Requirements

Valve exterior bodies and covers shall be cast iron.

Internal bushings, hinge pins, float guide and retaining screws, pins, etc., shall be stainless steel or bronze.

Orifice seats shall be Buna-N rubber.

Floats shall be stainless steel, rated at 1000 psi.

(3) Fire Hydrants

All fire hydrants shall comply with AWWA C-502 "AWWA Standard for Dry-Barrel Fire Hydrants" 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 5 ¼" nozzle shall be required to have a Hydra-Shield Hydra-Storz Quick Connect System (No alternates allowed). 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.

Color - red. Approved products: (1) Mueller Super Centurion, (2) American Darling 5¼" B-84-B, and (3) Clow Medallion (No alternates allowed).

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). 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.

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; its retaining pins, bolts, nuts, etc. of Type 302 or 304 stainless steel.

Coatings shall be durable and applied to clean surfaces. The coating shall be applied according to coating manufacturer's specifications. Other exposed ferrous metal shall receive asphalt-based varnish, or approved equal, applied according to the coating manufacturer's specifications.

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.

(4) Bedding, Embedment and Backfill Materials

These materials shall conform to Section 230 "Trenching."

500.3 Construction Methods

(1) Pipe Construction Methods

Pipe construction methods shall conform to Section 600 Subsection 600.3.

Minimum cover depth above the top of pipe shall be 3 feet.

(2) Setting Valves, Drains and Air Releases

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.

Unless otherwise indicated, 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.

Drainage branches or air blowoffs 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.

(3) Setting Fire Hydrants

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.

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.

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.

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. 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.

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.

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.

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.

(4) 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

(5) Valve Stem Box, Casing and Cover

Unless otherwise indicated, a vertical 6-inch D.I. riser pipe shall be installed over all valve square nuts extended to finish grade. A 18" x 18" x 4" 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.

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.

(6) Air Release Assemblies

Assemblies shall be installed as indicated.

(7) Pressure/Flow Control Valves

Assemblies shall be installed as indicated.

500.4 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.

(1) Pressure Test

The entire project or each valved section shall be tested, at a pressure of 200 psi for a sufficient period (10 minutes) to discover all leaking or defective materials. Repairs shall be made by the Contractor to correct any leaking or defective materials.

(2) Pressure Pipe Leakage Test

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.

(a) Allowable Leakage

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:

For Iron Pipe:

$$L = \frac{SDP^{0.5}}{148,000}$$

For Other Pipe:

$$L = \frac{SDP^{0.5}}{133,200}$$

where L = Leakage in gallons per hour
S = Length of pipe in feet
D = Diameter (inside) of pipe 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.

500.5 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.

The water supply authority 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 rate of \$ 3.50 per 1,000 gallons.

500.6 Sterilization of Potable Water Lines

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.

(1) Procedure and Dosage

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 parts per million 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.

(2) Bacteriological Testing

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 1000 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, as 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.

500.7 Submittals

The Contractor, prior to installation of any materials, shall submit to the Engineer the proposed product data and receive, from the Engineer, approval of any and all material to be utilized by the Contractor.

(1) Product Data

Submit manufacturer's technical product data and installation instructions for materials and products.

500.8 Measurement

Pipe and will be measured by the linear foot 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, bedding and backfill.

Concrete trench cap and encasement will be measured per linear foot for the width indicated.

Where wyes, branches or connections to existing pipe lines are involved, measurement of the new connecting pipe will be made from the intersection of its central axis with the outside surfaces of the pipe into which it connects.

All types of valves will be measured per each.

Fire hydrant assemblies and drain valves will be measured per each.

Pressure/flow control valve assemblies and both manual and automatic air release assemblies will be measured per each.

Taps, service leads, and service taps field located will be measured per each.

If provided as a pay item, waterline connections shall be measured per each.

Removal of existing pipe shall be measured per linear foot along the centerline of the pipe.

Standard blow-offs shall be measured per each.

Relocate meter box shall be measured per each.

500.9 Payment

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot for the various sizes of pipe, of the materials and class indicated.

The concrete seal, foundation rock or coarse aggregate shall be paid for at the unit price bid per cubic yard, which shall be full payment for all excavation and removal of unsuitable material and furnishing, placing and compacting the foundation rock, coarse aggregate or other approved material all complete in place.

Excavation, bedding and backfill, when included as pipe installation will not be measured as such but shall be included in the unit price bid for constructing pipe and measured as pipe complete in place including excavation, bedding and backfill. As established in the bid, pipe including excavation, bedding and backfill for any and all depth.

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 for all other incidentals necessary to complete the pipe and appurtenances installation as indicated.

(1) Pipe

When called for in the bid, pipe shall be paid for at the unit contract price bid per linear foot for the size and type of pipe specified at the depth specified, complete in place. The bid price per linear foot shall include all clearing, excavation, bedding material, fittings, plugs, lugs, pipe coatings, connection to the existing system, disposal of surplus materials, laying

of pipe, backfilling and cleanup. Measurement for depth shall be from the existing ground surface or proposed street subgrade, whichever is less, over the centerline of the pipe. Measurement for length shall be the horizontal distance along the centerline of the pipe as surveyed by the Engineer. Payment will also represent compensation for removal and replacement of pavement, curb, drainage structures, driveways and any other improvements damaged during construction. Concrete blocking for supporting and reinforcing bends and thrust blocks shall be included in the cost for pipe.

No separate payment will be made for harnessed joints required for thrust restraint which are scheduled or indicated.

(2) Wet Connections to Water Mains

Wet connections shall be, complete in place, according to the size of the main that is in service and shall be full compensation for all work required to make the connection and place the pipe in service, and shall include all necessary hardware, tapping sleeves, fittings, and other items required to complete the connection.

(3) Fittings

PVC, cast iron and ductile iron fittings of the class indicated, furnished in accordance with these specifications will be, complete in place, according to ANSI A 21.10 (AWWA C-110) 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. No separate payment will be made for these items; payment for all such items shall be included in the appropriate bid price for pipe.

(4) Concrete Trench Cap and Encasement

Where the distance between the top of the concrete encasement and the top of the trench cap is less than 36 inches, the concrete cap and encasement will be poured as one unit and paid for under this bid item at the contract price bid per linear foot. When the distance above is greater than 36 inches or when the trench cap is placed separately, the trench cap shall be paid for as a separate item, per linear foot, complete in place.

(5) Taps

Taps (both in pressurized and non-pressurized lines) will be complete in place, according to the size tap made and the size main tapped and shall be full payment for furnishing all necessary materials, including tapping sleeves, making the tap, testing and placing the connection in service. Valves will be paid separately.

(6) Trench Safety Systems

The Contractor shall employ Trench Safety Systems as appropriate and as described elsewhere in these specifications.

(7) Valves

Valves will be installed, including valve stem casing and cover, excavation and backfill, setting, adjusting to grade and anchoring.

(8) Fire Hydrants

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.

(9) Pressure/Flow Control Assemblies

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.

(10) Air / Vacuum Release Valves

Automatic air-vacuum release assemblies will include the main line tap or outlet, all pipe, valves, fittings, box, manhole structure, or vault and cover.

(11) Service Leads

Services will be of indicated size and configuration.

(12) Waterline Connections

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.

(13) Removal of Existing Pipe

When shown in the plans, existing sections of pipe, and associated fittings, shall be abandoned and removed and disposed. 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. Removal of existing pipe shall be paid per linear foot.

(14) Service Taps Field Located

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 be replace all existing meters and associated facilities that may be damaged during the relocation at his sole expense. In locations where installation of multiple service is called out, refer to the Contract Documents for multiple service installations. Measurement and payment shall be per each for each installation.

(15) Pressure Reducing Valve

Pressure reducing valve and assembly will include the main line tap or outlet, all pipe, valves, fittings, gauges, box, manhole structure, or vault and cover.

(16) Standard Blow - Off

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.

(17) Relocate Meter Box

Relocate existing water meter boxes as shown on the construction plans and 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. Payment for this item shall include all additional pipe, labor, and incidentals required to connect the relocated meter box to the existing or to the proposed system as specified.

(18) Permanent Sampling Taps

The Contractor shall provide Permanent Sampling Taps (or other suitable fixtures) at intervals not exceeding 1,000 feet. 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.

(19) Additional Pipe Fittings

Payment for fittings is subsidiary to payment for Pipe. Additional Pipe Fittings may be required due to potential amendments of proposed alignments. Payment under Additional Pipe Fittings shall be paid only when additional fittings are required due to changes in the horizontal pipe alignment.

(20) Non-Potable Water Pipe

All materials and construction methods for Non-Potable Water Pipe (not sewer or force main) shall meet the requirements established in specification sections 500 and 800, excluding section 500.6 Sterilization of Potable Water Lines. The pipe shall be purple in color, and shall require tracer tape clearly labeled "NON-POTABLE WATER."

Payment for all items and tasks described in this Section shall be measured as described above and paid under one or more of the following items:

500.9.1	Pipe, Ductile Iron, {size as called for in Unit Price Schedule}	Per Linear Foot
500.9.2	Pipe, PVC {C900 or C905, as called out in Unit Price Schedule}, DR 18 {size as called for in Unit Price Schedule}	Per Linear Foot
500.9.3	Pipe, PVC {size, type, and DR as called for in Unit Price Schedule}	Per Linear Foot
500.9.4	Gate Valves, {size as called for in Unit Price Schedule}	Per Each
500.9.5	Fire Hydrants	Per Each
500.9.6	Reset Existing Fire Hydrant	Per Each
500.9.7	Air / Vacuum Release Valves	Per Each
500.9.8	Pressure Test	Lump Sum
500.9.9	Leakage Test	Lump Sum
500.9.10	System Sterilization	Lump Sum
500.9.11	Wet Connection {size as called for in Unit Price Schedule}	Per Each
500.9.12	Taps {size as called for in the Unit Price Schedule}	Per Each
500.9.13	Trench Safety Systems {depth as called for in the Unit Price Schedule}	Per Each
500.9.14	Remove Existing Pipe, all sizes	Per Linear Foot
500.9.15	Service Taps – Field Located {single or multiple and size as called out in Unit Price Schedule}	Per Each
500.9.16	Pressure Reducing Valve {size & type as called out in Unit Price Schedule}	Per Each
500.9.17	Standard Blow-off	Per Each
500.9.18	Relocate Meter Box and tie to {Existing or to Proposed Line as called out in the Unit Price Schedule}	Per Each

500.9.19	Concrete Trench Cap and Encasement {Width of cap or encasement called for in the Unit Price Schedule}	Per Linear Foot
500.9.20	Waterline Connection	Per Each
500.9.21	Permanent Sampling Taps	Lump Sum
500.9.22	Additional Pipe Fittings	Per Ton
500.9.23	Non-Potable Water Pipe	Per Linear Foot

The following cross-references are provided as a minimum to the specifications. Additional specifications if contained elsewhere herein may apply.

SPECIFIC CROSS-REFERENCE MATERIALS
Specification: "Water Supply and Appurtenances"

ANSI/AWWA Standards: _____

<u>Designation</u>	<u>Description</u>
A-21.11	American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings
C-105	American National Standard for Polyethylene Encasement for Ductile-Iron Pipe
C-500	Metal-Seated Gate Valves for Water Supply Service
C-502	Dry-Barrel Fire Hydrants
C-509	Resilient Seated Gate Valves for Water and Sewerage Systems

ASTM Standards

<u>Designation</u>	<u>Description</u>
ASTM A48/A48M	Specification for Gray Iron Castings
ASTM A 536	Specification for Ductile Iron Castings

National Fire Protection Association (NFPA)

National (American) Standard Fire Hose Coupling Screw Thread

END SECTION

501.1 Description

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.

501.2 Materials & Construction Methods

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.

501.3 Measurement

Temporary maintenance of the existing water line will be measured lump sum complete in place.

501.4 Payment

When no specific pay item is included in the contract documents for "Temporary Maintenance of Existing Water Line", 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" 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.

Payment, when included as a contract pay item will be made under:

501.4.1	Temporary Maintenance of Existing Water Line	Lump Sum
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END SECTION

508.1 Scope

Pipe casings shall comply with the following:

Steel pipe shall be new, smooth wall carbon steel pipe, which conforms to ASTM Specification A134, with minimum yield strength of 35,000 psi.

All steel pipe shall be square cut with beveled ends for welding.

Joints shall be welded.

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.

Steel casing shall have an outside circumference which is within 1% of the nominal circumference or which is within 1/2" whichever is less.

Steel casing shall have a minimum allowable straightness deviation in any 10' length of 1/8" inch or less.

STEEL CASING – WATER MAIN		
Pipe Size (Inches)	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

WATER MAINS IN CONDUITS			
Water Main Size (Inches)	Nom. Dia. RCP* Or Steel (Inches)	Steel Pipe Thickness (Inches)	Pipe Weight (Lbs/Ft)
6	18	0.375	70.59
8	18	0.375	70.59
10	18	0.375	70.59
12	18	0.375	70.59
16	30	0.375	118.65
20	36	0.438	166.19
24	42	0.438	194.02
30	48	0.500	259.02
36	54	0.500	291.07

*Class III or Class IV Tongue and Groove

508.2 Measurement

Pipe casing will be measured by the linear foot of pipe complete in place. Such measurements will be made between the ends of the casing along the central axis as installed.

508.3 Payment

Payment for the pipe casing, measured as prescribed above, will be made at the unit price bid per linear foot for the casing size, 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 and all incidental and subsidiary materials and work necessary to complete the installation as indicated.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under the following item.:

508.3.1	Steel Casing Pipe {size as called for in bid form}	Per Linear Foot
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END SECTION

510.1 Scope

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.

510.2 General 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.

- a. 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.
- b. 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.
- c. 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.
- d. 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%.
- e. 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.
- f. 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.

- g.** 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.
- h.** 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.
- i.** 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.
- j.** Unless noted otherwise, casing spacers shall be required on all carrier pipes installed in casing or tunnel applications.
- k.** 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.

510.3 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.

510.4 Measurement

Casing spacers will be measured by lump sum.

510.5 Payment

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.

Manufacturers	Locations	Model Numers
Pipeline Seal & Insulator, Inc.	Houston, TX	C8G-2 or S18G-2
Pipeline Seal & Insulator, Inc.	Houston, TX	C12G-2 or SIIG-2
Advance Products & Systems, Inc.	Lafayette, LA	APS S18-2 or APS SS18-2
Advance Products & Systems, Inc.	Lafayette, LA	APS S112-2 or APS SS112-2
Power Seal Pipeline Products, Inc.	Wichita Falls, TX	4810 SS (Stainless steel) 4810 CS (Carbon steel)
Cascade Waterworks Manufacturing Co.	Yorkville, IL	Style CSS

END SECTION

512.1 Description

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.

512.2 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.

512.3 Materials

A. Pipe

Carrier pipe and encasement pipe shall conform to Specification, "Water Supply & Appurtenances" and "Sanitary Sewage & Appurtenances" as appropriate, as well as "Concrete Encasement and Encasement Pipe" and "Drainage Piping" and shall be size, type materials, thickness and class indicated on the Drawings, unless otherwise specified.

B. Grout

Grout for void areas shall consist of 1 part Portland cement and 4 parts fine, clean sand mixed with water.

512.4 Construction Methods

A. General

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.

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.

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".

B. 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.

C. 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.

D. Joints

If reinforced concrete pipe is used, the joints shall be in accordance with TxDOT Specification Item 464, "Reinforced Concrete Pipe". All bell and spigot piping shall have all joints restrained as set forth by the Engineer.

512.5 Measurement

Jacking or boring pipe will be measured by the linear foot of pipe complete in place. Such measurement will be made between the ends of the pipe along the central axis as installed.

512.6 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" 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.

Payment for all items and tasks described in this Specification Item shall be measured as described above under the following item:

512.6.1	Jacking or Boring Pipe	Per Linear Foot
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<i>SPECIFIC</i> Cross Reference Materials
Specification Item 512, "Jacking or Boring Pipe"

TxDOT Standard Specifications For Construction And Maintenance Of Highways, Streets, And Bridges

<u>Designation</u>	<u>Description</u>
Item 464	Reinforced Concrete Pipe

TxDOT Testing Procedures

<u>Designation</u>	<u>Description</u>
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)

<u>Designation</u>	<u>Description</u>
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

<i>RELATED</i> Cross Reference Materials
Specification Item 512, "Jacking or Boring Pipe"

TxDOT Standard Specifications

<u>Designation</u>	<u>Description</u>
Item 476	Jacking, Boring or Tunneling Pipe

END SECTION

600.1 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 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 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, 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.

600.2 Materials

(1) Bedding, Embedment and Backfill Materials

These materials shall conform to Section 230 "Trenching."

(2) Pipe

Pipe and fittings shall conform to Section 800 "Pipe."

600.3 Construction Methods

(1) General

All construction methods shall conform to Section 230, Trenching, and to Section 800, Pipe.

(2) 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.

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 percent 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.

(3) Surplus Excavated Materials

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.

(4) Pipe Bedding, Embedment and Backfilling

The construction methods for pipe bedding, embedment and backfilling shall conform to Section 230.

(5) Tie Into Existing Facilities

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.

600.4 Measurement

Pipe will be measured by the linear foot 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.

Where wyes, branches or connections to existing pipe lines are involved, measurement of the new connecting pipe will be made from the insertion of its central axis with the outside surfaces of the pipe into which it connects. Where inlets, headwalls, catch basins, manholes, junction boxes or other structures are included in the lines of pipe, the length of pipe tying into the structure wall will be included for measurement but no other portion of the structure length or width will be so included.

For multiple pipes, the measured length will be the sum of the lengths of the barrels as prescribed above.

For tying into existing facilities, the measurement will be per each for each tie, complete in place.

600.5 Payment

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.

When called for in the Bid, pipe shall be paid for at the unit contract price bid per linear foot for size and type of pipe specified at the depth specified, complete in place. The bid price per linear foot shall include all

clearing, excavation, bedding material, fittings, plugs, lugs, pipe coatings, connection to the existing system, and disposal of surplus materials, lying of pipe, backfilling and cleanup. Payment will also represent compensation for removal and replacement of pavement, curb, drainage structures, driveways and any other improvements damaged during construction. Concrete blocking for supporting and reinforcing bends and thrust blocks shall be included in the cost for pipe.

No separate payment will be made for welded joints or harnessed joints required for thrust restraint, which are scheduled or indicated.

When specifically included as a pay item, pipe shall be paid under the following item:

600.5.1	Pipe {type and size as in the Unit Price Schedule}	Per Linear Foot
600.5.2	Tie Into Existing Facilities	Per Each

END SECTION

620.1 Description

All 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.

620.2 Design Loads

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.

620.3 Materials

(1) Approved Product

As approved by the Engineer.

(2) Forms

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.

(3) Concrete

(a) Aggregate

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.

(b) 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.

(c) Placing

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.

(d) Curing

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.

(3) Reinforcing Steel - Grade 60

All reinforcing steel, 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.

620.4 Grate

Grates shall have an open area of at least 50% and be rated for HS-20 loading.

620.5 Construction Method

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.

620.6 Measurement and Payment

Measurement and Payment will be made on a lump sum basis 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, 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.

Payment, when included as a Contract Pay Item, will be made as follows:

620.6.1	Precast Concrete Inlets	Per Each
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END SECTION

622.1 Description

This Item shall govern for the furnishing and installation of Interceptor Structures, in accordance with these specifications and as shown on the plans, whether precast or formed and poured in place.

622.2 Design Loads

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.

622.3 Materials

If formed and poured in place, the interceptor structure shall conform to the sizes, lines, and elevations shown in the construction plans.

All precast concrete sections will be manufactured in a plant specially 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.

Interceptor structures, whether precast or formed and poured in place, shall be constructed with materials as described below:

(1) Approved Product (precast)

As approved by the Engineer. The Contractor shall submit shop drawings for the Engineer's approval.

(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.

(3) Concrete

Concrete shall conform to Section 300 and shall be Class "A" with grade 8 aggregate. All forms shall be smooth and reasonably free of knots, bulges, and holes.

(4) Reinforcing Steel - Grade 60

Unless otherwise shown on the Construction Plans, or in approved shop drawings, all reinforcing steel, 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 shall be deformed in accordance with ASTM A305.

(5) Pipe Runners

Pipe runners shall be furnished as shown in the plans and in accordance with the following:

- ASTM A 53, Type E or S, Grade B

- ASTM A 500, Grade B; or
- API 5L, Grade X42

(6) Fasteners

Pipe runners shall be furnished and fastened in place as shown in the plans.

622.4 Construction Method

The Contractor shall prepare the excavation for the correct elevation after grading has been properly executed. The interceptor structures shall be poured or set according to the drawings. Backfill material should be free flowing and placed in lifts of approximately 2 feet around the interceptor structure so as not to shift the completed structure. 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.

622.7 Measurement

Measurement will be made per each for each Interceptor Structure complete in place

622.8 Payment

Payment for the Interceptor Structures, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, constructing and/or placing the interceptor structure and all incidental and subsidiary materials and works; preparing, shaping, 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 incidentals necessary for completion of the Work. Payment, when included as a Contract Pay Item, will be made as follows:

**622.8.1 Interceptor Structure {Interceptor Structure number as shown Per Each
on the Unit Price Schedule}**

END SECTION

625.1 Description

The requirements of this section shall govern for all concrete junction boxes, whether precast or formed and poured in place.

625.2 Design Loads

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.

625.3 Materials

If formed and poured in place, the junction boxes 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.

Junction boxes, whether precast or formed and poured in place, shall be constructed with materials as described below:

(1) Approved Product (precast)

As approved by the Engineer. The Contractor shall submit shop drawings for the Engineer's approval.

(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.

(3) Concrete

Concrete shall conform to Section 300 and shall be Class "A" with grade 8 aggregate. All forms shall be smooth and reasonably free of knots, bulges, and holes.

(4) Reinforcing Steel - Grade 60

Unless otherwise shown on the Construction Plans, or in approved shop drawings, all reinforcing steel, 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.

625.4 Frames, Grates, Rings, Covers

Frames, and cover shall be East Jordan Iron Works, Inc. V-1600-5 or approved equal.

625.5 Construction Method

The Contractor shall prepare the excavation for the correct elevation after grading has been properly executed. The junction box shall be poured or set according to the drawings. Backfill material should be free flowing and placed in lifts of approximately 2 feet around the junction box so as not to shift the completed structure. 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.

625.6 Measurement

Measurement will be made per each for each junction box installed. Excavation and backfill, along with any required frames, rings, and grates shall be included in the Unit Price Bid for the junction box.

625.7 Payment

Payment for the junction box, as prescribed, shall be full compensation, in accordance with the Pay Item in the Unit Price Bid for excavation, furnishing, hauling, constructing and/or placing the junction box and all incidental and subsidiary materials and works; preparing, shaping, 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 incidentals necessary for completion of the Work. Payment, when included as a Contract Pay Item, will be made as follows:

625.7.1 Concrete Junction Box {junction box number as shown on the Unit Price Schedule} Per Each

END SECTION

630.1 Description

This item shall consist of installing headwalls, wingwalls and splash pans (aprons) for proposed culvert or cross-drainage structures.

630.2 Installation

Headwalls and wingwalls shall conform to TxDOT Item 466. Splash pans shall conform to TxDOT Item 432 for concrete riprap. Details, concrete specifications, and concrete reinforcement requirements shown on the plans shall take precedence over requirements listed in the applicable TxDOT Items.

630.3 Measurement

Headwalls, wingwalls, and splash pans for culverts and cross-drainage structures shall be measured per each, with one unit consisting of all headwalls, wingwalls, and splash pans for a single culvert.

630.4 Payment

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.

Payment will be under the following item:

630.4.1	Headwalls, Wingwalls, Splash Pans for {type and size of culvert as called out in the Unit Price Schedule}	Per Each
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END SECTION

640.1 Description

This Item shall govern for the furnishing and installation of Culvert Outfalls, in accordance with these specifications and as shown on the plans. Culvert Outfalls include: concrete headwalls and wingwalls, 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.

640.2 Materials and Installation

The items and methods addressed in this Special Specification shall conform to the project specifications, except as otherwise detailed in this Special Specification or in the plans.

640.3 Measurement and Payment

The items in this Special Specification shall be measured and paid on a lump sum basis per each. The notation on the Unit Price Schedule shall supersede all other items as to measurement and payment.

640.3.1 Culvert Outfall {#, Station} shall comply with all details listed above, and shall be measured and paid per each complete in place.

END SECTION

650.1 Description

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.

650.2 Materials

Approved Manufacturer – ACO Polymer Products, Inc. or Approved Equal.

650.3 Construction Methods

The Trench Drains shall be installed per the installation details and specifications, found in the contract documents.

650.4 Measurement

The trench drain will be measured per each drain system complete in place.

650.5 Payment

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.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under the following item:

650.5.1	Trench Drain	Per Each
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END SECTION

700.1 Description

This item shall consist of furnishing and installing all pipe, manhole assemblies and 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 pipe and 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.

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.

As the project progresses, the Contractor shall be required to field verify that all proposed installations of sanitary sewage and appurtenances will meet the clearances specified in TCEQ Chapter 217, Design Criteria for Domestic Wastewater Systems, §§217.53 and Chapter 290 Public Drinking Water, 290.44. 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.

700.2 Materials

(1) Pipe

Pipe and Fittings shall conform to Section 800 "Pipe."

(2) Sanitary Sewer Manholes

(a) General

Provide precast reinforced concrete sewer manholes as indicated on the drawings and complying with ASTM C 478.

(b) Top

The Top shall be precast concrete of concentric cone, eccentric cone, or flat top type as of a size indicated on the drawings.

(c) 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.

(d) Pipe Connectors

All Pipe Connectors shall be resilient, complying with ASTM C 923.

(e) Frame and Cover

All Frames and Covers shall be 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."

(3) Bedding, Embedment and Backfill Materials

These materials shall conform to Section 230 "Trenching."

(4) Grinder Pump System

(a) Backflow Prevention Devices

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.

(b) Check Valves

Check valves should be of a swing check type with external levers. Rubberball check valves may be used.

(5) Combination Air/Vac Valves

The valve and appurtenances shall conform to required ASTM specifications. Approved product: APCO 2" 440 Combination Air/Vac Valve (or approved equal)

(1) 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. The small orifice system shall automatically release small volumes of air while the pipe is operating under normal conditions. The large air-vacuum orifice system shall automatically exhaust large volumes of air while the pipe is being filled and shall permit immediate re-entry of air while being drained.

(2) Valve manholes shall conform to standards set forth in these Standard Specifications.

(6) Flushing Connection

Two-inch pipe, two inch 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)

(7) Pressure Sewer Manhole Discharge

Materials, methods, and connections shall conform to the Contract Documents and the requirements of TCEQ Chapter 217 – Design Criteria for Domestic Wastewater Systems.

(8) Valves

(a) Gate Valves

Gate valves shall be epoxy-coated on the inside in accordance with the ANSI/AWWA specifications C550-81. Valves shall be in accordance with the ANSI/AWWA specification "Resilient-Seated Gate Valves" C-509, or latest version. They shall have a non-rising stem.

(b) Check Valves

Check valves shall be of the swing type and conform with ASTM A-216 Class B, with bronze seat disc ring.

(c) Valve Boxes

Valve boxes shall be 3 piece screw type cast iron of the extension type. Mueller H-10360 or approved equal.

(9) 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.

700.3 Construction Methods

(1) Pipe Construction Methods

Pipe construction methods shall conform to Section 600 Subsection 600.3.

(2) Installing Manholes

(a) General

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. 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.

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.

(b) 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.

(c) Construction of Inlets

Foundation: Concrete foundation 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.

Cast Iron: 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.

(3) Combination Air / Vacuum Release Valve Relocation

Combination air / vacuum release valves shall be relocated where indicated in the construction plans. All combination air / vacuum release valves called out to be relocated shall be moved in their entirety into the proposed right of way. In no case shall the relocations

be more than five feet inside the right of way, without prior approval from the Engineer. Combination air / vacuum release valve assembly drain lines shall be adjusted as necessary, and shall provide positive drainage. Relocations shall be performed so as not to damage the manhole, valves, or appurtenances. Any damage to the combination air / vacuum release valve assembly shall be repaired or replaced at the expense of the Contractor to the Engineer's satisfaction.

(4) Flush Valve Relocation

Flush valves shall be relocated where indicated in the construction plans. All flush valves called out to be relocated shall be moved in their entirety into the proposed right of way. In no case shall the relocations be more than five feet inside the right of way, without prior approval from the Engineer. Relocations shall be performed so as not to damage the valve, or any of its appurtenances. Any damage to the flush valve assembly shall be repaired or replaced at the expense of the Contractor to the Engineer's satisfaction.

(5) Pipe Plugs

All pipes indicated to be plugged shall be plugged at the connection to the structure using 3,000 psi concrete.

(6) Temporary Manhole Plugs

Unless specifically noted otherwise on the construction plans, all Temporary Manhole Plugs provided shall be installed and remain in place upon completion of the project, and shall become the property of the Owner.

700.4 Testing

(1) General

Alignment: Gravity sewer lines may be lamped for proper alignment at option of Engineer. If lamped, a sewer line will not be accepted if a clear lamp cannot be seen from manhole to manhole.

Deflection: Test flexible pipe sewer lines (PVC, ABS, ABS Truss) for excessive deflection in pipe cross section, for lateral pipe intrusions, and for joint offsets by pulling a mandrel through the pipe by hand. Testing shall be performed at least 30 days after backfilling is complete. Size mandrel at 95% of I.D. of pipe; repair obstructions encountered.

Defects: Visually inspect sewer lines 30 inches in diameter and larger for defects; smaller sewer lines may be televised.

Testing shall be in accordance with the latest requirements of 30 TAC Chapter 217 – Design Criteria for Domestic Wastewater Systems as published by the Texas Commission on Environmental Quality (TCEQ).

(2) Leakage Test

a) General

Test sanitary sewer facilities for leakage after completion of installation and backfill. Repair damage resulting from test, and any line that fails test. Perform tests in presence of Engineer; submit test results and calculations.

b) Alternative Wastewater Collection Systems

Pressure sewer installation shall be tested for leakage with a hydrostatic test. Leakage in the pressure sewer hydrostatic test shall be defined as the quantity of water that must be supplied into the pipe or any valved section thereof to maintain pressure. A pressure test must use the larger of 50 psi (pounds per square inch) above the normal operating pressure of a force main or 100 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 allow limit.

(3) Exfiltration Water Test

Seal ends of sewer lines and sewer line specials with watertight plugs. Fill section of line to be tested with water 24 hours prior to start of test. Fill section slowly from downstream manhole to avoid trapping air in line. Test for minimum of 2 hours.

Minimum starting test head shall be 2 feet above crown of line being tested at the upstream manhole. Add water to maintain the 2-foot head; leakage is the volume of water added to maintain the 2 feet of head. The allowable leakage for any section cannot exceed 50 gallons per inch of inside pipe diameter per mile of pipe per 24 hours.

For construction within the 25 year flood plain, the infiltration or exfiltration shall not exceed 10 gallons per inch of inside pipe diameter per mile of pipe at the same minimum test head.

(4) Infiltration Water Test

Infiltration test may be used where ground water level is 2 feet higher than crown of sewer line being tested.

Stop trench dewatering and allow ground water to return to normal level for at least 24 hours prior to test. Allow infiltration to flow at uniform rate through section being tested. Plug upstream end of section; measure flow through downstream end through calibrated 90 degree V-notch weir. Make five separate measurements at ½ hour intervals.

The average of the measurements will be used, discarding any measurement which differs more than 50% from the average of the other four. The allowable leakage cannot exceed 50 gallons per inch of inside pipe diameter per mile of pipe length per 24 hours.

(5) Low Pressure Test

Low pressure air test may be used when water is not available for exfiltration test or conditions are not right for infiltration 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.), except as to testing times as required in the table below or the following equation:

$$T = (0.085 * D * K) / Q$$

- T = time for pressure to drop 1.0 pound per square inch gauge in seconds
- K = $0.000419 * D * L$, but not less than 1.0
- D = average inside pipe diameter in inches
- L = length of same pipe size being tested, in feet
- Q = rate of loss, 0.0015 cubic feet per minute per square foot internal surface

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. The minimum permissible holding times in seconds for single runs of pipe and trunk lines including 4-inch, 6-inch and 8-inch intervals are indicated in Table 1.

Since a K value of less than 1.0 may not be used, the minimum testing time for each pipe diameter is shown in the following table:

Table C.3. - Minimum Testing Times for Low-Pressure Air Test 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

An owners inspector 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.

(6) Deflection

Deflection tests shall be performed on all flexible pipes. For pipelines with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter 27 inches and greater, an approved method shall be used to test for vertical deflections. Other methods shall provide a precision of \pm two tenths of one percent (0.2 %) deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of five percent. If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices. Upon completion of construction, a Texas Registered Professional Engineer appointed by the owner shall certify, to the Executive Director of the TCEQ, that the entire installation has passed the deflection test. This certification may be made in conjunction with the notice of completion required in 30 TAC 317.1(e)(1).

Mandrel Sizing. The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

Mandrel Design. The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.

Method Options. Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test.

(7) Manholes

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. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. 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 with water and maintained full for at least one hour. For concrete manholes a wetting period of 24 hours may be used prior to testing in order to allow saturation of the concrete.

a) 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. An owner shall 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 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.

700.5 Cleaning

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.

700.6 Cleanup and Restoration

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.

700.7 Measurement

Pipe will be measured by the linear foot 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, bedding and backfill.

Where wyes, branches or connections to existing pipe lines are involved, measurement of the new connecting pipe will be made from the intersection of its central axis with the outside surfaces of the pipe into which it connects.

All manhole assemblies will be measured per each, in accordance with these specifications, complete and accepted by the Engineer, including excavation, bedding and backfill.

The concrete seal, foundation rock or coarse aggregate shall be measured per cubic yard of foundation rock, coarse aggregate or other approved material all complete in place.

Excavation, bedding and backfill associated with pipe installation and manhole assemblies will not be measured as such but shall be included in the unit price bid for constructing pipe and measured as pipe and manhole assemblies complete in place including excavation, bedding and backfill.

Combination Air/Vac valves will be measured per each complete in place.

Flushing Connections will be measured per each complete in place.

Pressure Sewer Manhole Discharges will be measured per each complete in place.

Combination Air / Vacuum Release Valve Relocation will be measured per each.

Flush Valve Relocation shall be measured per each.

Pipe Plugs shall be measured per each.

If provided as a bid item, Wastewater Line Connections shall be measured per each.

700.8 Payment

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 for all other incidentals necessary to complete the pipe and manhole assemblies and appurtenances installation as indicated.

(1) Pipe

When called for in the bid, pipe shall be paid for at the unit contract price bid per linear foot for the size and type of pipe specified at the depth specified, complete in place. The bid price per linear foot shall include all clearing, excavation, bedding material, fittings, plugs, lugs, pipe coatings, connection to the existing system, disposal of surplus materials, laying of pipe, backfilling and cleanup. Measurement for depth shall be from the existing ground surface or proposed street subgrade, whichever is less, over the centerline of the pipe. Measurement for length shall be the horizontal distance along the centerline of the pipe as surveyed by the Engineer. Payment will also represent compensation for removal and replacement of pavement, curb, drainage structures, driveways and any other improvements damaged during construction. Concrete blocking for supporting and reinforcing bends and thrust blocks shall be included in the cost for pipe.

No separate payment will be made for harnessed joints required for thrust restraint which are scheduled or indicated.

(2) Concrete Trench Cap and Encasement

Where the distance between the top of the concrete encasement and the top of the trench cap is less than 36 inches, the concrete cap and encasement will be poured as one unit and paid for under this bid item at the contract price bid per linear foot. When the distance above is greater than 36 inches or when the trench cap is placed separately, the trench cap shall be paid for as a separate item, per linear foot, complete in place.

(3) Manhole Assemblies

Manhole Assemblies will be paid for at the unit price for the size and type installed, including base, barrel, sections, top, frame and cover, excavation and backfill pipe connections, setting, adjusting to grade with grade ring, anchoring, and venting structure.

(4) Service Leads

New Services Leads, when paid directly, will be paid as assemblies of a size and length.

For existing services, Service Leads shall be reconnected to the proposed line where indicated in the construction plans. All service leads called out to be reconnected shall include a new cleanout at the R.O.W. line, easement line, or where indicated on the plans, and installed in a manner to allow air testing of the line in accordance with the Standard Specifications & TCEQ requirements. Service leads shall be tested with the proposed main line. Reconstructions shall be performed so as not to damage the existing service line to customer's residence. Any damage to the existing service shall be repaired or replaced at the expense of the Contractor to the Engineer's satisfaction.

(5) Combination Air/Vac Valves

Combination Air/Vac Valves and appurtenances will be paid for at the unit price per each, including all materials, manholes, labor, equipment, tools and incidentals necessary to complete the work.

(6) Flushing Connections

Flushing Connections and appurtenances will be paid for at the unit price per each, including all materials, labor, equipment, tools and incidentals necessary to complete the work.

(7) Pressure Sewer Manhole Discharge

Pressure Sewer Manhole Discharges and appurtenances will be paid for at the unit price per each, including all materials, labor, equipment, tools and incidentals necessary to complete the work.

(8) Valves

Valves will be installed, including valve stem casing and cover, excavation and backfill, setting, adjusting to grade and anchoring.

(9) Wastewater Line Connections

If included as a bid item, Wastewater Line Connections shall be paid per each, and shall include all materials, labor, equipment, tools, and incidentals necessary for making the connection to the existing or proposed wastewater line as indicated in the construction plans. If no pay item is included, Wastewater Line Connections shall be considered subsidiary to payment for Pipe.

When specifically included as a pay item or items, payment for work under this Section shall be made under one or more of the following items:

700.8.1	Pipe {size, type, and depth as called out in the Unit Price Schedule}	Per Linear Foot
700.8.2	Concrete Trench Cap {Width of cap or encasement called for in the Unit Price Schedule}	Per Linear Foot
700.8.3	Concrete Encasement {Width of cap or encasement called for in the Unit Price Schedule}	Per Linear Foot
700.8.4	Concrete Trench Cap and Encasement {Width of cap or encasement called for in the Unit Price Schedule}	Per Linear Foot
700.8.5	Manhole Assemblies {size & type as listed on the Unit Price Schedule}	Per Each
700.8.6	Combination Air/Vac Valves	Per Each
700.8.7	Flushing Connection	Per Each
700.8.8	Pressure Sewer Manhole Discharge {size as called out in the Unit Price Schedule}	Per Each
700.8.9	Gate Valve {size as called out in the Unit Price Schedule}	Per Each
700.8.10	Check Valve {size as called out in the Unit Price Schedule}	Per Each
700.8.11	Service Lead {size as called out in the Unit Price Schedule}	Per Each
700.8.12	Combination Air / Vacuum Release Valve Relocation	Per Each
700.8.13	Flush Valve Relocation	Per Each
700.8.14	Pipe Plugs	Per Each
700.8.15	Wastewater Line Connection	Per Each
700.8.16	Temporary Manhole Plugs	Per Each

END SECTION

720.1 Description

This item shall govern the furnishing of materials and the methods of constructing a Portland cement concrete encasement or encasement pipe.

720.2 Submittals

The submittal requirements of this specification item include:

- A. Type of pipe, construction methods, and sequence,
- B. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- C. Proposed proportioning of materials for the mortar mix.

720.3 Materials

A. Portland Cement Concrete

The Portland cement concrete shall conform to Class B Concrete, Section 300, "Concrete."

B. Pipe

Portland Cement concrete pipe shall conform to ASTM C-76, Class IV or better.

Corrugated Metal Pipe (CMP) shall conform to the Section 800, "Pipe".

Steel Pipe shall conform to ASTM A134 with a minimum thickness of 3/8 inch for pipe with a diameter of 16 inches and greater and to the Section 508.

C. Grout

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.

720.4 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:

- (a) the top of the pipe would have less than 30 inches of cover,
- (b) the ground water invades the trench, or
- (c) 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:

- (a) encase the pipe with concrete,
- (b) change pipe material, or
- (c) 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.

720.5 Measurement and Payment

Concrete encasement will be measured by the lineal foot, for size of pipe being encased, complete in place. The measurement will be made between ends of the encasement, along the central axis as installed.

Encasement pipe will be measured by size of encasement installed, complete in place. The measurement will be made between the ends of the pipe, along the central axis as installed.

720.6 Payment

Work performed and materials furnished as prescribed by this item will be subsidiary to the item, "Drainage Piping" unless included as a separate pay item in the contract. When included for payment, it shall be measured as provided under "Measurement" 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 according to the pay item listed below. The unit bid price shall include full compensation for furnishing all materials, pipe for all preparation, hauling, installation and for all labor, tools, equipment and incidentals necessary to complete the work, including bench excavation and disposal of surplus material.

720.6.1	Concrete Encasement	{size as called out in the Unit Price Schedule}	Per Linear Foot
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<i>SPECIFIC</i> Cross Reference Materials
Standard Specification Item No. 514, "Concrete Encasement and Encasement Pipe"

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-134	Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)
C-76/C-76M	Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

<i>RELATED</i> Cross Reference Materials
Standard Specification Item No. 514, "Concrete Encasement and Encasement Pipe"

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 421	Portland Cement Concrete
Section 421.9	Quality of Concrete
Section 421.2(8)	Mortar and Grout
Item No. 501S	Jacking or Boring Pipe
Item No. 502S	Tunneling
Item No. 506S	Manholes
Item No. 507S	Bulkheads
Item No. 593S	Concrete Retards

END SECTION

740.1 Scope of Work

The purpose of this specification is to establish the minimum requirements for the purchase 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).

740.2 Acceptable Manufacturers/Supplier

Siemens or approved equal.

740.3 Submittals

- A. The Engineer's review and approval of product information, shop drawings and submittals on the following components is required prior to installation.
 - 1. Metering Feed Pumps
 - 2. Feed Control System (Schematics, Component Data Sheets)
 - 3. Liquid Storage Tanks
 - 4. Piping and Appurtenances
 - 5. Sulfide Control Chemical (Bioxide)
 - 6. Concrete Slab Design

740.4 Operation & Maintenance

The manufacturer shall submit complete Operation and Maintenance manuals to the Owner. These manuals shall include at a minimum:

- A. Information on hazards associated with the system and the appropriate safety precautions
- B. Material Safety Data Sheet for a Nitrate Solution
- C. Equipment installation instructions
- D. Equipment startup instructions
- E. Equipment maintenance procedures
- F. Troubleshooting guide
- G. Individual operation and maintenance information on major system components; including, but not limited to the following:

1. Chemical Feed Pumps
2. Chemical Feed Controls
3. Liquid Storage Tanks
4. Control Schematics
5. Component Catalog Data

740.5 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.

740.6 General

- A. 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.
- B. All components of the feed system shall be provided by a single manufacturer who shall have sole-source responsibility for the system.
- C. 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.

740.7 Functional Requirements

- A. Metering Pumps
 1. 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 740.1 and conform to one of the following:

<u>FLOW RANGE</u>	<u>MAX. RPM</u>	<u>MAX. DISCHARGE PRESSURE</u>
5-50 ml/min.	10	40 psi
12-120 ml/min.	24	40 psi
63-630 ml/min.	60	20 psi
105-1050 ml/min.	100	20 psi
151-1510 ml/min.	145	20 psi

2. 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.

3. 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.
4. 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.
5. Pump motor shall be 115 volt, 60 Hz, single phase, 2.7 amp.

B. Feed Controls

1. 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.

2. Enclosure

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:

- a. 1-15 amp breaker, 115 volt
- b. 2-HOA switches with L.E.D. Indicator Lights
- c. 1-Ground fault receptacle
- d. 1-Ventilator fan

3. Process System Controller

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.

4. Standards

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.

5. Disconnect Switch

A main power disconnect shall be located in the control stand.

6. 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.

C. Liquid Storage Tanks

1. With the feed system, 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.
2. The tank shall have one 24" (min.) gasketed and bolted manway, one 2" PVC "U" vent with screened opening.
3. 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.
4. 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.

5. Plastic Fittings

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.

6. 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.
7. 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.
8. The system shall contain no less than 2,000 gallons of nitrate solution.

D. Piping and Appurtenances

1. 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.
2. All underground primary fill lines shall be 2" Schedule 80 PVC. All secondary piping shall be 4" Schedule 40 PVC.
3. All above ground fill line pipes shall be 2" Schedule 80 PVC. All fill line valves, fittings, and connectors shall be Schedule 80 PVC.
4. Fill line shall have a 2" stainless steel male camlock with a 2" plastic female camlock cap.
5. All chemical feed seals shall be compatible with the chemicals to be used in the regular operation, maintenance, and cleaning of the feed system.

6. All fittings shall be solvent-welded or threaded.
- E. Chemical Product
1. Technical Requirements
 - a. The material supplied shall be an aqueous solution of calcium nitrate containing a minimum of 3.5 pounds of nitrate-oxygen per gallon.
 - b. The material shall be capable of reducing the dissolved hydrogen sulfide concentration in wastewater to less than 0.1 mg/l.
 - c. The material shall be free of any objectionable odor-producing compounds.
 - d. The pH of the material shall not be less than 4.0 nor greater than 7.5.
 2. Safety Requirements
 - a. The material shall contain no hazardous substances as defined by both the Federal EPA's and State CERCLA lists.
 - b. The material shall be exempt from Federal DOT placard requirements.
 - c. 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.
- F. Concrete Slab
1. A 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 Section 300.

740.8 Field Tests

- A. Before shipping the equipment, the Manufacturer shall perform shop tests. These tests shall include at a minimum:
1. Visual inspection of all equipment
 2. Complete assembly, start-up, and wet-test of feed pumps and calibration piping.
- B. After installation, the contractor shall contact the Engineer to perform system operation test at the site:
1. The performance of the system shall be demonstrated to reduce hydrogen sulfide to meet with the odor control levels set forth in these Specifications.

2. Manufacturer shall make any changes to the system, at his own expense.

740.9 Measurements

Odor control unit shall be measured by each unit complete in place.

740.10 Payment

The work performed and material furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price per each unit for "Odor Control Unit" if provided for in Unit Price Schedule. The Price shall include full compensation for furnishing, preparing, hauling and installing all required materials, labor, tools, equipment and incidentals necessary to complete work.

Payment for all items and tasks described in this specification item shall be measured as described above under the following item:

740.10.1	Odor Control Unit	Per Each
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END SECTION

750.1 Description

This item shall consist of locating and marking 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.

750.2 Staking and Marking the Proposed Alignment

The Contractor shall stake and mark the proposed waterline alignment(s) as described in the General Requirements Section of contract documents. No separate measurement or payment will be allowed for staking and marking the proposed alignment(s).

750.3 Locating Existing Underground Facilities

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.

At the Contractor's option, the location of existing facilities may be separated into as many as three separate areas, each of which may be independently completed as described above.

750.4 Potholing Existing Underground Facilities

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.

750.5 Crossing Sanitary Sewer Lines

As the installation of the proposed waterline progresses, the 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:

- 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.
- 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.

- Third, the minimum installed clearance of the proposed waterline shall be 2 feet above a non-pressurized sanitary line, or 6 inches above a pressurized line (measured from outside edges of pipes). If the proposed waterline can be installed to the appropriate minimum clearance as noted above with a minimum of 30 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.
- 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.

750.6 Testing Sanitary Facilities for Leaks

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 Section 700.

750.7 Replacing Existing Sanitary Sewer

If tested sanitary sewer facilities can not 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 included in the bid price for the appropriate line replacement, and no separate measurement or payment will be made for such tests.

750.8 Revision of Alignment

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, with full payment based on revised quantities as measured in the field.

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.

750.9 Measurement

Locating Existing Underground Facilities will be measured and paid on a lump sum basis, 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.

Testing Sanitary Facilities for Leaks shall be measured and paid on a per each 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.

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 sanitary sewer line replacement.

Replacing Existing Sanitary Sewer shall be measured per linear foot 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.

Adjustment of Waterline Below Sanitary Line as required to cross beneath sanitary sewer lines shall be measured and paid on a per each basis, with each adjustment paid as one unit. Pipe, fittings, bends, trench safety, and other items will be paid separately.

750.10 Payment

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under one or more of the following items:

750.10.1	Locating Existing Underground Facilities	Lump Sum
750.10.2	Testing Sanitary Facilities for Leaks	Per Each
750.10.3	Replacing San. Sewer: Pressurized Pipe, dia. 4 in. or less	Per Linear Foot
750.10.4	Replacing San. Sewer: Pressurized Pipe, dia. 4 – 8 in.	Per Linear Foot
750.10.5	Replacing San. Sewer: Pressurized Pipe, dia. over 8 in.	Per Linear Foot

750.10.6	Replacing San. Sewer: Non-pressurized Pipe, dia. 4 in. or less	Per Linear Foot
750.10.7	Replacing San. Sewer: Non-pressurized Pipe, dia. 4 -8 in.	Per Linear Foot
750.10.8	Replacing San. Sewer: Non-pressurized Pipe, dia. over 8 in.	Per Linear Foot
750.10.9	Adjustment of Waterline Below Sanitary Line	Per Each

END SECTION

755.1 Description

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.

755.2 Extent and Sequence of Operations

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.

755.3 Excavation 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.

755.4 Temporary Traffic Control and Safety Items

The Contractor shall employ trench safety measures as required and as described elsewhere in these specifications. Payment for any trench safety systems required for this Section will be paid separately as described elsewhere in these Specifications.

Temporary traffic control shall be provided at all points of investigation as required by the methods and recommendations listed in the current edition of the Texas Manual on Uniform Traffic Control Devices, or as otherwise shown on the construction drawings. 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 H20 load.

For open excavations that may pose a hazard to pedestrian traffic, the Contractor shall install and maintain appropriate safety fencing to guard the entire perimeter of the open area at all times.

All safety measures for each critical point shall be subject to the approval of the Engineer. If, at any time, the Engineer determines that the safety measures in place do not meet minimum standards, the Engineer may require work to be stopped until such safety measures are brought into compliance. No additional time or payment will be allowed for such stoppages.

755.5 Measurement

Any trench safety systems that are required at any critical point shall be measured and paid separately as described elsewhere in these Specifications.

Except for trench safety systems as noted above, no measurement of temporary traffic control or other safety measures used at any critical point shall be made.

No separate measurement shall be made for any surveying services or services of an RPLS for any critical point.

Measurement for each critical point shall be per each for each critical point called out in the construction drawings and listed in the Unit Price Schedule.

755.6 Payment

Payment for each critical point 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.

755.6.1	Critical Point Investigations {critical point number(s) as shown on the plans}	Per Each
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END SECTION

760.1 Scope of Work

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.

This item shall consist of the furnishing and installation of a lift station wet well and associated appurtenances in accordance with these specifications and as shown in the construction plans.

760.2 Related Specifications

The following specifications apply and are hereby included in their entirety by reference:

Section 300, Section 500, Section 700, Section 800, TxDOT Item 442, ASTM C478-07, and ASTM D3753.

760.3 Applicable Standards and Specifications

TCEQ 30 TAC Chapter 217, Chapter 290

AISI, ANSI, ASTM, OSHA, SSPC

760.4 Acceptable Manufacturers

For pre-cast concrete wet wells, Hanson Pipe & Precast or approved equal
For fiberglass wet wells, L.F. Manufacturing, Inc. or approved equal

760.5 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.

A. Submittals

1. Shop Drawings
2. Bill of Materials

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.

B. Operation and Maintenance Manuals

1. Shop Drawings
2. Product Information

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.

C. Shop Drawings

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.

760.6 Warranty

- A. 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.
- B. 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.

760.7 Construction

A. Materials

1. Reinforced Concrete

If wet well is to be cast in place (slip form construction), all sections of these specifications relating to concrete construction shall apply.

2. Concrete Pipe Sections and Base

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 in accordance with Section 300.

3. Precast Concrete Well

Wet well may be constructed using precast base and sections. Product must meet or exceed ASTM C-478 requirements.

4. Fiberglass Well

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 in accordance with Section 300.

5. Anti-floatation Ring

A concrete anti-floatation ring, consisting of Class A concrete, shall be constructed per the dimensions and reinforcing schedule provided in the construction plans.

B. Leakage Protection

1. Reinforced Concrete

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.

2. Pipe-Base

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.

3. Precast Well

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.

Pipe penetrations shall be pipe sleeves and conduit penetrations shall be sealed with Deneef Injecto or approved equal.

C. Coatings

All internal surfaces of the wet well and external surfaces of the internal piping and appurtenances shall be coated with a spraywall 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.

760.8 Functional Requirements

A. Required Clearances

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".

B. Accessibility

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.

C. Wet Well Floor

The wet well floor must be grouted to provide a smooth finish with a minimum 10% slope toward the pump intake.

760.9 Tools, Spare Parts, Accessories

A. Miscellaneous Hardware

All hardware and fasteners used in the wet well shall be 300 series stainless steel.

B. Wet Well Vents

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.

C. Access Covers

Approved access cover: Style "FLE-AOSH" SINGLE LEAF access hatch with Safe Hatch™ features, as manufactured for ITT WATER - 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 1/4" 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.

D. Freeze Proof Water Spigot

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.

760.10 Field Installation and Testing

A. Installation

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 Section 300 and TxDOT Item 442.

B. Bedding and Backfill

Bedding material shall consist of a minimum envelope of 2 feet around the outside diameter of the wet well in accordance with Section 230.10. All backfill material outside of the 2 foot envelope shall consist of common backfill in accordance with Section 230.12.

C. Field Start-up, Tests, and Checks

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.

760.11 Equipment Protection and Restoration

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 repainted to the satisfaction of the Inspector and Engineer.

760.12 Storage and Handling

Deliver, unload, and store products on site in a manner that prevents damage. Refer to related specifications for other storage handling requirements.

760.13 Measurement

Lift station wet well shall be measured per lump sum.

760.14 Payment

The work performed and materials furnished as prescribed by this specification and measured as provided under "Measurement" will be paid for at the unit price per lump sum for "Lift Station Wet Well" as provided for in the Unit Price Schedule. The price shall include full compensation for furnishing, preparing, hauling and installing required materials, labor, tools, equipment and incidentals necessary to complete work for lift station wet well and associated appurtenances as described in this specification.

Payment for all items and tasks described in this specification item shall be measured as described above under the following items:

760.14.1	Lift Station Wet Well	Per Lump Sum
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END SECTION

762.1 Description

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.

This Item shall govern for 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 not specifically identified in the construction plans, Project Manual, Special Provisions, Special Specifications, Section 740, or Section 760 necessary to produce a fully functioning lift station in accordance with TCEQ 30 TAC Chapter 217 requirements.

762.2 Related Specifications

The following specifications apply and are hereby included in their entirety by reference:

Section 300, Section 700, Section 760, Section 800, TxDOT Item 442, and National Electric Code (NEC).

762.3 Submittals

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. Submittals shall include shop drawings and bill of materials for the following:

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.

B. Installation

The essence of this Pay Item is that the Contractor is required to furnish and install all required pumps, piping, fittings, valves, valve vault, controls, electrical facilities (including a separate meter pole and service leads), housing,

connections, and all other incidentals required to produce a fully functioning system that meets the requirements listed above and detailed on the construction drawings. The Contractor shall also be required to pay all necessary expenses and make all arrangements for installation of a local service meter pole to provide electrical service to the proposed Lift Station.

The manufacturer shall submit complete Installation, Service, 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

C. Minimum Requirements

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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.
7. An audio visual alarm system shall be installed adjacent, and connected to the control panel.
8. 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.
9. 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, 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.

D. Shop Drawings

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.

762.4 Testing

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.

762.5 Warranty

- A. 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.
- B. The Contractor and Manufacturer shall guarantee that the station's structure shall be free from defects in design, materials and workmanship for one year from date of acceptance by the Owner.

762.6 Measurement

Lift station pumps will be measured by each pump and appurtenances complete in place necessary to produce a fully functioning lift station.

762.7 Payment

The work performed and material furnished as prescribed by this section and measured as provided under "Measurement" will be paid for at the unit bid price per each pump and appurtenances for "Lift Station Pump" if provided for in the Unit Price Schedule. The price shall include full compensation for furnishing, preparing, hauling, installing, and testing all required materials, labor, tools, equipment and incidentals necessary to complete work.

Payment for all items and tasks described in this specification section shall be measured as described above under the following item:

762.7.1 Lift Station Pump {Location as called out in the Unit Price Schedule} Per Each

END SECTION

780.1 Description

This item shall consist of locating existing force main, wet connection to existing force main, maintenance and reconstruction of all existing landscaping, rock walls, irrigation systems and any other existing structures disturbed during construction, labor and other incidentals required to complete the work, as specified by the Engineer.

780.2 Construction Methods

All methods of construction shall produce a final product that is equivalent to the existing structure, at completion of the project. The wet connection shall be performed in accordance with Section 500 of these specifications. All temporary and permanent construction shall meet all requirements in the contract documents.

780.3 Measurement

Force main locate, connection, and all other labor, materials and incidentals required to complete the work will be measured per each complete in place.

780.4 Payment

Force main locate and connection, if included in the bid, shall be measured as specified above and paid for at the contract unit price bid for "Force Main Locate and Connection" 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.

Payment, when included as a contract pay item will be made under:

780.4.1	Force Main Locate and Connection	Each
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END SECTION

800.1 Description

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.

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.

800.2 Materials

(1) Water and Sewer Pipe

(a) Iron Pipe

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. Barrels shall have a nominal thickness required by Table 1 of AWWA C-115, which thickness corresponds to Special Class 53 in sizes through 54 inch, and Class 350 in 60 and 64 inch sizes. Flanges shall be ductile iron (gray iron is not acceptable); they shall be as shown in ANSI/AWWA C115/A21.15 and shall conform to dimensions shown in Table 2 and Figure 1 of AWWA C115. 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. 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: 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.

1. Ductile Iron

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 product: Protecto 401 Epoxy Lining or SewperCoat.

2. Joint Materials

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.

3. 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.

4. Marking

Each pipe joint and fitting shall be marked as required by the applicable AWWA specification. This includes in all cases: Manufacturer's identification, Country where cast, year of casting, and "DUCTILE" or "DI". Barrels of flanged pipe shall show thickness class; others shall show pressure class. The flanges of pipe sections shall be stamped with the fabricators identification; fittings shall show pressure rating, the nominal

diameter of openings and the number of degrees for bends. Painted markings are not acceptable.

The manufacturer's name or trademark code and seal of approval (NSF mark) of the National Sanitation Foundation.

(b) Polyethylene Tubing

1. General

All polyethylene (PE) plastic tubing shall be high density, high molecular weight plastic tubing meeting ASTM D2737, 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.

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:

Temperature	Time	Pressure
73.4 F	1,000 hours	400 psi
100 F	1,000 hours	330 psi

2. Markings

Permanent marking on the tubing shall include the following at intervals of not more than 5 feet:

Nominal tubing size.

The type of plastic material, i.e., PE 3408.

The Standard Dimension Ratio (SDR) and the pressure rating in psi for water at 73.4 F (e.g., SDR-9, 200 psi).

ASTM D 2737 designation.

The manufacturer's name or trademark code and seal of approval (NSF mark) of the National Sanitation Foundation.

3. Tube Size

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:

Nominal Tube Size (Inches)	Outside Diameter (Inches)	Tolerance (Inches)	Average Minimum Wall Thickness (Inches)	Tolerance (Inches)
¾	0.875	±0.004	0.097	+0.010
1	1.125	±0.005	0.125	+0.012
1¼	1.375	±0.005	0.153	+0.015
1½	1.625	±0.006	0.181	+0.018
2	2.125	±0.006	0.236	+0.024

(c) Copper Tubing

All copper service tubing shall be annealed seamless Type K water tube meeting ASTM B88 and rated at 150 psi working pressure. The tubing shall be homogenous throughout and free from cracks, holes, crimping, foreign inclusions or other defects. It shall be uniform in density and other physical properties.

Nominal Tube Size (Inches)	Outside Diameter (Inches)	Average Minimum Tolerance (Inches)	Average Minimum Wall Thickness (Inches)	Tolerance (Inches)
¾	0.875	±0.0003	0.065	±0.0045
1	1.125	±0.00035	0.065	±0.0045
1-1/4	1.375	±0.0004	0.065	±0.0045
1-½	1.625	±0.0045	0.072	±0.005
2	2.125	±0.005	0.083	±0.007

(d) Service Connection Fittings

All fittings used in customer service connection - tapping mains, connecting meters, etc. - must be in accordance with the requirements of the regulatory authority.

(e) 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.

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.

Exposed threads shall be covered with plastic caps or sheeting to protect the threads.

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:

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.

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.

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.

Flanges shall conform to ANSI B16.1, Class 125 (or Class 250 where so noted), as to dimensions, drillings, etc.

Brass pipe shall conform to the weight and dimensions of Table 2 in the appendix for AWWA C-800.

All fittings shall be suitable for use at hydrostatic working pressures up to 150 psi.

(f) PVC, Up to a Diameter of 3 Inches – (excludes SDR-21)

1. General

Polyvinyl chloride pipe and fittings shall be Type I, Grade 1, Schedule 40, 200 psi.

2. 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:

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	0.0000670 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

3. 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.

4. Dimensions and Tolerance

Dimensional measurements of plastic pipe will be made on the outside diameter, wall thickness and out-of-roundness. Pipe not meeting these requirements shall be rejected. Dimensions and tolerances shall be in accordance with Commercial Standard CS 256-63.

5. Marking and Identification

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.

6. PVC Pipe Fittings

All fittings shall be of Schedule 40 or heavier plasticized polyvinyl chloride.

Fittings may be solvent welded.

7. Inspection and Testing of Materials

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.

8. Handling of PVC Pipe and Fittings

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.

9. Threaded Connections

On PVC to metal connections, 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.

(g) PVC, 4 Inches Through 12 Inches Diameter – DR - 18

1. General

All polyvinyl chloride (PVC) water 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.

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.

All fittings shall conform to AWWA C-110. All ductile iron fittings shall be Megalug Restraining Glands.

2. Applicable Specifications

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 and 12 inch nominal sizes, having Cast Iron Pipe size outside diameters.

Fittings used with PVC Pressure Pipe shall be AWWA C-110 Full-Body Cast Iron Fittings.

Standard sizes, dimensions and tolerances shall be as follows:

DR-18

Nominal Tube Size (Inches)	Outside Diameter (Inches)	Tolerance (Inches)	Average Minimum Wall Thickness (Inches)	Tolerance (Inches)
4	4.800	±0.009	0.267	±0.032
6	6.900	±0.011	0.383	±0.046
8	9.050	±0.015	0.503	±0.060
12	13.200	±0.015	0.733	±0.088

All pipe 4 inches and larger must be approved Underwriter's Laboratories for use in buried water supply and fire protection systems.

3. Material Requirements

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.

4. Marking

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

- Nominal pipe size and OD base (e.g., 4 CIPS).
- The type of plastic material (e.g. PVC 12454B).
- The standard Dimension Ratio and the pressure rating in psi for water at 73 F (e.g., DR 18, 150 psi).
- The AWWA or ASTM designation with which the pipe complies (e.g., AWWA C 900).
- The manufacturer's name or code and the National Sanitation Foundation (NSF) mark.

- (h) PVC, AWWA C905 Polyvinyl Chloride (PVC) Water Transmission Pipe, 14 Inches Through 24 Inches Diameter – DR – 18

1. General

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.

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.

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.

2. Material Requirements

- a. 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.
- b. Dimensions and tolerances for each nominal pipe size shall be in accordance with Table 2 Dimensions for PVC Transmission Pipe with CI Outside Diameter of Section 3 Pipe Requirements in AWWA C905-97. All pipes shall be suitable for use as a pressure conduit.
- c. Pipe shall be furnished in standard laying lengths of 20 feet plus or minus 1 inch (6.1 m +/- 25 mm) 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.
- d. 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.

e. 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. (1.5 m) 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.

f. 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.

g. 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.

h. 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.

i. 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.

j. 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.

3. Tests

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.

4. References

The documents listed below are referenced in this specification.

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.

(i) PVC, 3/4 Inches Through 3-1/2 Inches Diameter – SDR - 21

1. General

All polyvinyl chloride (PVC) sewer pipe shall meet or exceed ASTM and National Sanitation Foundation (NSF) standards and requirements and must bear the NSF seal of approval for potable water pipe. Pipe shall be pressure rated at 200 psi, SDR-21.

Concrete thrust blocking shall be placed behind bends and tees. Concrete support cradles or blocking shall be required for support of all valves and fittings.

Fittings may be solvent welded.

2. Applicable Specifications

Except as modified or supplemented herein, PVC pipe shall meet the following standards:

Rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784, and having Cast Iron Pipe size outside diameters.

PVC SDR pipe shall be manufactured in accordance with ASTM D2241 for physical dimensions and tolerances and meet the testing requirements thereof for all components.

Standard sizes, dimensions and tolerances shall be as follows:

SDR-21

Nominal Tube Size (Inches)	Outside Diameter (Inches)	Average Inside Dia (Inches)	Average Minimum Wall Thickness (Inches)
1.5	1.900	1.700	0.090
2.0	2.375	2.129	0.113
2.5	2.875	2.581	0.137
3.0	3.500	3.146	0.167
3.5	4.000	3.596	0.190

3. Material Requirements

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.

4. Marking

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

- Nominal pipe size and OD base (e.g., 4 CIPS).
- The type of plastic material (e.g. PVC 12454-B).
- The Standard Dimension Ratio and the pressure rating in psi for water at 73° F (e.g., SDR 21, 200 psi).
- The ASTM designation with which the pipe complies (D2241).

The manufacturer's name or code and the National Sanitation Foundation (NSF) seal of approval.

5. Handling PVC Pipe and Fittings

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.

6. PVC Pipe Fittings

All fittings shall be pressure-rated at 200 psi.

7. Threaded Connections

On PVC to metal connections, 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.

(j) PVC, 4 Inches Through 12 Inches Diameter – SDR - 21

1. General

All polyvinyl chloride (PVC) sewer pipe shall meet or exceed ASTM and National Sanitation Foundation (NSF) standards and requirements and must bear the NSF 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 200 psi, SDR-21.

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 D3139. All gaskets shall meet or exceed ASTM F477 requirements. Solvent welding of PVC sewer 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.

All fittings shall conform to AWWA C-110. All ductile iron fittings shall be Megalug Restraining Glands.

2. Applicable Specifications

Except as modified or supplemented herein, PVC pipe shall meet the following standards:

Rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784, and having Cast Iron Pipe size outside diameters.

PVC SDR pipe shall have shall be manufactured in accordance with ASTM D2241 for physical dimensions and tolerances and meet the testing requirements thereof for all components.

Fittings used with PVC Pressure Pipe shall be AWWA C-110 Full-Body Cast Iron Fittings.

Standard sizes, dimensions and tolerances shall be as follows:

Nominal Tube Size (inches)	Outside Diameter (inches)	SDR-21	
		Average Inside Diameter (inches)	Average Minimum Wall Thickness (inches)
4.0	4.500	4.072	0.214
6.0	6.625	5.993	0.316
8.0	8.625	7.805	0.410
10.0	10.750	9.728	0.511
12.0	12.750	11.538	0.606

3. Material Requirements

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.

4. Marking

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

- Nominal pipe size and OD base (e.g., 4 CIPS).
- The type of plastic material (e.g. PVC 12454-B).
- The Standard Dimension Ratio and the pressure rating in psi for water at 73° F (e.g., SDR 21, 200 psi).
- The ASTM designation with which the pipe complies (D2241).
- The manufacturer's name or code and the National Sanitation Foundation (NSF) seal of approval.

(k) Polyvinyl Chloride (PVC) Pipe (Nonpressure) and Fittings

1. General

Where PVC sewer or wastewater pipe is indicated, it shall conform to STM D 3034, Type PSM or ASTM F 679, Type T-1 Wall Polyvinyl Chloride (PVC) sewer pipe and fittings. Minimum wall dimension ratio shall be SDR 26.

2. Joint Material

PVC pipe shall have elastomeric gasket joints conforming to ASTM D 3212; gaskets to ASTM F 477.

3. Pipe Markings

Permanent marking on the pipe and fittings shall include the following at intervals of not more than 5 feet:

Manufacturer's name and/or trademark.

Nominal pipe size.

Minimum cell classification (12454-B).

The legend "Type PSM SDR 26 PVC Sewer Pipe."

Designation ASTM D 3043 or ASTM F 679 Pipe.

4. Tracer Tape

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.

(l) PVC, 4 Inch Through 24 Inches Diameter – SDR-26/PS-115

1. General

All polyvinyl chloride (PVC) sewer pipe shall meet or exceed ASTM and National Sanitation Foundation (NSF) standards and requirements and must bear the NSF 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 160 psi, SDR-26/PS-115.

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 sewer pipe shall not be allowed.

All fittings shall conform to AWWA C-110. All ductile iron fittings shall be Megalug Restraining Glands.

2. Applicable Specifications

Except as modified or supplemented herein, PVC pipe shall meet the following standards:

Rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784, and having Cast Iron Pipe size outside diameters.

PVC SDR pipe shall be manufactured in accordance with ASTM D3034 and F679 for physical dimensions and tolerances and meet the testing requirements thereof for all components.

Fittings used with PVC Pressure Pipe shall be AWWA C-110 Full-Body Cast Iron Fittings.

Standard sizes, dimensions and tolerances shall be as follows:

SDR-26/PS-115

Nominal Tube Size (Inches)	Outside Diameter (Inches)	Average Inside Dia (Inches)	Average Minimum Wall Thickness (Inches)
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	24.803	23.025	0.889

3. Material Requirements

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.

4. Marking

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

- Nominal pipe size and OD base (e.g., 4 CIPS).
- The type of plastic material (e.g. PVC 12454-B).
- The Standard Dimension Ratio and the pressure rating in psi for water at 73° F (e.g., SDR 26/PS-115, 160 psi).
- The ASTM designation with which the pipe complies (D2241).
- The manufacturer's name or code and the National Sanitation Foundation (NSF) seal of approval.

(m) Acrylonitrile – Butadiene – Styrene (ABS) Pipe (Nonpressure)

1. General

Where ABS sewer or wastewater pipe is indicated, it shall conform to ASTM D2661, Type I or IV. Use shall be limited to 4 inches through 6 inches in diameter sizing.

2. Fittings

Fittings shall be ABS complying with ASTM D2661, solvent cement joints complying with ASTM D2235 or threaded joints.

(2) Drainage Pipe

General

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.

(a) PVC Pipe (or approved equal)

Approved Product: A-2000 Manufacturer: Contech

1) Material

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.

2) Manufacture

Pipe manufacture shall conform to ASTM F949-90 for pipe and fittings with a minimum pipe stiffness of 50 p.s.i. 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.

3) 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.

4) Installation

Pipe shall be installed per ASTM D2321.

(b) Corrugated Metal Pipe (or approved equal)

1) Material

Unless otherwise specified on the plans or herein, corrugated metal pipe may be galvanized steel, aluminized steel, aluminum or precoated galvanized steel conforming to the following:

Galvanized Steel	AASHTO M218
Aluminized Steel	AASHTO M274
Aluminum	AASHTO M197
Precoated 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.

2) 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) Precoated Galvanized Steel Pipe. Precoated 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.

3) 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.

(c) HDPE Pipe

Approved Manufacturer: ADS (or approved equal)

a. Material

The high density polyethylene pipe shall meet or exceed the requirements of ASTM D 3350.

(d) Reinforced Concrete Pipe

Approved Manufacturer: Hanson Pipe & Precast (or approved equal)

All reinforced concrete pipe (RCP) shall be Class IV with rubber gasketed joints unless otherwise specified in the construction documents. All RCP shall comply with TxDOT Standard Specification Item No. 464

(e) Reinforced Concrete Boxes

Approved Manufacturer: Hanson Pipe & Precast (or approved equal)

All reinforced concrete boxes shall conform to TxDOT Item 462. 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.

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.

800.3 Laying Pipe

(1) General

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 direct 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.

Backfilling shall closely follow pipe laying so that no pipe is left exposed and unattended after initial assembly. All open ends, outlets or other openings in the pipe shall be protected from damage and shall be properly plugged and blocked watertight to prevent the entrance of trench water, dirt, etc. The interior of the pipeline shall at all times be kept clean, dry and unobstructed.

(2) Assembling of Pipe

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.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing or other materials shall be placed in the pipe.

(3) Joints

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.

(4) Trench Depth and 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.

(5) Classification of Excavation

Excavation will not be considered or paid for as a separate item of work, so excavated material will not be classified as to type or measured as to quantity. Full payment for all excavation required for the construction shall be included in the various unit or lump sum contract prices for the various items of work installed, complete in place. No extra compensation, special treatment or other consideration will be allowed due to rock, pavement, caving, sheeting and bracing, falling or rising water, working under and in the proximity of trees or any other handicaps to excavation.

(6) Dewatering Excavation

Underground piped utilities shall not be constructed or the pipe laid in the presence of water. All water shall be removed from the excavation prior to the pipe placing operation to ensure a dry firm granular bed on which to place the underground piped utilities and shall be maintained in such dewatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point installation as conditions warrant.

Before attempting to lay pipe, all water, slush, debris, loose material, etc., encountered in the trench must be pumped or bailed out and the trench must be kept clean and dry while the pipe is laid and backfilled. Where needed, sump pits shall be dug adjoining the trench and pumped as necessary to keep the excavation dewatered.

(7) Trench Conditions

The construction methods for pipe bedding, embedment and backfilling shall conform to Section 230, "Trenching".

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.

No debris shall remain in the trench or associated structures.

Where the soil encountered at established footing grade is a quicksand, saturated or unstable material, the following procedure shall be used unless other methods are indicated:

All unstable soils shall be removed to a depth of a minimum of 2 feet below bottom of piped utility or as required to stabilize the trench foundation. Such excavation shall be carried out for the entire trench width.

All unstable soil so removed shall be replaced with a concrete seal, foundation rock or coarse aggregate materials placed across the entire trench width in uniform layers not to exceed 6 inches, loose measure and compacted by mechanical tamping or other means which will provide a stable foundation for the utility.

Forms, sheathing and bracing, pumping, additional excavation and backfill required in unstable trench conditions shall be subsidiary to pipe bid.

(8) Lines and Grades

Grades, lines and levels shall be sufficiently marked by the Owner or Contractor as required. Any damage to the above by the Contractor shall be reestablished at the Contractor's expense.

The location of the lines and grades indicated may be changed only by the direction of the Engineer and it is understood that the Contractor will be paid on the basis of his unit contract prices bid for such work actually performed and will make no claim for damages or loss of anticipated profits due to the change of location or grade.

The Contractor shall furnish, at his expense, all necessary batter boards or electronic devices for controlling the work. Batter boards shall be of adequate size material and shall be supported substantially. The boards and all location stakes must be protected from possible damage or change of location. The Contractor shall furnish good, sound twilled lines for use in achieving lines and grades and the necessary plummets and graduated poles.

Should the Contractor's procedures not produce a finished pipe placed to grade and alignment, the pipe shall be removed and re-laid and the Contractor's procedures modified to the satisfaction of the Engineer. No additional compensation shall be paid for the removal and re-laying of pipe required above.

(9) Surplus Excavated Materials

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.

(10) Pipe Restraints Under Pavement

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.

800.4 Measurement and Payment

Pipe will be measured and paid as part of Sections 500, 600, and 700. All items in this specification shall be considered subsidiary to each of the applicable pay items under Sections 500, 600, and 700. No separate measurement and payment will be allowed for items in this Specification Section, unless specifically included as such in the Unit Price Schedule.

The following cross-references are provided as a minimum to the specifications. Additional specifications if contained elsewhere herein may apply.

SPECIFIC CROSS-REFERENCE MATERIALS
Specification: "Water Supply and Appurtenances"

ANSI/AWWA Standards: _____

<u>Designation</u>	<u>Description</u>
A-21.11	American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings
C-105	American National Standard for Polyethylene Encasement for Ductile-Iron Pipe

ASTM Standards

<u>Designation</u>	<u>Description</u>
ASTM A48/A48M	Specification for Gray Iron Castings
ASTM A 536	Specification for Ductile Iron Castings

END SECTION

810.1 General

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 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.

810.2 Submittals

The submittal requirements of this specification item include:

- (A) Aggregate type, gradations and physical characteristics for the Portland cement concrete mix.
- (B) Proposed proportioning of materials for the mortar mix.
- (C) Type structures and proposed adjustment technique (lowering, raising, lateral displacement).
- (D) 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

810.3 Materials

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.

- (A) Portland Cement Concrete

The Portland cement concrete shall be Class A conforming to Section 300, "Concrete".

- (B) Mortar

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" as given in Section 300, "Concrete".

810.4 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.

810.5 Measurement

Structures to be adjusted shall be measured per each for each specific type of structure to be adjusted as called out on the Unit Price Schedule.

810.6 Payment

Payment for adjusting structures shall be made under one or more of the following items:

810.6.1	Adjusting Structures	{type as called out on the Unit Price Schedule}	Per Each
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END SECTION

820.1 General

This item shall govern construction of manholes, complete in place, and the materials used therein, including excavation, installation, backfilling and surface restoration. It shall also include furnishing and installing rings, covers, and appurtenances, as well as any pumping and drainage necessary to complete the work. Wastewater manholes shall be 'acceptance tested' by the Contractor.

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work are of the kind and quality that satisfies the specified functions and quality as specified or presented in the Drawings.

820.2 Submittals

The submittal requirements of this specification item include:

- (A) 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.
- (B) Aggregate types, gradations and physical characteristics for the Portland cement concrete mix.
- (C) Proposed proportioning of materials for the mortar mix.
- (D) Proposed Acceptance testing procedure and associated test equipment and materials Type structures and proposed adjustment technique (lowering, raising, lateral displacement).
- (E) Proposed product for coating the interior surface of new and/or existing wastewater manholes.

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.

Name of the manhole manufacturer
Interior surface coating type and application method for Wastewater Manholes
Model and manufacturer of vacuum tester
Date tested/date re-tested
Passed/failed and state what was done to correct the problem
Test Method Used
Location/station of manhole
Precast/cast-in-place bottom
Any repairs made to the joints.

820.3 Materials and Components

- (A) Concrete and Cement Stabilized Sand
All concrete shall conform to the Concrete Section of these specifications. The cast in place concrete shall be Class A, and the precast concrete manhole base sections, riser sections and appurtenances shall conform to the requirements of ASTM C478 with Class I concrete. Concrete for backfill of over-excavated areas shall be as indicated on the Drawings. Cement stabilized sand for bedding or backfilling, when indicated or required on the Drawings, shall contain 2 bags of Portland Cement per cubic yard. The sand shall meet the requirements for "Fine Aggregate" in Section 300.
- (B) Mortar
The mortar shall be composed of one part Portland cement, one part masonry cement (or 1/4 part hydrated lime), and sand equal to 2-1/2 to 3 times the sum of the volumes of the cements and lime used. The sand shall meet the requirements for "Fine Aggregate" in Section 300.
- (C) Reinforcement
The reinforcing steel shall conform to the requirements of TxDOT Item 440. Secondary, non-structural steel in cast-in-place stormwater manholes may be replaced by collated fibrillated polypropylene fibers, if approved by the Engineer or designated representative.
- (D) Brick
The brick for ring adjustment courses and for stormwater manholes shall be of first quality, sound, hard burned, perfectly shaped brick conforming to the requirements of ASTM C 62, Grade SW, or concrete brick meeting the requirements of ASTM C 55, Grade N-1.
- (E) Rings and Covers
Rings and covers shall be as shown in the contract documents.
(1) Replacement Rings and Covers, 30 in. diameter Lids.
This ring and cover shall be used for the replacement of broken rings and covers, minor manhole adjustment, or as otherwise directed by the Engineer or designated representative.
(2) Rings and Covers, 32 in. diameter Lids.
This ring and cover shall be used for all new manhole construction, except as otherwise directed by the Engineer or designated representative.
- (F) Bulkheads.
End caps plastic, rubber or concrete. Bulkheads shall consist of untreated wood, reasonably free of knots, warps, and bends and have a nominal 3-inch thickness.
- (G) Precast Base Sections, Riser Sections, and Cones.
Precast concrete base sections, riser sections, and cones shall conform to the requirements of ASTM C 478. The width of the invert shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped with a minimum depth of three fourths of the largest pipe diameter. The invert shall have a minimum difference of 0.10 feet (30 mm) between the inlet and outlet. Where lines enter the manhole up to 24 inches (610 mm) above the flowline of the outlet, the invert shall be filleted to prevent splashing and solids deposition. A drop pipe shall be provided for a sewer entering a manhole at more than 24 inches (610 mm) above the flow line of the outlet.

Joints for wastewater base sections, riser sections, and cones shall conform to the requirements of ASTM C 443. Additionally, joint dimensions for 48-inch inside diameter wastewater manhole sections and cones shall comply with contract documents. Precast bases for 48 inch inside diameter manholes shall have preformed inverts. Inserts acceptable to the Engineer or designated representative shall be embedded in the concrete wall of the manhole sections to facilitate handling; however, through-wall holes for lifting will not be permitted. Any voids between the pipe and boot shall be filled to the springline with a product recommended by the manhole manufacturer to prevent solids collection.

- (H) **Precast Junction Boxes.**
Precast junction boxes shall be allowed only where indicated on the Drawings or acceptable to the Engineer or designated representative. Joints for wastewater junction boxes shall conform to the requirements of ASTM C 443.
- (I) **Pipe-to-Manhole/Junction Box Assemblies**
Precast bases and precast junction boxes shall have flexible, resilient and non-corrosive boot connectors or ring waterstops acceptable to the Engineer or designated representative conforming to the requirements of ASTM C 923 on all wastewater pipe connections.
- (J) **Precast Flat-Slab Transition/Junction Box Lids.**
Precast slab transitions and lids shall be designed to safely resist pressures resulting from loads which might result from any combination of forces imposed by an HS-20 loading as defined by the American Association of State Highway and Transportation Officials (AASHTO). The joints of precast slab transitions and of lids for wastewater applications shall conform to the requirements of ASTM C443.
- (K) **Precast-Prefabricated Tee Manholes.**
Tee manholes shall be allowed only where indicated on the Drawings or as directed by the Engineer or designated representative. The main pipe section shall conform to the requirements of Sections 500 and 700. The vertical manhole portion (tee) above the main pipe shall conform to the requirements of the precast components.

The manhole tee shall have a minimum inside diameter of 48 inches and shall rise vertically centered or tangent to the main pipe, as indicated on the Drawings or as directed by the Engineer or designated representative. An access hole less than 48-inches in diameter shall be cut into the main pipe to allow a ledge for support of access ladders.

- (L) **Precast Grade Rings**
Rings shall be reinforced Class A.
- (1) **Precast Grade Rings, 24-1/2 inches inside diameter:**
This adjustment ring shall be used only for adjusting existing manholes with 24 inch lids and for Wastewater Access Device. Inside to outside diameter dimension of ring shall be 6 inches with a thickness of 3 inches to 6 inches.
- (2) **Precast Grade Rings, 35 inches inside diameter:**
This adjustment ring shall be used for all new manhole construction with 32 inches lids. Inside to outside diameter dimension of ring shall be 6 inches with a thickness of 4 inches to 6 inches.
- (M) **New Manhole Construction and Minor Manhole Adjustment:**
For new manhole construction, the maximum vertical allowable ring adjustment, including the depth of the ring casting, shall be limited to 18 inches. For adjustments of existing manholes

- that fall within the limits of overlay and street reconstruction projects, the maximum vertical allowable, including the depth of the ring casting, shall be limited to two feet. All other existing manholes shall have a maximum allowable ring adjustment, including the depth of the ring casting, of one foot. All manholes not located in paved areas shall have bolted covers.
- (N) **Waterproofing Joint Materials.**
O-rings and wedge seals for the joints of all wastewater manholes, and for stormwater manholes when indicated on the Drawings, shall conform to the requirements of ASTM C443. Cold applied preformed plastic gaskets for stormwater manholes shall be as shown in contract documents. The connections between reinforced concrete wastewater manhole structures and pipes shall meet the requirements of ASTM C923.
- (O) **Structural Lining for Wastewater Manholes**
The interior surfaces of all wastewater manholes shall be coated with a minimum ½ inch thick cementitious, corrosion resistant lining. Approved product: Sewpercoat PG or approved equal. Linings shall be installed in accordance with the manufacturer's specifications.
- (P) **Existing Manhole Connections**
Connections to existing manholes shall include coring existing manhole, reworking inverts, connecting proposed piping, labor and all other incidentals necessary to complete the work per the Specifications and Construction Documents.
- (Q) **Proposed Manhole Connections**
Connections to new manholes shall include connecting existing piping to new manhole, labor and all other incidentals necessary to complete the work per the Specifications and Construction Documents.
- (R) **Abandonment of Existing Manholes**
When designated on the Drawings for abandonment, existing manholes shall be removed to a level not less than four feet below grade. The inlets and outlets shall be securely plugged and the structure filled with flowable fill or as directed by the Engineer or designated representative.
- (S) **Temporary Manhole Plugs**
When designated in the Construction Documents, Temporary Manhole Plugs shall be performed using mechanical type pipe plugs, as approved by the Engineer. Unless specifically noted otherwise in the Construction Documents, Temporary Manhole Plugs shall remain in place upon completion of the project, and shall become the property of the Owner. The Contractor shall submit shop drawings of the mechanical type pipe plug to the Engineer for approval prior to ordering any materials.
- (U) **Permanent Manhole Plugs**
When designated in the Construction Documents, Permanent Manhole Plugs shall be performed by installing a Class A Concrete plug, a minimum of two feet in length as measured along the centerline of the pipe entering the manhole.
- (U) **Removal of Existing Manholes**
When designated in the Construction Documents, Removal of Existing Manholes shall be performed by cutting and removing all inlet and outlet pipes for a minimum distance of two feet as measured along the centerline of the pipe from the manhole. The ends of the inlet and outlet pipe shall be capped after being cut. Subsequent to removing and capping all inlet and outlet pipes, all manhole components may be removed, hauled off, and disposed of to the

satisfaction of the Engineer. After removal of the manhole components, the void shall be backfilled with common backfill in accordance with Section 230 of the specifications, unless otherwise indicated by the Engineer.

820.4 Construction

All manholes shall have a minimum inside diameter of 48 inches. Manhole base section or junction box dimension shall be appropriately increased to accommodate all converging pipe. A minimum horizontal clearance of 12 inches shall be maintained between adjacent pipes. Pipe ends within the base section or junction box walls shall not be relied upon to support overlying manhole dead and live load weights. All wastewater branch connections to new or existing mains shall be made at manholes with the influent pipe crown installed at the elevation of the effluent pipe crown. Where lines enter the manhole up to 24 inches above the flowline of the outlet, the invert shall be sloped upward to receive the flow, thus preventing splashing or solids deposition. Where the springline of an influent pipe is 24 inches or more above the springline of the effluent pipe, a drop manhole shall be used. Construction of extensions to existing systems shall require placement of bulkheads at locations indicated or directed by the Engineer or designated representative. Unless otherwise indicated on the Drawings, stormwater manholes shall have eccentric cones; wastewater manholes shall have concentric cones, except on manholes over large mains where an eccentric cone shall be situated to provide access to an invert ledge. Eccentric cones may be used where conflicts with other utilities dictate. Flat-slab tops may be used where clearance problems exist.

Manholes shall be founded at the established elevations on uniformly stable subgrade. Unstable subgrade shall be over-excavated a minimum of 12 inches and replaced with a material acceptable to the Engineer or designated representative. Precast base units shall be founded and leveled on a 6 inch coarse aggregate bedding. A pipe section with a prefabricated tee manhole and half the length of the adjoining pipe sections on each side shall be founded on a minimum of 6 inch unreinforced Class A concrete. The cast-in-place concrete cradle shall be placed against undisturbed trench walls up to the pipe's springline.

All adjustments shall be completed prior to the placement of the final surface.

Manhole components to be reused 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 expense.

If the adjustment involves lowering the top of a manhole, a sufficient depth of precast concrete rings or brick courses shall be removed to permit reconstruction. The mortar shall be cleaned from the top surface remaining in place and from all brick or concrete rings to be reused and the manhole rebuilt to the required elevation. The manhole ring and cover shall then be installed with the top surface conforming to the proposed grade.

If the adjustment involves raising the elevation of the top of the manhole, the top of brick or concrete ring shall be cleaned and built up vertically to the new elevation, using new or salvaged concrete rings or bricks and the ring and cover installed with the top surface conforming to the proposed grade.

Cast-in-place foundations shall have a minimum depth of 12 inches at the invert flowline. The widths of all manhole inverts shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped with a minimum depth of three fourths of the largest pipe diameter. The invert shall have a minimum fall of 0.10 of a foot between the inlet and outlet. The lowermost riser section may be set in the Portland cement concrete, while still green, after which the foundation shall be cured a minimum of 24 hours prior to proceeding with construction of the manhole up to 12 feet in depth. The foundation shall be cured an

additional 24 hours prior to continuing construction above the 12 foot level. Manhole depth shall be measured from the invert flowline to the finish surface elevation.

Wastewater manholes having cast in place foundations may be constructed over existing wastewater pipes, except polyvinyl chloride (PVC), and the top half of the pipe removed to facilitate invert construction. The manhole bottom shall rise from the springline elevation of the pipe, approximately one inch for each 12 inches of run (8%). Wastewater manholes with lines larger than 18 inches shall require precast bases; manholes constructed over in-service mains however, may be built on cast-in-place foundations if the flow cannot be interrupted. Precast and cast-in-place wastewater junction boxes shall be allowed only where indicated on the Drawings or acceptable to the Engineer or designated representative. The floors of stormwater manholes also, shall rise outwardly from the springline on a slope of 1:12 (8%).

Wastewater lines, except reinforced concrete pipe, set in cast-in-place foundations, shall require a waterstop seal or gasket acceptable to the Engineer or designated representative around the outside perimeter of the pipe. It shall be approximately centered under the manhole section wall.

Cast-in-place storm water manholes, junction boxes and flat-slab transitions shall be reinforced, Class A concrete. All structural concrete work shall conform to Section 300. Forms will be required for all cast-in-place walls above the foundation. Where the surrounding material can be trimmed to a smooth vertical face, outside forms may be omitted.

Backfilling for manholes shall conform to the density requirements of Sections 500 and 700. Manhole construction in roadways may be staged to facilitate base construction. Manholes constructed to interim elevations shall be covered with steel plates of sufficient thickness to support vehicular traffic. Steel plates on wastewater manholes shall be set in mortar to minimize inflow. Manholes shall be completed to finish elevation prior to placement of the roadway's finish surface. The excavation for completion of manhole construction shall be backfilled with cement stabilized sand with 2 sacks of cement per cubic yard up to the bottom of Portland Cement pavement slabs or to within 2 inches of finish elevation of asphaltic concrete pavements. The cement stabilized sand shall be a minimum of 12 inches thick.

After rings and covers are set to grade, the inside and outside of the concrete rings shall be wiped with mortar so placed as to form a durable water-tight joint smooth and even with the manhole cone section. No grouting shall be performed when the atmospheric temperature is at or below 40°F, and when necessary, because of a sudden drop in temperature, joints shall be protected against freezing for at least 24 hours.

820.5 Acceptance Testing of Wastewater Manholes

Manholes shall be tested separately and independently of the wastewater lines. All manholes shall be tested after manholes have been established to the proposed finished grade, including the installation of grade rings as necessary.

(A) Test by the Vacuum Method:

A vacuum test shall be performed by the Contractor prior to backfilling those manholes that fall within the right-of-way that require detouring of vehicular traffic. A second vacuum test will not be required after backfilling and compaction is complete unless there is evidence that the manhole has been damaged or disturbed subsequent to the initial vacuum test.

For manhole installations which do not require detouring of vehicular traffic, the vacuum method is recommended and may be used by the Contractor prior to backfilling the manhole to insure proper installation so that defects may be located and repaired; however, a vacuum

test shall be performed after backfilling, and compaction are complete. Testing after backfill and compaction are complete will be the basis for acceptance of the manhole.

(1) Equipment:

- a). The manhole vacuum tester shall be a device approved for use by the Engineer or designated representative.
- b). Pipe sealing plugs shall have a load resisting capacity equal to or greater than that required for the size of the connected pipe to be sealed.

(2) Procedures - applicable to new 4'-0" diameter manholes.

- a). Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before installation or unless it is applied at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.
- b). After cleaning the interior surfaces of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer. Plugs and the ends of pipes connected by flexible boots shall be blocked to prevent their movement during the vacuum test.
- c). The vacuum test head shall be placed on the top of the cone section or, inside of the top of the manhole cone section, and the compression seal band inflated to the pressure recommended by its manufacturer. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches of mercury (-5 psig) has been attained, the valve shall be closed and the time noted. Tampering with the test equipment will not be allowed.
- d). The manhole shall have passed the test if the vacuum does not drop below 9 inches of mercury (-4.5 psig) within five (5) minutes of the time the valve was closed. The actual vacuum shall be recorded at the end of the five (5) minutes during which the valve was closed.
- e). When the standard vacuum test cannot be performed because of design or material constraints (examples: T-Type manholes, T-Lock Liners, or other reasons acceptable to the Engineer or designated representative), testing of individual joints shall be performed as directed by the Engineer or designated representative.

(B) Test by the Exfiltration Method:

At the discretion of the Engineer or designated representative, the Contractor may substitute the Exfiltration Method of testing for the Vacuum test described in Paragraph 5. A above. This method may only be used when ground water is not present. If ground water is present a Vacuum Test shall be used unless otherwise directed by the Engineer or designated

representative. All backfilling and compaction shall be completed prior to the commencement of testing.

The procedures for the test shall include the following:

- (1) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before field assembly, or at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.
- (2) After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer.
- (3) Concrete manholes shall be filled with water or otherwise thoroughly wetted for a period of 24 hours prior to testing.
- (4) At the start of the test, the manhole shall be filled to the top with water. The test time shall be 1 hour (60 minutes). The Construction Inspector must be present for observation during the entire time of the test. Permissible loss of water in the 1 hour test time is 0.025 gallons per diameter foot, per foot of manhole depth. 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.

(C) Failure to Pass the Test - Records of Tests.

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. In no case shall cold applied preformed plastic gaskets be used for repair. Records of all manhole testing shall be made available to the Engineer or designated representative at the close of each working day, or as otherwise directed by the Engineer or designated representative. Any damaged or visually defective products, or any products out of acceptable tolerance shall be removed from the site.

(D) Inspection.

The Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is considered to be in its final condition. The inspection shall determine the completeness of the manhole; any defects shall be corrected to the satisfaction of Engineer or designated representative.

820.6 Measurement

Each "Standard Manhole" or "Drop Connection Manhole" shall be measured by each structure of the indicated type for the first 8 feet of depth. Manhole depth will be measured from the invert flow line to the finished surface elevation.

Manhole depth, measured per foot as described above, in excess of 8 feet will be made for each structure of the indicated type.

"Minor Manhole Adjustment" and "Major Manhole Adjustment" will be measured per each, regardless of the type or size of structure. Only existing manholes will be measured for minor or major manhole height adjustment.

"Existing Manhole Connection" or "Existing Junction Box Connection" will be measured per each for the indicated type of structure and location.

"Structural Lining" for wastewater manholes will not be measured, and no direct payment will be made. Such lining or coating shall be considered subsidiary to each individual structure.

New manholes constructed to interim elevations to facilitate stage construction shall be measured as one unit regardless of the number of interim elevations constructed. All labor, materials and other expenses necessary for the stage construction shall be considered subsidiary to the completed unit.

Abandonment of Existing Manholes shall be measured per each for each abandoned structure as called out in the Construction Documents.

Temporary Manhole Plugs shall be measured per each for each location specified in the Construction Documents.

Permanent Manhole Plugs shall be measured per each for each location specified in the Construction Documents.

Removal of Existing Manholes shall be measured per each for each location specified in the Construction Documents.

Each "Precast Large Base Manhole" shall be measured by each structure for the depth and configuration as specified in the plans. No payment for adjustment of depth or configuration shall be allowed.

820.7 Payment

Payment for the above measured items shall be made under one, or more of the following pay items. Payment shall include all labor, hauling, disposal, earthwork, equipment, materials (including but not limited to frames and grates, rings and covers, adjusting rings, cone sections, riser sections, gaskets, drop piping and fittings, bases, pipe-to-manhole connectors, concrete, reinforcing steel, non-shrink grout, mortar, plugs, joint wrap where specified, and, for wastewater manholes, interior coatings), time and incidentals necessary to complete the work in accordance with the requirements established in this specification. Each pay item, when listed on the Unit Price Form, shall be preceded by WW to indicate Wastewater Manholes, or be preceded by SD to indicate Storm Drain Manholes.

820.7.1	{WW or SD} Standard Manhole	Per Each
820.7.2	{WW or SD} Drop Connection Manhole	Per Each
820.7.3	{WW or SD} Extra Manhole Depth	Per Linear Foot
820.7.4	{WW or SD} Minor Manhole Adjustment	Per Each
820.7.5	{WW or SD} Major Manhole Adjustment	Per Each
820.7.6	{WW or SD} Existing Manhole Connection	Per Each
820.7.7	{WW or SD} Proposed Manhole Connection	Per Each
820.7.7	{WW or SD} Existing Junction Box Connection	Per Each
820.7.8	{WW or SD} Abandon Existing Manhole	Per Each
820.7.9	{WW or SD} Precast Large Base Manhole, Sta _____	Per Each
820.7.10	{WW or SD} Temporary Manhole Plugs	Per Each
820.7.11	{WW or SD} Permanent Manhole Plugs	Per Each
820.7.12	{WW or SD} Removal of Existing Manholes	Per Each

END SECTION

830.1 General

This item shall govern furnishing and installation of frames, grates, rings and covers for inlets, manholes and other structures indicated on the Drawings.

830.2 Submittals

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.

830.3 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is the kind and quality that satisfies the specified functions and quality.

(A) Welded Steel

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".

(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.

- (C) Manhole Cover Riser Rings
Height-adjustment inserts for wastewater manhole rings, which are used for raising standard manhole covers, shall be used as required.
- (D) 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.
- (E) Mortar
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 and sufficient water to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements in Section 300.

830.4 Construction Methods

Frames, grates, rings and covers shall be constructed of the specified materials in accordance with the Contract Documents. The Frames, grates, rings and covers shall be placed carefully to the lines or grades indicated on the Drawings or as directed by the Engineer or designated representative.

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.

Painting of gray iron castings will not be required, except when used in conjunction with structural steel shapes.

830.4 Measurement and Payment

No direct measurement or payment shall be made for items in this Section. These items shall be considered subsidiary to the structures within which they are installed.

END SECTION

850.1 General

This item shall govern furnishing and installing plywood or end caps as a temporary utility plug at locations indicated on the Drawings or as directed by the Engineer or designated representative. The work will be placed in conjunction with installation of a pipe where a continuation of the utility system will be performed later.

850.2 Submittals

The submittal requirements of this specification item include the type (wood, plastic, rubber, etc.) and application (pipe characteristics and location) of bulkheads.

850.3 Materials

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.

850.4 Construction Methods

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.

850.5 Measurement and Payment

No separate measurement or payment will be allowed for this item. All bulkheads included in this item shall be totally subsidiary to the pay item for the associated facility to be bulkheaded.

END SECTION

900.1 Description

This item shall consist of the erection and maintenance and removal of silt fence for the purpose of trapping sediment from storm water runoff at a location as specified by the Engineer.

900.2 Materials

- (1) Geotextile fabric – to be 4.5 oz. minimum non-woven, 36” wide.
- (2) Woven Wire - 12 ga., 2” x 4” welded wire.
- (3) Steel Fence Posts – 48” minimum heavy weight t-post.

900.3 Construction Methods

A 6-inch by 6-inch trench shall be excavated along the length of the fence location shown by the Engineer. The steel fence posts shall be driven in the center of the trench spaced no greater than 6 feet to depth of at least 12 inches. The woven wire shall extend to the bottom of the trench a minimum of 24 inches height and shall be firmly attached to the metal fence posts. The geotextile fabric shall be firmly attached to the woven wire as recommended by the manufacturer.

The trench must then be backfilled and firmly compacted.

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.

900.4 Measurement

Silt fence will be measured by the linear foot of fence complete in place. Such measurements will be made between the ends of the fence including the full length around any J-hooks.

900.5 Payment

Payment for the silt fence, measured as prescribed above, will be made at the unit price bid per linear foot for the silt fence as indicated in the plans.

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.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under the following item:

900.5.1	Silt Fence	Per Linear Foot
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END SECTION

901.1 Description

This item shall include the construction, maintenance, and removal of all Curb Inlet Protection 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.

901.2 Materials

All materials shall conform to the Contract Documents.

901.3 Construction

All Curb Inlet Protection construction shall conform to the Contract Documents.

901.4 Measurement

All Curb Inlet Protection will be measured per linear foot complete in place. Curb inlet protection for curb inlets, grate inlets, and combination curb and grate inlets shall be measured parallel to the gutter line. Curb inlet protection for area inlets shall be measured along the outside edge of the perimeter of installed protection, complete in place.

901.5 Payment

Curb Inlet Protection, 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.

Payment, when included as a contract pay item will be made under:

901.5.1	Curb Inlet Protection	Per Linear Foot
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END SECTION

905.1 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.

905.2 Materials

All materials shall conform to the Contract Documents.

905.3 Construction and Location

All Concrete Washout construction shall conform to the Contract Documents. 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.

905.4 Measurement

All Concrete Washouts will be measured per lump sum, such measurement to include all concrete washouts used for the project, regardless of whether the concrete washouts are actually shown on the construction drawings.

905.5 Payment

Concrete Washouts, 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.

Payment, when included as a contract pay item will be made under the following item:

905.5.1	Concrete Washouts	Per Lump Sum
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END SECTION

910.1 Description

This item shall consist of preparing a seed bed to the lines and grades indicated, sowing of seeds, fertilizing, mulching with straw, asphalt, cellulose fiber, wood fiber and other management practices along and across such areas as are indicated or as directed by the Engineer.

910.2 Materials

(1) Seeds

All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing pure live seed (PLS), name and type of seed. Seed furnished shall be of the previous season's crop and the date of analysis shown on each bag shall be within nine months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Engineer/Architect. The amount of seed planted per acre shall be of the type specified below.

(2) Water

Water shall be clean and free of industrial wastes and other substances harmful to the growth of grass or the area irrigated.

(3) Topsoil

Topsoil shall be generally free of stones and calcareous material and may be site spoils as approved by the Engineer.

(4) Fertilizer

The fertilizer used shall have an analysis of 15-15-15, homogeneous 13-13-13 or the analysis indicated.

(5) 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.

(6) Cellulose Fiber Mulch (Natural Wood)

Cellulose Fiber Mulch 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.

(7) Wood Fiber Mulch (Newsprint)

Wood Fiber Mulch 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.

(8) Erosion Control Blanket

Approved Product: Contech Excelsior Standard Plus (or 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 polymetric 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.

(9) Erosion Control Mat

Approved Product: 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.

(10) High Shear Stress Soil Retention Blanket

Approved Product: 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's 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.

910.3 Construction Methods

(1) Seeding

(a) Preparing Seed Bed

After the designated areas have been rough graded to the lines, grades and typical sections indicated or as provided for in other items of this contract and any other soil area disturbed by the construction, a suitable seed bed shall be cultivated and rolled sufficiently to remove all surface clods larger than 1.5 inches in diameter and to a state of good tilth which could prevent the seed from being covered too deep for optimum germination. The optimum depth for seeding shall be ¼ inch. Water shall be applied as required to prepare the seed bed. Seeding shall be performed in accordance with the requirements hereinafter described.

When required by conditions specified herein, or as specified in the plans, Erosion Control Blankets, Erosion Control Mats, and/or High Shear Stress Soil Retention Blankets shall be installed within six hours after seeding.

(b) Watering

Broadcast and mulch seeded 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. The Owner shall assume responsibility for watering once sufficient growth is obtained.

(2) Sodding

(a) Preparing Surface

After the designated areas have been rough graded to the lines, grades and typical sections indicated or as provided for in other items of this contract and any other soil area disturbed by the construction, the surface shall be worked to a minimum depth of 4 inches with a disc or tiller. Fertilizer shall be applied and tilled. Areas shall be reworked as necessary to an acceptable condition before sodding and be given continuous care until the sod is accepted. Sodding shall be performed in accordance with the requirements hereinafter described.

(b) Placement

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.

(c) Watering

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 waterings 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 Engineer.

(d) Finishing

Sodded areas shall be rolled with light equipment once the sod is sufficiently dry after the initial watering application.

910.4 Seeding Methods

(1) Hydraulic Seeding

The seed bed shall be prepared as specified above and hydraulic seeding equipment, which is capable of placing all materials in single operation, shall be used.

(2) Broadcast Seeding

The seed bed shall be prepared as specified above. The seed or seed mixture shall be uniformly distributed over the seed bed area in accordance with the distribution rates specified for the seeding type. Upon completion of seeding activities, roll the planted area with a light roller or drag a weighted section of chain link fence (or other rough flat object as approved by the Engineer) across the seedbed to better obtain seed-soil contact.

910.5 Seeding Types and Distribution Rates

(1) Native Seeding

The seed bed shall be prepared as specified above.

Seeding shall consist of hydraulic or broadcast seeding and shall comply with the following distribution rates:

- Indiangrass shall be applied at a rate of 0.15 pounds per 1000 square feet
- Sideoats grama shall be applied at a rate of 0.20 pounds per 1000 square feet
- Green sprangletop shall be applied at a rate of 0.15 pounds per 1000 square feet
- Buffalo Grass shall be applied at a rate of 0.25 pounds per 1000 square feet
- Little Bluestem shall be applied at a rate of 0.20 pounds per 1000 square feet
- Blue Grama Grass shall be applied at a rate of 0.15 pounds per 1000 square feet
- Canada Wild Rye shall be applied at a rate of 0.20 pounds per 1000 square feet
- Eastern gamagrass shall be applied at a rate of 0.25 pounds per 1000 square feet
- Purple Three-Awn shall be applied at a rate of 0.15 pounds per 1000 square feet
- Switchgrass shall be applied at a rate of 0.10 pounds per 1000 square feet
- Bushy Bluestem shall be applied at a rate of 0.10 pounds per 1000 square feet
- Big Bluestem shall be applied at a rate of 0.10 pounds per 1000 square feet

(2) Bermuda Seeding

March 1 to September 15

Hydraulic seeding mixture and minimum rate of application per 1000 square feet:

Hulled Bermuda Seed (PLS = 0.83)	Water Soluble Fertilizer	Fiber Mulch Cellulose / Wood	Soil Tackifier
1 lb.	15 lbs.	45.9 lbs. / 57.4 lbs.	1.4 / 1.5 lbs.

* From May 16 – September 15 Fox Tail Millet can be applied at a rate of 2 lbs. per 1000 square feet.

Broadcast seeding mixture and minimum rate of application per 1000 square feet:

Hulled Bermuda Seed	Water Soluble Fertilizer
2 lb.	15 lbs.

* From May 16 – September 15 Fox Tail Millet can be applied at a rate of 2 lbs. per 1000 square feet.

September 15 to March 1

For hydraulic seeding, add 7 pounds per 1000 square feet of winter wheat with a PLS = 0.83 to the above mixture. Fertilizer shall conform to a 15-15-15.

For broadcast seeding, use an unhulled Bermuda seed at the same application rate, and add 7 pounds per 1000 square feet of winter wheat with a PLS = 0.83 to the above mixture. Fertilizer shall conform to a 15-15-15.

(a) Shredded Brush Mulch

Small brush or tree limbs, except Juniper, which have been shredded may be used for mulching Native Grass seeding.

(b) Straw Mulch

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 Engineer/Architect. Straw may be hand or machine placed and adequately secured.

(c) Fiber Mulch

Cellulose and wood fiber mulch shall be spread uniformly over the area indicated or as designated by the Engineer/Architect at the rate of 45 to 80 lbs. per 1000 square feet.

(3) 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:

- Bluebonnets shall be applied at a rate of 0.15 pounds per 1000 square feet
- Indian Blanket shall be applied at a rate of 0.10 pounds per 1000 square feet
- Missouri Primrose shall be applied at a rate of 0.05 pounds per 1000 square feet
- Clasping Coneflower shall be applied at a rate of 0.05 pounds per 1000 square feet
- Purple Horsemint or Lemon Mint shall be applied at a rate of 0.05 pounds per 1000 square feet
- Plains Coreopsis shall be applied at a rate of 0.05 pounds per 1000 square feet
- Pink Evening Primrose shall be applied at a rate of 0.05 pounds per 1000 square feet
- Indian Paintbrush shall be applied at a rate of 0.05 pounds per 1000 square feet

910.6 Sodding

Sod shall consist of living Bermuda or St. Augustine grass with a healthy root system consisting of thickly matted roots and a minimum soil thickness of 1 inch. The sod shall be cut in minimum 12 inch by 12 inch squares. The sod shall be free of weeds, Johnson grass, or other deleterious material. Straw mulch and fertilizer shall be applied as specified above. All sources for sod must be submitted to the Engineer for approval prior to ordering.

910.7 Measurement

Revegetation performed by seeding, for the type described and called out in the construction documents shall consist of hydraulic seeding or broadcast seeding as previously described in this Specification Item. Work and acceptable material for Revegetation performed by seeding will be measured by the square yard, complete in place, with a minimum of 95 percent coverage with no bare areas exceeding 16 square feet and a 1½ inch stand of grass. Bare areas shall be re-prepared and replanted as required to develop an acceptable stand of grass.

Revegetation performed by sodding, for the type described and called out in the construction documents shall comply with the requirements described in this Specification Item. Work and acceptable material for Revegetation performed by sodding will be measured by the square yard, complete in place.

910.8 Payment

The work performed and materials furnished and measured will be paid for at the unit price bid, when direct payment is provided, for Revegetation which price shall be full compensation for furnishing all materials, including all topsoil (unless paid under separate item), water, seed, tackifier, fertilizer, mulch, erosion control blanket, erosion control mats, high shear stress soil retention blankets, and for performing all operations necessary to complete the work.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under the following items:

910.8.1	Revegetation, seeding, {type as called out in the Unit Price Schedule}	Per Square Yard
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910.8.2 **Revegetation, sodding, {type as called out
in the Unit Price Schedule}** **Per Square Yard**

END SECTION

920.1 Description

This item shall consist of the erection and maintenance and removal of a rock filter dam for the purpose of trapping sediment from storm water runoff at a location as specified by the Engineer.

Rock Filter Dams shall comply with the Contract Documents. Special Rock Filter Dams shall comply with the Contract Documents.

920.2 Measurement

Rock Filter Dams will be measured by the linear foot of dam complete in place. Such measurements will be made between the ends of the dam.

920.3 Payment

Payment for the Rock Filter Dams, measured as prescribed above, will be made at the unit price bid per linear foot for the dam as indicated in the plans.

Payment shall be full compensation, in accordance with the pay items set in the bid, for furnishing all materials including aggregate, wire and all incidental and subsidiary materials for performing all operations necessary to complete the work.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under one or more of the following items:

920.3.1	Rock Filter Dam, {type as called for in Unit Price Schedule}	Per Linear Foot
920.3.2	Special Rock Filter Dam, {Sta ___ as called out in the Unit Price Schedule}	Per Linear Foot

END SECTION

930.1 Description

This item shall consist of the installation, maintenance and removal of temporary construction entrances/exits for the purpose of keeping mud and sediment off public roadways.

Construction entrances/exits shall comply with the Contract Documents.

930.2 Measurement

Rock construction entrances/exits will be measured per each per installation complete in place.

930.3 Payment

Payment for the rock construction entrances/exits, measured as prescribed above, will be made at the unit price bid per each per installation as indicated in the plans.

Payment shall be full compensation, in accordance with the pay items set in the bid, for furnishing all materials including aggregate and all incidental and subsidiary materials for performing all operations necessary to complete the work.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under the following item:

930.3.1	Rock Construction Entrances/Exits	Per Each
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END SECTION

940.1 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 Engineer.

Tree protection shall comply with the Contract Documents.

940.2 Measurement

Tree protection will be measured by lump sum 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.

940.3 Payment

Payment for Tree Protection, measured as prescribed above, will be made at the unit price bid per lump sum for the tree protection as indicated in the construction documents.

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.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under one or more of the following items:

940.3.1 Tree Protection, {type as called for in Unit Price Schedule} Per Lump Sum

END SECTION

950.1 Description

This item shall include the construction of all Infiltration Trench, and all of the materials, labor, and other incidentals required to complete the work at location specified by the Engineer.

950.2 Materials

- (1) Geotextile Fabric - as approved by Engineer.
- (2) Clean Native Rock or Stone Block - as approved by Engineer.

950.3 Construction

All Infiltration Trench construction shall conform to the Contract Documents.

950.4 Measurement

All Infiltration Trench will be measured per linear foot complete in place at the specified width and depth as specified by the Engineer.

950.5 Payment

Infiltration Trench, 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.

Payment, when included as a contract pay item will be made under:

950.5.1	Infiltration Trench (Width and Depth)	Per Linear Foot
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END SECTION

960.1 Description

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.

960.2 Materials

- (1) Geotextile Fabric - as approved by Engineer.
- (2) Clean Native Rock or Stone Block - as approved by Engineer.

960.3 Construction

All Level Spreader construction shall conform to the Contract Documents.

960.4 Measurement

All Level Spreader will be measured per linear foot complete in place at the specified width and depth as specified by the Engineer.

960.5 Payment

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.

Payment, when included as a contract pay item will be made under:

960.5.1	Level Spreader (Width and Depth)	Per Linear Foot
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END SECTION

1000.1 Description

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.

1000.2 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 with TxDOT Item 662 for Type II work-zone pavement markings.

1000.3 Measurement

Temporary traffic control devices will be measured by lump sum, which shall include all maintenance, revisions, and relocations.

1000.4 Payment

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.

Payment will be under the following item:

1000.4.1	Temporary Traffic Control Devices	Per Lump Sum
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END SECTION

1020.1 Description

This item shall consist of furnishing and installing all pavement markings associated with Fire Lane Striping 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.

1020.2 Installation

Install all pavement markings in conformance with TxDOT Item 666 for Type II Markings "Traffic Paint."

1020.3 Measurement

Fire Lane Striping will be measured per linear foot or lump sum, complete in place, as indicated in the Unit Price Schedule.

1020.4 Payment

Fire Lane Striping shall be paid as described above, and shall include the cost of all materials, labor and incidental and subsidiary materials and work necessary to complete installation and meet all requirements as indicated in this Specification.

Payment will be under the following item:

1020.4.1	Fire Lane Striping	Per Linear Foot
1020.4.2	Fire Lane Striping	Per Lump Sum

END SECTION

1100.1 Description

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

1100.2 Construction Methods

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

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

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.

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.

1100.3 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.

1100.3 Safety Program

The Contractor shall submit a safety program specifically for the construction of trench excavation.

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

1100.5 Additional Quantities

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.

1100.6 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.

1100.7 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.

1100.8 Measurement

Trench Safety shall be measured per linear foot along the centerline of the installed safety system, without adjustment for changes in width at manholes, junction boxes, or any other facilities.

1100.9 Payment

Payment for Trench Safety Systems shall be made under one or more of the following items, 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, and removing and disposing of any materials used in the Trench Safety System.

1100.9.1 Trench Safety {depth as called out in the Unit Price Schedule} Per Linear Foot

END SECTION

1500.1 Summary

This section defines the requirements to be met for blasting operations within the jurisdiction of the local governing authority, and also describes the minimum qualifications of personnel performing or supervising blasting operations.

1500.2 Definitions

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.

1500.3 Blasting Permit

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.

Permit requirements: 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 requirements shall be met for each permit application:

1. 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.
2. The permit shall not be assigned or transferred.
3. The permit shall not be issued to a person under 21 years of age.
4. All permit applications shall include the following information:
 - a. Site Plan of area to be blasted.
 - b. Type and quantity of explosives and blasting agents to be used.
 - c. Location and means of transportation and storage of all explosives and blasting agents.
 - d. Length of time of blasting operations. (Approximate)
 - e. 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:
 - i. 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.

- ii. There shall be no blasting within one hundred (100) feet of any structure or building.
 - iii. 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.
 - iv. The Blaster shall conduct seismic monitoring of all blasts.
 - v. 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.
 - vi. 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.
 - vii. Approved blasting machines shall be used. All other equipment is prohibited.
 - viii. 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.
- f. 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.
- g. 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.

1500.4 Blasting Log

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.

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.

1500.5 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.

1500.6 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.

1500.7 Minimum Operational Requirements

Loading explosives or blasting agents shall be performed using the minimum standards and procedures listed below:

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 nonsparking 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 refired 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. 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.
13. No explosive shall be loaded or used underground in the presence of combustible gases or combustible dusts.
14. 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.
15. All blast holes in open work shall be stemmed to the collar or to a point which will confine the charge.
16. 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.
17. 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.

18. Drill holes which have been sprung or chambered, and which are not water-filled, shall be allowed to cool before explosives are loaded.
19. No loaded holes shall be left unattended or unprotected.
20. 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.
21. When loading blasting agents pneumatically over electric blasting caps, semi-conductive delivery hose shall be used and the equipment shall be bonded and grounded.

Transporting explosives or blasting agents shall be performed using the minimum standards and procedures listed below:

1. 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.
2. 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.
3. 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.
4. Vehicles used for transporting explosives shall be strong enough to carry the load without difficulty, and shall be in good mechanical condition.
5. 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.
6. 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.
7. Every motor vehicle or conveyance used for transporting explosives shall be marked or placarded on sides, the front, and the rear.
8. 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.
9. Motor vehicles or conveyances carrying explosives, blasting agents, or blasting supplies, shall not be taken inside a garage or shop for repairs or servicing.
10. No motor vehicle transporting explosives shall be left unattended.

1500.8 Supervision

The fire code official is authorized to require operations permitted under the provisions of Section 3301.2 of the fire Code to be supervised at any time by the fire code official in order to determine compliance with all safety and fire regulations.

1500.9 Notification

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.

1500.10 General

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>

1500.11 Manufacturer's Instructions

Blasting operations shall be performed in accordance with the instructions of the manufacturer of the explosive materials being used.

- A. No smoking shall be permitted within fifty 50 feet (15.25m) of any location where explosives are being handled or used.
- B. No blasting operation shall be conducted in a manner contrary to the instructions of the manufacturer of the explosive materials being used.

1500.12 Blasting in Congested Areas

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.

1500.13 Restricted Hours

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.

1500.14 Utility Notification

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.

1500.15 Exception

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.

1500.16 Electronic Detonator Precautions

Precautions shall be taken to prevent accidental discharge of electric detonators from currents induced by radar and radio transmitters, lightning, adjacent power lines, dust and snow storms, or other sources of extraneous electricity.

1500.17 Non Electric Detonator Precautions

Precautions shall be taken to prevent accidental initiation of non electric detonators from stray currents induced by lightning or static electricity.

1500.18 Blasting Area Security

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.

1500.19 Drill Holes

Holes drilled for the loading of explosive charges shall made and loaded in accordance with NFPA 495.

1500.20 Removal of Excess Explosive Materials

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.

1500.21 Initiation Means

The initiation of blasts shall be by means conforming to the provisions of NFPA 495.

1500.22 Connections

The Blaster shall supervise the connecting of the blast holes and the connection of the load line to the power source or initiation point. Connections shall be made progressively from the blast hole back to the

initiation point. Blasting lead lines shall remain shunted (shorted) and shall not be connected to the blasting machine or other source of current until the blast is to be fired.

1500.23 Firing Control

No blast shall be fired until the Blaster has made certain that all surplus explosive materials are in a safe place in accordance with Section 3307.10, all persons and equipment are at a safe distance or under sufficient cover, and that an adequate warning signal has been given.

1500.24 Post-blast Procedures

After the blast, the following procedures shall be observed.

1. No person shall return to the blast area until allowed to do so by the Blaster in charge.
2. 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.
3. The Blaster shall inspect the entire blast site for misfires before allowing other personnel to return to the blast area.

1500.25 Misfires

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.

1500.26 Ongoing Observation

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.

1500.27 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.

END SECTION

2000.1 General

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.

2000.2 Construction Methods

Proposed conduit shall be installed in water line trench where shown on the revised details. 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.

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.

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.

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.

2000.5 Submittals

Communications manholes and communications pull boxes shall be constructed as shown in the construction drawings. 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.

2000.6 Measurement

Measurement of conduit shall be by the linear foot along the centerline of the installed conduit, complete in place for each type and/or size of conduit listed in the Unit Price Schedule. Measurement of communications manholes and/or communications pull boxes shall be per each installed, complete in place. Measurement of oversized communications manholes and/or communications pull boxes shall be per each installed, complete in place.

2000.7 Payment

Payment for conduit shall be by the linear foot, complete in place for each type and/or size of conduit listed in the Unit Price Schedule, which shall include all bends and fittings. No additional payment is allowed for bends, fittings, or other appurtenances unless specifically included as a pay item on the Unit Price Schedule. Payment for communications manholes and for communications pull boxes shall be per each for the item installed, complete in place. Payment for oversized communications manholes and for oversized communications pull boxes shall be per each for the item installed, complete in place. Payment for each of these items shall include furnishing material, additional trenching, installation, testing, and all other items necessary to provide a completed installation.

Payment shall be made under one or more of the following items:

2000.7.1	Conduit {Type and Size}	Per Linear Foot
2000.7.2	Communications Manhole	Per Each
2000.7.3	Communications Pull Box	Per Each
2000.7.4	Oversized Communications Manhole	Per Each
2000.7.5	Oversized Communications Pull Box	Per Each

END SECTION

2010.1 General

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.

2010.2 Construction Methods

Proposed conduit shall be installed as shown on the construction drawings. At corners, crossings, and electrical pull boxes, additional trenching shall be included as necessary to accomplish routing of the conduit under and across other utilities, into and out of electrical 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.

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 (11-1/4 deg., 22-1/2 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.

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 pull boxes shall be installed as indicated, with the proposed conduit routed into and out of the installed pull boxes. Oversized electrical pull boxes may be required for multiple conduits being routed into and out of the pull box. At specific locations where a conduit run is terminated at an electrical pull box, and where a stub location is noted in the construction drawings, the terminal pull box shall be constructed to include a conduit stub installed in the pull box and continuing in the direction shown for at least 4 feet past the outside edges of the pull box, where the stub shall be capped. No additional payment will be allowed for such stubs and caps.

Electrical pull boxes outside the roadway shall be adjusted to have the tops match finished grade.

Electrical pull boxes shall be capable of sustaining a single H20 wheel load on an occasional basis without damage. Lids and/or tops on electrical pull boxes shall be capable of being bolted in place.

All electrical pull boxes shall have the word: "Electrical" permanently cast or engraved on the lid in letters at least 1.5 inches high.

2010.5 Submittals

Electrical pull boxes shall be constructed as shown in the construction drawings and be capable of supporting a 16 kip wheel load. Prior to ordering any material, the Contractor shall submit, for the Engineer's approval, supplier's shop drawings for electrical pull boxes.

2010.6 Measurement

Measurement of conduit shall be by the linear foot along the centerline of the installed conduit, complete in place for each type and/or size of conduit listed in the Unit Price Schedule. Measurement of electrical pull boxes and oversized electrical pull boxes shall be per each installed, complete in place.

2010.7 Payment

Payment for conduit shall be by the linear foot, complete in place for each type and/or size of conduit listed in the Unit Price Schedule, which shall include all bends and fittings. No additional payment is allowed for bends, fittings, or other appurtenances unless specifically included as a pay item on the Unit Price Schedule. Payment for electrical pull boxes and oversized electrical pull boxes shall be per each for the item installed, complete in place. Payment for each of these items shall include furnishing material, additional trenching, installation, testing, and all other items necessary to provide a completed installation.

Payment shall be made under one or more of the following items:

2010.7.1	Conduit {Type and Size}	Per Linear Foot
2010.7.2	Electrical Pull Box	Per Each
2010.7.3	Oversized Electrical Pull Box	Per Each

END SECTION

2020.1 Description

This item shall consist of furnishing and installing all materials, labor, and other incidentals required to complete the installation of Transformer Pads at locations specified by the Engineer.

2020.2 Materials

Transformer Pads shall be constructed using the materials specified in the details provided.

2020.3 Construction

Transformer Pads shall be constructed in accordance with the details provided.

2020.4 Measurement

Measurement for Transformer Pads shall be per each installed, complete in place.

2020.5 Payment

Payment for Transformer Pads shall be per each for the item installed, complete in place. Payment shall include furnishing and hauling of all material, grading, installation, testing, and all other items necessary to provide a completed installation.

Payment shall be made under one or more of the following items:

2020.5.1	Transformer Pad	Per Each
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END SECTION

2100.1 Description

This item shall consist of furnishing and installing all fencing, and other incidentals required to complete the fencing at a location specified by the Engineer.

Fencing 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.

2100.2 Materials

The materials requirements for this specification shall conform to the Contract Documents.

2100.3 Removal & Reconstruction

Fence details referenced below are as shown on the Contract Documents.

- Fence 1: 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.
- Fence 2: 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.
- Fence 3: 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.
- Miscellaneous Fence: All fence indicated shall be called out in the construction documents by station number and shall be reconstructed in kind.
- 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.
- Installation of H-Braces, Reconnection and Re-stretching of Existing Fence: All installations shall be performed as indicated in the construction documents.
- 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.

2100.4 Fence Gates

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.

2100.5 Wooden Lift Station Enclosure

The materials and construction methods for Wooden Lift Station Enclosures shall conform to the details included in the construction plans.

2100.6 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.

2100.7 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.

2100.6 Measurement

Fences 1-3 and Miscellaneous Fence removal and reconstruction shall be measured per linear foot for each installation. If a specific bid item is included for Installation of H-Braces, Reconnection and Re-stretching of Existing Fence, it shall be measured per each for each location indicated, otherwise it shall be considered subsidiary to Fences 1-3 and Miscellaneous Fence. If a specific bid item is included for Removal and Disposal of Existing Fence, it shall be measured per linear foot, otherwise it shall be considered subsidiary to Fences 1-3, Miscellaneous Fence and H-Braces, Reconnection and Re-stretching of Existing Fence.

Fence gates shall be measured per linear foot for each installation. If a specific bid item is included for Installation of H-Braces, Reconnection and Re-stretching of Existing Fence, it shall be measured per each for each location indicated, otherwise it shall be considered subsidiary to Fence gates.

Cattle Panel and Fence Water Gaps shall be measured per linear foot for each installation. If a specific bid item is included for Installation of H-Braces, Reconnection and Re-stretching of Existing Fence, it shall be measured per each for each location indicated, otherwise it shall be considered subsidiary to Cattle Panel or Fence Water Gaps.

2100.7 Payment

Payment for all items and tasks described in this Specification Item, whether paid directly or indirectly, 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.

Payment for all items and tasks described in this Specification Item shall be measured as described above and paid under one of the following items:

2100.7.1	Fence Detail 1	Per Linear Foot
2100.7.2	Fence Detail 2 {# strands}	Per Linear Foot
2100.7.3	Fence Detail 3 {# strands}	Per Linear Foot
2100.7.4	Miscellaneous Fence {Station # - Station #}	Per Linear Foot
2100.7.5	Installation of H-Braces, Reconnection and Re-stretching of Existing Fence	Per Each
2100.7.6	Removal and Disposal of Existing Fence	Per Linear Foot
2100.7.7	Pedestrian Safety Fence	Per Linear Foot
2100.7.8	Fence Gate {Type-Detail}	Per Each
2100.7.9	Wooden Lift Station Enclosure	Per Linear Foot
2100.7.10	Cattle Panels	Per Linear Foot
2100.7.11	Fence Water Gaps	Per Linear Foot

END SECTION

2110.1 Scope of Work

This item shall consist of furnishing and installing of a chain link security fence complete in place.

2110.2 Warranty

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.

2110.3 Substitution

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.

2110.4 Fence Materials

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.

All materials and hardware for 6 foot tall fence shall be galvanized according to Chain Link Fence Manufacturers Institute.

Fabric:	Cedar fencing
Posts:	Extra strong steel pipe, all posts attached to concrete structures shall be SCH-40 galvanized steel pipe.
Line Posts:	2-3/8 in. OD pipe, 3.12 lb. per ft.
Terminal Posts:	2-3/8" OD pipe, 3.12 lb. per ft. (End, Corner & Pull)
Gate Post:	2-3/8 in. OD pipe, 3.12 lb./ft.
Gate Frames	Steel pipe, 2-3/8 in.
Gate Drop Rod & Appurtenances:	1-5/8 in. OD pipe
Top & Intermediate Brace Rail:	1-5/8" OD pipe, 1.82 lb. per ft.
Rail Couplings:	Sleeve type, 6 inches long.

Post Tops:	Malleable iron with pressed steel extension arms, with hole for top rail, designed to prevent entry of moisture into tubular posts.
Barbed Wire:	Galvanized, ASTM A 121, Class 2 two 12-1/2 gauge steel wires with 4 point barbs.
Stretcher Bars:	Steel 3/16 inch by 3/4 inch, or equivalent area.
Fabric Ties:	Galvanized wires.
Tension Wire:	Galvanized coated coil spring wire, 7 gauge
Setting Cement:	Domestic Portland Cement with regular aggregate mixed to form concrete at 3000 PSI at 28 days

2110.5 Personal 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.

A. Gate Posts

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.

B. Hardware

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.

2110.6 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.

2110.7 Construction

A. Rules and Regulations

All work and materials shall be in full accordance with the latest rules and regulations of the Owner and/or local governing authority.

B. 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. Should 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.

C. 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.

D. 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.

2110.7.1 Contractor's Responsibilities

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.

2110.7.2 Excavation

The Contractor shall restore all excavated surfaces, and any utilities or structures damaged as a result of the excavation, to their original conditions. The Contractor shall thoroughly excavate and clean the inside of the inserts embedded for the fence posts, removing all dirt, trash, excess concrete, and any other material which might prevent secure bonding of the non-shrink grout to the walls of the inserts.

2110.7.3 Fence Installation

- A. 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.
- B. Unless provided for otherwise, line posts shall be embedded at least 30" into concrete foundation; gate and terminal posts at least 36".
- C. 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.
- D. 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.

- E. 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.
- F. 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.
- G. 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.
- H. Center posts shall be braced in both directions.
- I. 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.

2110.8 Cleaning

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.

2110.9 Inspection

All identified deficiencies shall be corrected by the Contractor prior to the acceptance of the project by the Owner.

2110.10 Measurement

Security Fence shall be measured by the linear foot complete in place.

2110.11 Payment

Security Fence shall be paid under the following item, which payment shall be full compensation for furnishing, hauling, and installing the fence and all appurtenances as shown on the construction drawings.

2110.11.1	Security Fence	Per Linear Foot
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END SECTION

2120.1 Description

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.

2120.2 Implementation

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.

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.

2120.3 Measurement

Guy wire replacement will be measured per each of each replacement.

2120.4 Payment

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.

Payment will be under the following item:

2120.4.1	Guy Wire Replacement, Permanent	Per Each
2120.4.2	Guy Wire Relocation, Temporary	Per Each

END SECTION

2130.1 Description

This Item shall govern for the furnishing and installing of modular retaining walls as shown on the plans and as specified in the specifications.

2130.2 Materials and Construction Methods

All materials and all construction methods utilized shall be as shown on the plans and in the Specifications.

2130.3 Measurement

Modular retaining walls will be measured by the square foot of surface face, as shown on the plans, complete and in place.

2130.4 Payment

The work performed and materials furnished, measured as provided for under "Measurement", will be paid under the item below, which price shall be full compensation for furnishing all materials, equipment, labor, tools and incidentals necessary to complete the work.

2130.4.1	Modular Retaining Walls	Per Square Foot
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END SECTION

2140.1 Description

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.

2140.2 Working Drawings

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.

2140.3 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

1. 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

2. 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

2140.4 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:

A. 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.

B. 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.

C. Honeycombed or open surfaces.

As approved by the Owner.

D. Any damage, which would prevent making a satisfactory joint.

The date of manufacture, lot number, and type of unit in accordance with the approved erection drawings shall be clearly marked on each lot.

2140.5 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.

2140.6 Measurement

"Concrete Block Retaining Walls", walls will be measured by the square foot of front surface area of the wall between the top of the leveling pad and top of wall including any coping required, as shown in the plans.

2140.7 Payment

The work performed and materials furnished will be paid under the following item, measured as specified above. This price shall be full compensation for excavation; for furnishing and placing all temporary shoring including soldier shafts or piling; furnishing, hauling and mixing all concrete materials; fabricating, curing and finishing all units; concrete for foundation and coping, if required; furnishing and placing earth reinforcements and filter fabric, if required; for all reinforcing steel; for all backfill, including select backfill; for furnishing filter material and drainpipe, if required; for wall erection, sprinkling and compaction of all backfill material; and for all labor, tools, equipment and incidentals necessary to complete the work.

2140.7.1	Concrete Block Retaining Walls	Per Square Foot
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END SECTION

2150.1 Description

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

2150.2 Measurement

Temporary Power Pole Relocation shall be measured per each.

2150.3 Payment

Payment for all items and tasks described in this Specification Item, whether paid directly or indirectly, shall include the cost of all materials, equipment, tools, labor and incidentals necessary to complete the work and meet all requirements as indicated.

Payment for this item and tasks described in this Specification Item shall be measured as described above and paid under the following item:

2150.3.1	Temporary Power Pole Relocation	Per Each
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END SECTION

2160.1 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.

2160.2 Measurement

Removal and Disposal of Power Poles shall be measured per each.

2160.3 Payment

Payment for all items and tasks described in this Specification 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.

Payment for this item and tasks described in this Specification Item shall be measured as described above and paid under the following item:

2160.3.1	Removal and Disposal of Power Poles	Per Each
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END SECTION

2170.1 Description

This item shall consist of all temporary and permanent grading and stabilization activities within the limits of the project necessary to complete the work, as well as to return the site to a condition equal to, or better than its pre-construction condition at specified locations shown in the plans, as determined by the Engineer. All earthwork shall be constructed and compacted to the satisfaction of the Engineer. All materials and work shall be in conformance with the requirements established elsewhere in the specifications, as well as comply with any ordinances and/or requirements established by the Owner.

2170.2 Measurement

Slope Grading and Stabilization shall be measured on a lump sum basis.

2170.3 Payment

Payment for all items and tasks described in this Specification Item, whether paid directly or indirectly, shall include the cost of all materials, equipment, tools, labor and incidentals necessary to complete the work and meet all requirements as indicated.

If included in the Unit Price Schedule as a pay item, payment for this item and tasks described in this Specification Item shall be measured as described above and paid under the following item:

2170.3.1	Slope Grading and Stabilization	Per Lump Sum
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END SECTION

2500.1 Description

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.

2500.2 Materials

(1) Subgrade Preparation

Subgrade Preparation shall conform to Section 106 "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 Class B Borrow.

(2) Flexible Base

Flexible Base shall conform to Section 240 "Flexible Base."

(3) Concrete

Concrete shall conform to Section 300 "Concrete."

(4) Concrete Curb

Concrete Curb shall conform to Section 330 "Concrete Curb and Gutter."

(5) Hot Mix Asphaltic Concrete

Hot Mix Asphaltic Concrete shall conform to Section 410 "Hot Mix Asphaltic Concrete." All Hot Mix used for Hike and Bike Trails shall be Type D with a minimum thickness of 1.5".

(6) Reinforcing Steel or Fiber Reinforcing

Reinforcing steel shall conform to TxDOT Item 440, "Reinforcing Steel."

Fiber reinforcing may be used in lieu of reinforcing steel. Fiber reinforcing shall conform to Section 330 "Concrete" under 330.3(H) "Fiber."

(7) 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
- 5) Sieve Analysis

Tex-106-E
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:

Sieve Size	Percent Passing
$\frac{5}{8}$ inch	100
No. 40	40 - 45
No. 200	15 - 25
Maximum Liquid Limit	35
Plasticity Index	12 - 18

2500.3 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
- 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.

2500.4 Construction Requirements

- (1) Density

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.

(2) Containment of Granite Gravel

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.

2500.5 Measurement

Hike and Bike Trail will be measured by the square yard, including curbs (if required) regardless of depth required.

2500.6 Payment

"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."

Payment, when included in the contract, will be made under the following item:

2500.6.1	Hike and Bike Trail {Type, width, and depth of surface}	Per Square Yard
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END SECTION

3000.1 Description

This Item shall govern for the furnishing and installation of illumination in accordance with these specifications and as shown on the plans. 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.

3000.2 Materials and Installation

The luminaires 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.

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.

All items shall be furnished and installed as specified in TxDOT Item 610 and as further specified in DMS-11010 as referenced therein.

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.

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.

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.

3000.3 Shop Drawings

As required by TxDOT Item 610, the Contractor shall submit shop drawings of the complete Illumination Assembly for the Engineer's review and approval.

As described in the previous paragraph, for the Engineer's review and approval, the Contractor shall provide separate submittals of revised wire and conduit runs to conform to final placement of service poles and transformers.

3000.4 As-built Drawings

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.

3000.6 Measurement and Payment

The items in this Special Specification shall be measured and paid as detailed below; however, if so noted on the Unit Price Schedule, these items shall be treated as Plans Quantity Items. The notation on the Unit Price Schedule shall supersede all other items as to measurement and payment.

3000.6.1 Illumination Assemblies shall comply with all details listed above, along with the requirements of TxDOT Item 610 and shall be measured and paid per each according to TxDOT Item 610.

3000.6.2 Pole Foundations shall comply with all details listed above and on the plans, along with the requirements of TxDOT Item 416 and shall be measured and paid per each according to TxDOT Item 416.

3000.6.3 Wiring for all wire runs and service pole attachments shall be measured and paid per linear foot as detailed for Electrical Conductors in TxDOT Item 620.

3000.6.4 Conduit {size, type and use as listed in the Unit Price Schedule} shall meet the requirements detailed above and in TxDOT Item 618, and shall be measured and paid per linear foot as in TxDOT Item 618.

3000.6.5 Pull Boxes {use as specified in the Unit Price Schedule} shall meet the requirements in the plans and for fabricated precast polymer concrete ground boxes in TxDOT Item 624, including DMS 11070, and shall be measured and paid per each as in TxDOT Item 624.

3000.6.6 Service Pole Attachments shall include all breaker boxes, breakers, conduit, risers, and other necessary hardware and wiring to attach all associated wire runs to electrical service at each service pole. Service Pole Attachments shall be measured and paid per each, complete in place.

3000.6.7 **Illumination Testing and Configuration** shall meet the minimum requirements detailed above and shall be measured and paid by lump sum. Any repairs, replacement, or other costs associated with testing and configuration shall be considered subsidiary to this pay item.

END SECTION

