CITY OF HUMBLE

STANDARD CONSTRUCTION SPECIFICATIONS

FOR

WASTEWATER COLLECTION SYSTEMS, WATER LINES, STORM DRAINAGE, AND STREET PAVING

March 2016

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SECTION 01015

CONTRACTOR'S USE OF PREMISES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A Section includes general use of the site including properties inside and outside of rights-of-way, work affecting road, ramps, streets and driveways and notification to adjacent occupants.

1.02 RIGHTS-OF-WAY

A Confine access and operations and storage areas to rights-of-way provided by Owner as stipulated in Document 00700 - General Conditions; trespassing on abutting lands or other lands in the area is not allowed.

B Contractor may make arrangements, at Contractor's cost, for temporary use of private properties, in which case Contractor and Contractor's surety shall indemnify and hold harmless the Owner against claims or demands arising from such use of properties outside of rights-of-way.

C Restrict total length which materials may be distributed along the route of the construction at any one time to 1,000 linear feet unless otherwise approved by Engineer.

1.03 PROPERTIES OUTSIDE OF RIGHTS-OF-WAY

A Altering the condition of properties adjacent to and along rights-of-way will not be permitted unless authorized by the Engineer.

B Means, methods, techniques, sequences, or procedures which will result in damage to properties or improvements in the vicinity outside of rights-of-way will not be permitted.

C Any damage to properties outside of rights-of-ways shall be repaired or replaced to the satisfaction of the Engineer and at no cost to the Owner.

1.04 USE OF SITE

A Obtain approvals of governing authorities prior to impeding or closing public roads or streets. Do not close more than two consecutive intersections at one time.

B Notify Engineer 72 hours prior to closing a street or a street crossing. Permits for street closures are required in advance and are the responsibility of the Contractor.

C Maintain access for emergency vehicles including access to fire hydrants.

D Avoid obstructing drainage ditches or inlets; when obstruction is unavoidable due to requirements of the Work, provide grading and temporary drainage structures to maintain unimpeded flow.

E Locate and protect private lawn sprinkler systems which may exist on rights-of-ways within the site. Repair or replace damaged systems to condition equal to or better than that existing at start of Work.

F Perform daily clean up of dirt outside the construction zone, and debris, scrap materials, and other disposable items. Keep streets, driveways, and sidewalks clean of dirt, debris and scrap materials. Do not leave buildings, roads, streets or other construction areas unclean overnight.

1.05 NOTIFICATION TO ADJACENT OCCUPANTS

A Notify individual occupants in areas to be affected by the Work of the proposed construction and time schedule. Notification shall be not less than 72 hours or more than 2 weeks prior to work being performed within 200 feet of the homes or businesses.

B Include in notification names and telephone numbers of two company representatives for resident contact, who will be available on 24-hour call. Include precautions which will be taken to protect private property and identify potential access or utility inconvenience or disruption.

C Submit proposed notification to Engineer for approval. Consideration shall be given to the ethnicity of the neighborhood where English is not the dominant language. Notice shall be in an understandable language.

1.06 PUBLIC, TEMPORARY, AND CONSTRUCTION ROADS AND RAMPS

A Construct and maintain temporary detours, ramps, and roads to provide for normal public traffic flow when use of public roads or streets is closed by necessities of the Work.

B Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment or exceptionally large or heavy trucks or equipment.

C Construct and maintain access roads and parking areas as specified in Section 01500 - Temporary Facilities and Controls.

1.07 EXCAVATION IN STREETS AND DRIVEWAYS

A Avoid hindering or needlessly inconveniencing public travel on a street or any intersecting alley or street for more than two blocks at any one time, except by permission of the Engineer.

B Obtain the Engineer's approval when the nature of the Work requires closing of an entire street. Permits required for street closure are the Contractor's responsibility. Avoid unnecessary inconvenience to abutting property owners.

C Remove surplus materials and debris and open each block for public use as work in that block is complete.

D Acceptance of any portion of the Work will not be based on return of street to public use.

E Avoid obstructing driveways or entrances to private property.

F Provide temporary crossing or complete the excavation and backfill in one continuous operation to minimize the duration of obstruction when excavation is required across drives or entrances.

G Provide barricades and signs in accordance with Section VI of the State of Texas Manual on Uniform Traffic Control Devices.

1.08 TRAFFIC CONTROL

A Comply with traffic regulation as specified in Section 01570 - Traffic Control and Regulation.

1.09 SURFACE RESTORATION

A Restore site to condition existing before construction to satisfaction of the Owner and Engineer.

B Repair paved area per the requirements of Section 02571 - Pavement Repair for Utilities.

C Repair turf areas which become damaged, level with bank run sand conforming to Section 02227 - Excavation and Backfill for Utilities, or topsoil conforming to Section 02920 - Topsoil, as approved by the Engineer and resod in accordance with Section 02935 - Sodding. Water and level newly sodded areas with adjoining turf using steel wheel rollers appropriate for sodding. Do not use spot sodding or sprigging.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Procedures for measurement and payment plus conditions for nonconformance assessment and nonpayment for rejected products.

1.02 AUTHORITY

A. Measurement methods delineated in Specification sections are intended to complement the criteria of this section. In the event of conflict, the requirements of this Specification section shall govern.

B. Measurements and quantities submitted by the Contractor will be verified by the Engineer.

C. Contractor shall provide necessary equipment, workers, and survey personnel as required by Engineer to verify quantities.

1.03 UNIT QUANTITIES SPECIFIED

A. Quantity and measurement estimates stated in the Agreement are for contract purposes only. Quantities and measurements supplied or placed in the Work and verified by Engineer shall determine payment as stated in the General Conditions.

B. If the actual Work requires greater or lesser quantities than those quantities indicated in the Bid Proposal, provide the required quantities at the unit prices contracted, except as otherwise stated in the General Conditions.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement by Weight will be measured by CRSI or AISC Manual of Steel Construction weights or scale weights.

B. Measurement by Volume:

1. Stockpiles: Measured by cubic dimension using mean length, width, and height or thickness.

2. Excavation and Embankment Materials: Measured by cubic dimension using the in place average end area method.

C. Measurement by Area: Measured by square dimension using mean length and width or radius.

D. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

E. Stipulated Price Measurement: By unit designated in the agreement.

F. Other: Items measured by weight, volume, area, or lineal means or combination, as appropriate, as a completed item or unit of the Work.

G. Measurement by Each: Measured by each instance or item provided.

H. Measurement by Lump Sum: Measure includes all associated work.

1.05 PAYMENT

A. Payment Includes: Full compensation for all required supervision, labor, products, tools, equipment, plant, transportation, services, and incidentals; and erection, application or installation of an item of the Work; and Contractor's overhead and profit.

B. Total compensation for required Unit Price Work shall be included in Unit Price bid in Bid Proposal. Claims for payment as Unit Price Work, but not specifically covered in the list of unit prices contained in Bid Proposal, will not be accepted.

C. Interim payments for stored materials will not be made unless allowed in Special Conditions. Such materials must be stored on the job site or at a location approved by the Engineer.

D. Progress payments will be based on the Engineer's observations and evaluations of quantities incorporated in the Work multiplied by the unit price.

E. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities determined by Engineer multiplied by the unit price for Work which is incorporated in or made necessary by the Work.

1.06 NONCONFORMANCE ASSESSMENT

A. Remove and replace the Work, or portions of the Work, not conforming to the Contract Documents.

B. If, in the opinion of 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 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 Engineer, if the modified work is deemed to be less suitable than originally specified.

C. Specification sections may modify these options or may identify a specific formula or percentage price reduction.

D. The authority of Engineer to assess the nonconforming work and identify payment adjustment is final.

1.07 NONPAYMENT FOR REJECTED PRODUCTS

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 not completely unloaded from transporting vehicle.

4. Products placed beyond the lines and levels of the required Work.

5. Products remaining on hand after completion of the Work, unless specified otherwise.

6. Loading, hauling, and disposing of rejected products.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 GENERAL

A. It is the intent of the Proposal that the aggregate bid amount as submitted shall cover all work required by Contract Documents in place, complete, and ready for use.

B. Unit prices in the Proposal include all compensation for full completion of all work items in place, and include providing all labor, materials, tools, equipment, services, supplies, incidentals and all necessary operations.

C. Work to protect items to remain by installation of temporary construction; including posting of warning signs, placement of protective fencing, barriers, barricades and covers, and restoration of damaged items to remain; will be considered incidental to the various pay items and no separate payment for this work will be made.

D. Work necessary to HAUL materials from original positions to points of disposition, including excavation of earth materials and utilization in construction or other disposition, will be considered incidental to the various pay items and no separate payment for this work will be made. No separate payment will be made for HAUL only.

E. Work necessary to provide proper drainage during construction; including maintaining sections, existing ditches, channels, culverts, and sewers and including temporary construction, pumping and maintenance of ditches and drainage ways, will be considered incidental to the various pay items and no separate payment for this work will be made.

F. No costs in connection with work required by the Contract Documents for proper and successful completion of the Contract will be paid outside of or in addition to unit prices submitted in the Bid Proposal.

G. Work and materials not specifically set forth in the Bid Proposal as unit price pay items shall be considered subsidiary obligations of Contractor and costs shall be included in unit prices named in the Bid Proposal. For the Contractor to be considered a Qualified Responsive Low Bidder, a Statement of Qualifications must be submitted as required by the Instructions to Bidders showing similar work has been performed by the Contractor. A Contractor who submitted a bid on this project must consider himself qualified to perform and prepare a unit price bid for the work described in the Contract Documents and fully understand what work and materials are required to complete the project. The contract unit price proposal is to be full compensation for all work and materials needed to complete the project described in the Contract Document. Any work or materials not specifically called out in the unit price bid proposal shall be incidental to the project. In preparing the bid for this project, Contractor shall request clarification from the Engineer for any item he feels may have been omitted from the unit price bid proposal. The Contractor, who has done similar work who considers himself qualified to prepare the unit price bid proposal, by submitting his bid, acknowledges that the total price bid is adequate for completing the entire project described in the Contract.

PART 4 UNIT PRICES

****

Insert unit price descriptions in this section for unit price bid items identified in the Bid Proposal form. Each unit price description shall include the method of measurement of quantities for payment purposes (i.e. lump sum, square yard, linear foot, etc.) and provide a brief description of the proposed work and incidentals associated with each unit price bid item.

****

[4.01]

[4.02]

END OF SECTION

SECTION 01035

CHANGE ORDER PROCEDURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Procedures for processing Change Orders, including:

1. Assignment of a responsible individual for approval and communication of changes in the Work;

2. Documentation of change in Contract Price and Contract Time;

3. Change procedures, using proposals and construction contract modifications, work change directive, stipulated price change order, unit price change order, time and materials change order;

4. Execution of Change Orders;

5. Correlation of Contractor submittals.

1.02 REFERENCES

A. Rental Rate Blue Book for Construction Equipment (Data Quest Blue Book). Rental Rate is defined as the full unadjusted base rental rate for the appropriate item of construction equipment.

1.03 RESPONSIBLE INDIVIDUAL

A. Contractor shall provide a letter indicating the name and address of the individual authorized to execute change documents, and who shall also be responsible for informing others in Contractor's employ and Subcontractors of changes to the Work. The information shall be provided at the Preconstruction Conference.

1.04 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

A. Contractor shall maintain detailed records of changes in the Work. Provide full information required for identification and evaluation of proposed changes, and to substantiate costs of changes in the Work.

B. Contractor shall document each proposal for a change in cost or time with sufficient data to allow evaluation of the proposal.

C. Proposals shall include, as a minimum, the following information as applicable:

1. Quantities of items in the original Bid Schedule with additions, reductions, deletions, and substitutions.

2. When Work items were not included in the Bid Schedule, Contractor shall provide unit prices for the new items, with supporting information as required by the Engineer.

3. Justification for any change in Contract Time.

4. Additional data upon request.

D. For changes in the Work performed on a time-and-material basis, the following additional information may be required:

1. Quantities and description of products and equipment.

2. Taxes, insurance and bonds.

3. Overhead and profit.

4. Dates and times work was performed, and by whom.

5. Time records and certified copies of applicable payrolls.

6. Invoices and receipts for products, rented equipment, and subcontracts, similarly documented.

E. Rented equipment will be paid to the Contractor by actual invoice cost for the duration of time required to complete the extra work. If the extra work comprises only a portion of the rental invoice where the equipment would otherwise be on the site, the Contractor shall compute the hourly equipment rate by dividing the actual monthly invoice by 176. (One day equals 8 hours and one week equals 40 hours.) Operating costs shall not exceed the estimated operating costs given for the item of equipment in the Blue Book.

F. For changes in the work performed on a time-and-materials basis using Contractor-owned equipment, compute rates with the Blue Book as follows:

1. Multiply the appropriate Rental Rate by an adjustment factor of 70 percent plus the full rate shown for operating costs. The Rental Rate utilized shall be the lowest cost combination of hourly, daily, weekly or monthly rates. Use 150 percent of the Rental Rate for double shifts (one extra shift per day) and 200 percent of the Rental Rate for more than two shifts per day. No other rate adjustments shall apply.

2. Standby rates shall be 50 percent of the appropriate Rental Rate shown in the Blue Book. Operating costs will not be allowed.

1.05 CHANGE PROCEDURES

A. Changes to Contract Price or Contract Time can only be made by issuance of a Change Order. Issuance of a Work Change Directive or written acceptance by the Engineer of changes will be formalized into Change Orders. All changes will be in accordance with the requirements of the General Conditions.

B. The Engineer will advise of minor changes in the Work not involving an adjustment to Contract Price or Contract Time as authorized by the General Conditions by issuing supplemental instructions.

C. Contractor may request clarification of Drawings, Specifications or Contract Documents or other information. Response by the Engineer to a Request for Information does not authorize the Contractor to perform tasks outside the scope of the Work. All changes must be authorized as described in this section.

1.06 PROPOSALS AND CONTRACT MODIFICATIONS

A. The Engineer may issue a Request for Proposal, which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications. The Engineer may also request a proposal in the response to a Request for Information. Contractor will prepare and submit its Proposal within 7 days or as specified in the request.

B. The Contractor may propose an unsolicited change by submitting a Proposal to the Engineer describing the proposed change and its full effect on the Work, with a statement describing the reason for the change and the effect on the Contract Price and Contract Time including full documentation.

1.07 WORK CHANGE DIRECTIVE

A. Engineer may issue a signed Work Change Directive instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

B. The document will describe changes in the Work and will designate a method of determining any change in Contract Price or Contract Time.

C. Contractor shall proceed promptly to execute the changes in the Work in accordance with the Work Change Directive.

1.08 STIPULATED PRICE CHANGE ORDER

A. A stipulated price Change Order will be based on an accepted Proposal including the Contractor's lump sum price quotation.

1.09 UNIT PRICE CHANGE ORDER

A. Where Unit Prices for the affected items of Work are included in the Bid Schedule, the unit price Change Order will be based on unit prices as originally bid, subject to provisions of the General Conditions.

B. Where unit prices of Work are not pre-determined in the Bid Schedule, Work Change Directive or accepted Proposal will specify the unit prices to be used.

1.10 TIME-AND-MATERIAL CHANGE ORDER

A. Contractor shall provide an itemized account and supporting data after completion of change, within time limits indicated for claims in the General Conditions.

B. Engineer will determine the change allowable in Contract Price and Contract Time as provided in the General Conditions.

C. Contractor shall maintain detailed records of work done on time-and-material basis as specified in paragraph 1.04, Documentation of Change in Contract Price and Contract Time.

D. Contractor shall provide full information required for evaluation of changes, and shall substantiate costs for changes in the Work.

1.11 EXECUTION OF CHANGE DOCUMENTATION

A. Engineer will issue Change Orders, Work Change Directives, or accepted Proposals for signatures of parties as described in the General Conditions.

1.12 CORRELATION OF CONTRACTOR SUBMITTALS

A. For Stipulated Price Contracts, Contractor shall promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.

B. For Unit Price Contracts, the next monthly estimate of work after acceptance of a Change Order will be revised to include any new items not previously included and the appropriate unit rates.

C. Contractor shall promptly revise progress schedules to reflect any change in Contract Time, and shall revise schedules to adjust time for other items of work affected by the change, and resubmit for review.

D. Contractor shall promptly enter changes to the on-site and record copies of the Drawings, Specifications or Contract Documents as required in Section 01720 - Project Record Documents.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01040

COORDINATION AND MEETINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Section includes general coordination including preconstruction conference, site mobilization conference, and progress meetings.

1.02 RELATED DOCUMENTS

A. Coordination is required throughout the documents. Refer to all of the Contract Documents and coordinate as necessary.

1.03 ENGINEER AND REPRESENTATIVES

A. The Engineer may act directly or through designated representatives as defined in the General Conditions and as identified by name at the preconstruction conference.

1.04 CONTRACTOR COORDINATION

A. Coordinate scheduling, submittals, and Work of the various Specifications sections to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Coordinate completion and clean up of Work for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

C. Coordinate access to site for correction of nonconforming Work to minimize disruption of Owner's activities where Owner is in partial occupancy.

1.05 PRECONSTRUCTION CONFERENCE

A. Engineer will schedule a preconstruction conference.

B. Attendance Required: Engineer's representatives, Consultants, Contractor, and major Subcontractors.

C. Agenda:

1. Distribution of Contract Documents

2. Designation of personnel representing the parties in Contract, and the Consultant.

3. Review of insurance

4. Discussion of formats proposed by the Contractor for schedule of values, and construction schedule

5. Procedures and processing of shop drawings and other submittals, substitutions, pay estimates or applications for payment, Requests for Information, Request for Proposal, Change Orders, and Contract closeout

6. Scheduling of the Work and coordination with other contractors

7. Review of Subcontractors

8. Appropriate agenda items listed for Site Mobilization Conference, paragraph 1.06 C, when preconstruction conference and site mobilization conference are combined

9. Procedures for testing

10. Procedures for maintaining record documents

11. Owner's requirements

12. Construction Schedule

13. Storm Water Pollution Prevention Plan

14. Submittals and NPDES Requirements

1.06 SITE MOBILIZATION CONFERENCE

A. When required by the Contract Documents, Engineer will schedule a conference at the Project site prior to Contractor occupancy.

B. Attendance Required: Engineer representatives, Consultants, Contractor's Superintendent, and major Subcontractors.

C. Agenda:

1. Use of premises by Owner and Contractor

2. Safety and first aid procedures

3. Construction controls provided by Owner

4. Temporary utilities

5. Survey and layout

6. Security and housekeeping procedures

1.07 PROGRESS MEETINGS

A. Project meetings shall be held at Project field office or other location as designated by the Engineer. Meeting shall be held at monthly intervals, or more frequent intervals if directed by Engineer.

B. Attendance Required: Job superintendent, major Subcontractors and suppliers, Engineer representatives, and Consultants as appropriate to agenda topics for each meeting.

C. Engineer or his representative will make arrangements for meetings, and recording minutes.

D. Engineer or his representative will prepare the agenda and preside at meetings.

E. Contractor shall provide required information and be prepared to discuss each agenda item.

F. Agenda:

1. Review minutes of previous meetings
2. Review of Work progress schedule submittal, and pay estimates, payroll and compliance submittals
3. Field observations, problems, and decisions
4. Identification of problems which impede planned progress
5. Review of submittals schedule and status of submittals
6. Review of Request for Information and Request for Proposal status
7. Change order status
8. Review of off-site fabrication and delivery schedules
9. Maintenance of progress schedule
10. Corrective measures to regain projected schedules
11. Planned progress during succeeding work period
12. Coordination of projected progress
13. Maintenance of quality and work standards
14. Effect of proposed changes on progress schedule and coordination
15. Other items relating to Work

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01050

FIELD SURVEYING

PART 1 G E N E R A L

1.01 QUALITY CONTROL

A. Conform to State of Texas laws for surveys requiring licensed surveyors. Employ a land surveyor acceptable to Engineer, if required.

1.02 SUBMITTALS

A. Submit to Engineer the name, address, and telephone number of Surveyor before starting survey work.

B. Submit documentation verifying accuracy of survey work on request.

C. Submit information under provisions of Section 01300 - Submittals.

1.03 PROJECT RECORD DOCUMENTS

A. Maintain a complete and accurate log of control and survey work as it progresses.

B. Submit Record Documents under provisions of Section 01720 - Project Record Documents.

1.04 EXAMINATION

A. Verify locations of survey control points prior to starting Work.

B. Verify Elevations of any key points (such as connections to existing utilities or locations or possible conflicts with existing utilities) prior to starting Work.

C. Notify Engineer immediately of any discrepancies discovered.

1.05 SURVEY REFERENCE POINTS

A. Control datum for survey is that established by Owner-provided survey and indicated on Drawings. This only applies to areas if provided on the plan drawings.

B. Locate and protect survey control points, including property corners, prior to starting site work; preserve permanent reference points during construction.

C. Notify Engineer 48 hours in advance of need for relocation of reference points due to changes in grades or other reasons.

D. Report promptly to Engineer the loss or destruction of any reference point.

E. Contractor shall reimburse Owner for cost of reestablishment of permanent reference points disturbed by Contractor's operations.

1.06 SURVEY REQUIREMENTS

A. Utilize recognized engineering survey practices.

B. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on Project Record Documents.

C. Establish elevations, lines and levels to provide quantities required for measurement and payment and to provide appropriate controls for the Work. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stakes for grading; fill and topsoil placement; utility locations, slopes, and invert elevations.

2. Grid or axis for structures.

D. Verify periodically layouts by same means.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01090

REFERENCE STANDARDS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Section includes general quality assurance as related to Reference Standards and a list of references.

1.02 QUALITY ASSURANCE

A. For Products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on the date as stated in the General Conditions.

C. Request clarification from Engineer before proceeding should specified reference standards conflict with Contract Documents.

1.03 SCHEDULE OF REFERENCES

AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W Washington, DC 20001
ACI	American Concrete Institute P.O. Box 19150 Redford Station Detroit, MI 48219-0150
AGC	Associated General Contractors of America 1957 E Street, N.W. Washington, DC 20006
AI	Asphalt Institute Asphalt Institute Building College Park, MD 20740
AITC	American Institute of Timber Construction 333 W. Hampden Avenue Englewood, CO 80110

AISC	American Institute of Steel Construction 400 North Michigan Avenue, Eighth Floor Chicago, IL 60611
AISI	American Iron and Steel Institute 1000 16th Street, N.W. Washington, DC 20036
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017
ANSI	American National Standards Institute 1430 Broadway New York, NY 10018
APA	American Plywood Association Box 11700 Tacoma, WA 98411
API	American Petroleum Institute 1220 L Street, N.W. Washington, DC 20005
AREA	American Railway Engineering Association 50 F Street, N.W. Washington, DC 20001
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
AWPA	American Wood-Preservers' Association 7735 Old Georgetown Road Bethesda, MD 20014
AWS	American Welding Society P.O. Box 35104 Miami, FL 33135
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235

CLFMI	Chain Link Fence Manufactures Institute 1101 Connecticut Avenue, N.W. Washington, DC 20036
CRD	U.S.A. Corps. Of Engineers
CRSI	Concrete Reinforcing Steel Institute 933 Plum Grove Road Schaumburg, IL 60173-4758
EJMA	Expansion Joint Manufacturers Association 707 Westchester Avenue White Plains, NY 10604
FS	Federal Standardization Documents General Services Administration, Specifications Unit (WFSIS) 7th and D Streets, S.W. Washington, DC 20406
ICEA	Insulated Cable Engineer Association P.O. Box 440 S. Yarmouth, MA 02664
IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane P.O. Box 1331 Piscataway, NJ 0855-1331
MIL	Military Specifications General Services Administration, Specifications Unit (WFSIS) 7th and D Streets, S.W. Washington, DC 20406
NACE	National Association of Corrosion Engineers P.O. Box 986 Katy, TX 77450
NEMA	National Electrical Manufacturers' Association 2101 L Street, N.W., Suite 300 Washington, DC 20037
NFPA	National Fire Protection Association Batterymarch Park, P.O. Box 9101 Quincy, MA 02269-9101

OSHA	Occupational Safety Health Administration U.S. Department of Labor, Government Printing Office Washington, DC 20402
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077-1083
PCI	Prestressed Concrete Institute 201 North Wacker Drive Chicago, IL 60606
SDI	Steel Deck Institute Box 9506 Canton, OH 44711
SSPC	Steel Structures Painting Council 4400 Fifth Avenue Pittsburgh, PA 15213
TAC	Texas Administrative Code
TNRCC	Texas Commission on Environmental Quality P.O. Box 13087 Austin, TX 78711-3087
TxDOT	Texas Department of Transportation 11th and Brazos Austin, TX 78701-2483
UL	Underwriters' Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062
UNI-BELL	UNI-BELL Pipe Association 2655 Villa Creek Drive, Suite 155 Dallas, TX 75234

PART 2 PART 2 P R O D U C T S - NOT USED

PART 3 PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01292

SCHEDULE OF VALUES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Preparation and submittal of a Schedule of Values for stipulated price contracts or for major lump sum items on unit price contracts for which the Contractor requests progress payments.

1.02 DEFINITION

A. The Schedule of Values is an itemized list that establishes the value of each part of the Work for a stipulated price contract and for major lump sum items in a unit price contract. The Schedule of Values is used as the basis for preparing applications for payments. Quantities and unit prices may be included in the schedule when designated by the City Engineer.

B. A major lump sum item is a lump sum item in the Schedule of Unit Price Work which qualifies as Major Unit Price Work as defined in General Conditions.

1.03 PREPARATION

A. For stipulated price contracts, subdivide the Schedule of Values into logical portions of the Work, such as major work items or work in contiguous geographic areas. Use Section 01310 - Construction Schedule to guide the subdivision of work items. The items in the Schedule of Values will correlate directly with the tasks enumerated in the Construction Schedule. Then organize each portion using the Table of Contents of this Project Manual as an outline for listing the value of work by Sections. A pro rata share of mobilization, bonds, and insurance may be listed as separate items for each portion of the work.

B. For unit price contracts, items should include a proportional share of Contractor's overhead and profit so that the total of all items will equal the Contract Price.

C. For lump sum equipment items where submittal of operation/maintenance data and testing are required, include a separate item for equipment operation and maintenance data submittal valued at 5 percent of the lump sum amount for each equipment item and a separate item for testing and adjusting valued at 5 percent of the lump sum amount for each equipment item.

D. Round off figures for each listed item to the nearest $100.00 except for the value of one item, if necessary, to make the total of all items in the Schedule of Values equal the Contract Price for stipulated price contracts or the lump sum amount in the Schedule of Unit Price Work.

E. Type the schedule of values on 8-1/2-inch by 11-inch white bond paper.

1.04 SUBMITTAL

A. Submit the Schedule of Values in accordance with the requirements of Section 01300 - Submittals. Submit at least 10 days prior to submitting the first application for progress payment.

B. Revise the Schedule of Values and resubmit for items affected by contract modifications, change orders, and work change directives. After the changes are reviewed without exception by the City Engineer, make the submittal at least 10 days prior to submitting the next application for progress payment.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Submittal procedures for:

1. Schedule of Values

2. Construction Schedules

3. Shop Drawings, Product Data, and Samples

4. Operations and Maintenance Data

5. Manufacturer's Certificates

6. Construction Photographs

7. Project Record Documents

8. Design Mixes

1.02 SUBMITTAL PROCEDURES

A. Scheduling and Handling

1. Schedule submittals well in advance of the need for the material or equipment for construction. Allow time to make delivery of material or equipment after submittal is approved.

2. Develop a submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. The Engineer will review and return submittals to the Contractor as expeditiously as possible but the amount of time required for review will vary depending on the complexity and quantity of data submitted. In no case will a submittal schedule be acceptable which allows less than 30 days for initial review by the Engineer. This time for review shall in no way be justification for delays or additional compensation to the Contractor.

3. The Engineer's review of submittals covers only general conformity to the Drawings, Specifications and dimensions which affect the layout. The Contractor is responsible for quantity determination. No quantities will be verified by the Engineer. The Contractor is responsible for any errors, omissions or deviations from the Contract requirements; review of submittals in no way

relieves the Contractor from his obligation to furnish required items according to the Drawings and Specifications.

4. Submit 5 copies of documents unless otherwise specified in the following paragraphs or in the Specifications.

5. Revise and resubmit submittals as required. Identify all changes made since previous submittal.

6. The Contractor shall assume the risk for material or equipment which is fabricated or delivered prior to approval. No material or equipment shall be incorporated into the Work or included in periodic progress payments until approval has been obtained in the specified manner.

B. Transmittal Form and Numbering

1. Transmit each submittal to the Engineer with a transmittal form.

2. Sequentially number each transmittal form beginning with the number 1. Resubmittals shall use the original number with an alphabetic suffix (i.e., 2A for first resubmittal of Submittal 2 or 15C for third resubmittal of Submittal 15). Each submittal shall only contain one type of work, material, or equipment. Mixed submittals will not be accepted.

3. Identify variations from requirements of Contract Documents and identify product or system limitations.

4. For submittal numbering of videotapes, see paragraph 1.10 Video.

C. Contractor's Certification

1. Each submittal shall contain a statement or stamp signed by the Contractor, certifying that the items have been reviewed in detail and are correct and in accordance with Contract Documents, except as noted by any requested variance.

1.03 SCHEDULE OF VALUES

A. Submit a Schedule of Values at least 10 days prior to the first Application for Payment. A Schedule of Values shall be provided for each of the items indicated as Lump Sum (LS) in the Bid Schedule for which the Contractor requests to receive progress payments.

B. Schedule of Values shall be typewritten on 8-1/2" x 11", plain bond, white paper. Use the Table of Contents of this Project Manual as a format for listing costs of Work by Section.

C. Round off figures for each listed item to the nearest $100.00 except for the value of one item, if necessary, to make the total price for all items listed in the Schedule of Values equal to the applicable lump sum amount in the Bid Schedule.

D. For Unit Price Contracts, items should include a proportional share of Contractor's overhead and profit, such that the total of all items listed in the Schedule of Values equals the Contract amount. For Stipulated Price Contracts, mobilization, bonds, and insurance may be listed as separate items in the Schedule of Values.

E. For lump sum equipment items where submittal of operations and maintenance data and testing are required, include a separate item for equipment operation and maintenance data submittal valued at 5 percent of the lump sum amount and a separate item for testing and adjusting valued at 5 percent of the lump sum amount.

F. Revise the Schedule of Values and resubmit for items affected by Contract Modifications, Change Orders, and Work Change Directives. Submit revised Schedule of Values 10 days prior to the first Application for Payment after the changes are approved by the Engineer.

1.04 CONSTRUCTION SCHEDULES

A. Submit Construction Schedules for the Work in accordance with the requirements of this Section. The Construction Schedule Submittal shall be a bar chart, either computer generated, or prepared manually and a narrative report.

B. During the Pre-construction Meeting, as noted in Section 01040 - Coordination and Meetings, the Contractor shall provide a sample of the format to be used for the Construction Schedule Submittal. The format is subject to approval by the Engineer. Review of the submittal will be provided within 7 days of the submittal of the sample.

C. Within 7 days of the receipt of approval of the Contractor's format, or 14 days of the Notice to Proceed, whichever is later, the Contractor shall submit a proposed Construction Schedule for review. The Construction Schedule Submittal shall meet the following requirements:

1. The schedule shall usually include a total of at least 20 but not more than 50 activities. Fewer activities may be accepted, if approved by the Engineer.

2. For projects with work at different physical locations, each location should be indicated separately within the schedule.

3. For projects with multiple crafts or significant subcontractor components, these elements should be indicated separately within the schedule.

4. For projects with multiple types of tasks within the scope, these types of work should be indicated separately within the schedule.

5. For projects with significant major equipment items or materials worth over 30 percent of the Total Contract Price, the schedule shall indicate dates when these items are to be purchased, when they are to be delivered, and when installed.

6. For projects where operating plants are involved, each period of work which will require the shut down of any process or operation shall be identified in the Schedule and must be agreed to by the Engineer prior to starting work in the area.

7. A tabulation of the estimated monthly billings for the work shall be prepared and submitted by the Contractor with the first schedule submittal. This information is not required in the monthly updates, unless significant changes in Work require resubmittal of the schedule for review. The total for each month and a cumulative total will be indicated. These monthly forecasts are only for planning purposes of the Engineer. Monthly payments for actual work completed will be made by the Engineer in accordance with the General Conditions.

D. The Contractor must receive approval of the Engineer for the Schedule and billing estimate prior to the first monthly Application for Payment. No payment will be made until these are accepted.

E. Upon written request from the Engineer, the Contractor shall revise and submit for approval all or any part of the Construction Schedule to reflect changed conditions in the Work or deviations made from the original plan and schedule.

F. The Contractor's Construction Schedule shall thereafter be updated with the Actual Start and Actual Finish Dates, Percent Complete, and Remaining Duration of each Activity and submitted monthly. The date to be used in updating the monthly Construction Schedule shall be the same Date as is used in the monthly Application for Payment. This monthly update of the schedule shall be required before the monthly Application for Payment will be processed for payment.

G. The narrative Schedule Report shall include a description of changes made to the Construction Schedule; Activities Added to the Schedule; Activities Deleted from the Schedule; any other changes made to the Schedule other than the addition of Actual Start Dates and Actual Finish Dates and Remaining Durations.

1.05 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

A. Shop Drawings

1. Submit shop drawings for review as required by the Specifications.

2. Contractor's Certification, as described in paragraph 1.02C, shall be placed on each drawing.

3. The drawings shall accurately and distinctly present the following:

a. Field and erection dimensions clearly identified as such

b. Arrangement and section views

c. Relation to adjacent materials or structure including complete information for making connections between work under this Contract and work under other contracts

d. Kinds of materials and finishes

e. Parts list and descriptions

f. Assembly drawings of equipment components and accessories showing their respective positions and relationships to the complete equipment package

g. Where necessary for clarity, identify details by reference to drawing sheet and detail numbers, schedule or room numbers as shown on the Contract Drawings.

4. Drawings shall be to scale, and shall be a true representation of the specific equipment or item to be furnished.

B. Product Data

1. Submit product data for review as required in Specification sections.

2. Contractor's Certification, as described in paragraph 1.02C, shall be placed on each data item submitted.

3. Mark each copy to identify applicable products, models, options to be used in this Project. Supplement manufacturers' standard data to provide information unique to this Project, where required by the Specifications.

4. For products specified only by reference standard, give manufacturers, trade name, model or catalog designation and applicable reference standard.

5. For products proposed as alternates to "approved" products, as described in Section 01630 - Product Options and Substitutions, provide all information required to demonstrate the proposed products meet the level of quality and performance criteria of the "approved product".

C. Samples

1. Submit samples for review as required by the Specifications.

2. Contractor's Certification, as described in paragraph 1.02C, shall be placed on each sample or a firmly attached sheet of paper.

3. Submit the number of samples specified in Specifications; one of which will be retained by the Engineer.

4. Reviewed samples which may be used in the Work are identified in Specifications.

1.06 OPERATIONS AND MAINTENANCE DATA

A. When specified in Specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, operation, adjusting, finishing, and maintenance.

B. Contractor=s Certification, as described in paragraph 1.02C, shall be placed on front page of each document.

C. Identify conflicts between manufacturers= instructions and Contract Documents.

1.07 MANUFACTURER'S CERTIFICATES

A. When specified in Specification sections, submit manufacturers' certificate of compliance for review by Engineer.

B. Contractor's Certification, as described in paragraph 1.02C, shall be placed on front page of the certificate.

C. Submit supporting reference data, affidavits, and certifications as appropriate.

D. Certificates may be recent or previous test results on material or product, but must be acceptable to Engineer.

1.08 CONSTRUCTION PHOTOGRAPHS

A. Prints: Prepare 2 prints of each view and submit 1 print directly to the Engineer within 7 days of taking photographs. One print shall be retained by the Contractor and made available at all times for reference.

B. Negatives: With each submittal, include photographic negatives, in protective envelopes, identify by Project name, Contractor, and date photographs were taken.

C. PRECONSTRUCTION PHOTOGRAPHS

1. Prior to the commencement of any construction, take 35mm color photographs of the entire route of the project.

2. Photographs: Two prints; color, matte finish; 3 x 5 - inch size, mounted on 8-1/2 x 11-inch soft card stock, with left edge binding margin for three hole punch, or in plastic pockets in three-ring notebook.

3. The photographs shall show:

a. Date photographs were taken

b. Location of the photograph, house number and street name. This information may be shown on a chalkboard in the photograph or by a label on the mountings.

4. Photographs should show the condition of the following:

a. Esplanades and boulevards

b. Yards (near side and far side of street)

c. Housewalk, sidewalk and driveway.

d. Curb

e. Area between walk and curb

(1). Particular features (yard light, shrubs, fences, trees, etc.)

(2). Trees, shrubs and grass

B. POST CONSTRUCTION PHOTOGRAPHS

1. On completion of construction, provide photographs of any public or private property which has been repaired or restored and any damage which is the subject of complaints.

2. Submit in same quantity and format as the preconstruction photographs.

1.09 PROJECT RECORD DOCUMENTS

A. Maintain one record copy of documents at the site in accordance with the General Conditions, paragraph 3.02.

B. Store Record Documents and samples in field office if a field office is required by Contract Documents, or in a secure location. Provide files, racks, and secure storage for Record Documents and samples.

C. Label each document "PROJECT RECORD" in neat, large, printed letters.

D. Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.

E. Keep Record Documents and Samples available for inspection by Engineer.

F. RECORDING

1. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.

2. Contract Drawings and Shop Drawings: Legibly mark each item to record all actual construction, or "as built" conditions, including:

   a. Measured horizontal locations and elevations of underground utilities and appurtenances, referenced to permanent surface improvements.

   b. Elevations of underground utilities referenced to benchmark utilized for project.

   c. Field changes of dimension and detail.

   d. Changes made by modifications.

   e. Details not on original contract drawings.

   f. References to related shop drawings and Modifications.

G. Record information with a red pen or pencil on a set of blue line opaque drawings, provided by Engineer.

1.10 DESIGN MIXES

A. When specified in Specifications, submit design mixes for review.

B. Contractor's Certification as described in paragraph 1.02C, shall be placed on front page of each design mix.

C. Mark each design mix to identify proportions, gradations, and additives for each class and type of design mix submitted. Include applicable test results on samples for each mix.

D. Maintain a copy of approved design mixes at mixing plant.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULE

PART 1 G E N E R A L

1.01 DESCRIPTION

A. Furnish projected construction schedule for entire work.

B. Revise monthly.

1.02 FORM OF SCHEDULE

A. Prepare by bar chart method.

B. Arrange by chronological order by beginning of each item of work.

1.03 CONTENT OF SCHEDULES

A. Include complete sequence of construction by activity:

1. Shop drawings, product data and samples: Submittal dates and dates reviewed copies will be required.

2. Decision dates.

3. Product procurement and delivery dates.

4. Dates for beginning, and completion of each element of construction.

B. Show projected percentage of completion for each item of work as of first day of each month.

C. Furnish subschedules to define critical portions of entire schedule.

D. Show anticipated payment to complete work.

1.04 UPDATING

A. Show all changes occurring since previous month's submission of updated schedule.

B. Indicate progress of each activity.

C. Show completion dates.

D. If in opinion of the Owner, Contractor falls behind in scheduled progress, Contractor shall take steps required to regain lost progress without additional cost to Owner, and likewise revise schedule accordingly.

SUBMITTALS

E. Submit initial schedules within fifteen days after execution of Contract or at the time of the Pre-Construction conference.

F. Engineer will review schedules and return review copy within ten days after receipt.

G. If required, resubmit within seven days after return of review copy.

H. Submit periodically updated schedules accurately depicting progress to first day of each month.

I. Submit number of copies required by Contractor plus four copies to be retained by Engineer.

1.05 DISTRIBUTION

A. Distribute copies of reviewed schedules to:

1. Engineer

2. Job-site file

3. Subcontractors

4. City representative

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Photographic requirements for construction photographs and submittals

1.02 UNIT PRICES

A. No separate payment will be made for work under this section. Include the cost in the unit price of related work.

1.03 SUBMITTALS

A. Refer to Section 01300 for submittal requirements.

B. Prints: Prepare 2 prints of each view and submit 1 print directly to the Engineer within 7 days of taking photographs. One print shall be retained by the Contractor and made available at all times for reference.

C. Negatives: With each submittal, include photographic negatives, in protective envelopes, identify by Project name, Contractor, and date photographs were taken.

PART 2 P R O D U C T S

2.01 PRECONSTRUCTION PHOTOGRAPHS

A. Prior to the commencement of any construction, take 35mm color photographs of the entire route of the project.

B. Photographs: Two prints; color, matte finish; 3 x 5-inch size, mounted on 8-1/2 x 11-inch soft card stock, with left edge binding margin for three hole punch, or in plastic pockets in three-ring notebook.

C. The photographs shall show:

1. Date photographs were taken

2. Location of the photograph, house number and street name.

This information may be shown on a chalkboard in the photograph or by a label on the mountings.

D. Photographs should show the condition of the following:

1. Esplanades and boulevards
2. Yards (near side and far side of street)
3. Housewalk, sidewalk and driveway.
4. Curb
5. Area between walk and curb
6. Particular features (yard light, shrubs, fences, trees, etc.)
7. Trees, shrubs and grass

2.02 POST CONSTRUCTION PHOTOGRAPHS

A. On completion of construction, provide photographs of any public or private property which has been repaired or restored and any damage which is the subject of complaints.

B. Submit in same quantity and format as the preconstruction photographs.

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01410

TESTING LABORATORY SERVICES

1.0 GENERAL

1.1 CONDITIONS

A. Testing, inspection, and control of materials required by these specifications shall be performed by a commercial testing laboratory meeting the specified requirements.

B. Owner will select and pay for services of commercial testing laboratory to perform density tests for field control and to perform the various laboratory testing services necessary for field control of the work as specified in respective specification sections, except Contractor shall pay for services of commercial testing laboratory approved by Owner to perform the following:

1. Pipe diameter deflection tests on all flexible and semi-rigid sanitary sewer collection system pipe installation.
2. Testing of systems or partially completed systems, such as testing of water and sewer systems, water supply and drainage systems, air systems, electrical systems and grounding systems.
3. Laboratory services required to establish mix design proposed for use for Portland cement concrete, asphaltic concrete mixtures, and other material mixes requiring control by testing laboratory.
4. Analysis of aggregates, fixing gradations, and the preparation and testing of design cylinders, beams, or specimens, and other services required to establish design or redesign of material mixes requiring control by testing laboratory when required because of change in source of materials or other conditions not caused by Owner.
5. Tests required to establish optimum moisture of earth and base materials and to determine required compactive effort to meet density requirements (Contractor shall pay for all proctor curves to establish optimum moisture and Owner shall pay for all density tests).
6. Cores to test for thickness of paving.
7. Testing and inspection performed for the Contractor's convenience.
8. Retesting and repetitions of laboratory services when initial tests indicate work does not comply with requirements of Contract Documents.

C. Specified testing frequencies are recommended standards, and may be increased or decreased by the Owner or Engineer as deemed necessary for quality control of materials and the work.

D. Reports and commentaries by testing laboratory shall in no way relieve Contractor of his obligation to perform work in full compliance with standards and provisions of the Contract Documents.

E. The Contractor shall not be relieved of his obligation to perform work in full compliance with the standards and provisions of the Contract Documents by reason of the Owner's performance in testing or refraining from testing the work.

F. Owner reserves right to take samples and specimens, and conduct tests on material and work provided by Contractor to assure quality control.

1.2 REQUIREMENTS OF LABORATORY

A. Meet basic requirements of ASTM E329.

B. Testing Equipment: Calibrated at maximum twelve month intervals by devises of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

C. Testing laboratory is only required to have testing facilities for work included in this project.

D. Submit copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during most recent tour of inspection.

E. Submit memorandum of remedies of any deficiencies reported by inspection.

1.3 LABORATORY DUTIES AND LIMITATIONS OF AUTHORITY

A. Cooperate with Engineer, Owner and Contractor.
   1. Unless directed by Owner or Engineer, types and frequencies of tests as specified in specifications sections for field quality control shall not be exceeded.
   2. Owner may not accept charges for tests in excess of types and frequencies specified in specifications sections unless authorized by Engineer or Owner.
   3. Charges for tests to be paid for by Owner shall be submitted promptly to Engineer to allow adequate time for his review before time for payment by Owner.
   4. Unless otherwise directed or stipulated, samples, specimens, and field test locations shall be selected under the control of the Engineer.

B. Provide qualified personnel promptly on notice.

C. Perform required inspections, sampling, and testing of materials and methods of construction, including making and curing concrete test specimens.

D. Ascertain Contractor's compliance with specifically named standards of the Contract Documents.

E. Comply with specified testing and sampling standards, or recognized authoritative testing and sampling standards when none are specifically named in the Specifications.

F. Promptly notify Engineer, Owner and Contractor of irregularities or deficiencies of work which are observed during performance of services.

G. Promptly distribute copies of reports of inspections and tests:
   1. Owner: One copy.
   2. Engineer: One copy.
   3. Contractor: Two copies.

H. Perform additional services as required by Owner.

I. Laboratory is not authorized to:
   1. Revoke, alter, enlarge on, or waive requirements of Contract Documents.
   2. Approve or accept any portion of work.
   3. Perform any duties of Contractor.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Before starting to use proposed design mix and mix materials in construction, arrange for testing of design mixes and mix materials for Portland cement concrete, asphaltic concrete, and other material mixes requiring control by testing laboratory.

B. Cooperate with laboratory personnel, provide access to work, and to construction and fabrication operations.

C. Provide samples of materials to be tested in required quantities.

D. Provide adequate on-site storage area for testing laboratory.

E. Furnish copies of mill test reports for the materials being used on the job when requested by Engineer.
   1. Mill certificates will be acceptable when it is definite that certified mill test sheets apply to the material being supplied.

F. Furnish casual labor to provide access to work to be tested, to obtain and handle samples at site, and to facilitate inspections and tests.

G. Notify laboratory and Engineer 48 hrs. minimum in advance of operations requiring control by testing laboratory, to allow for assignment of personnel and scheduling of tests.

H. Arrange with laboratory and pay for:
   1. Retesting required for failed tests.
   2. Retesting for nonconforming Work.
   3. Additional sampling and tests requested by Contractor beyond specified requirements.
   4. Insufficient notification of cancellation of tests for work scheduled but not performed.

1.5 SPECIFIC TESTS, INSPECTIONS AND METHODS REQUIRED

A. Certification of Products: As required by respective specification sections.

B. Test, Adjust and Balance of Equipment: As required by respective specification sections.

C. Sampling and Laboratory Tests: As required by respective specification sections.

END OF SECTION

SECTION 01420

CONSTRUCTION INSPECTION SERVICES

1.0 GENERAL

1.1 SECTION INCLUDES

A. Inspection services and references

1.2 CONDITIONS

A. Owner reserves right to observe and inspect samples and specimens to be tested, and observe tests on material and work provided by Contractor to assure quality control.

B. Inspection level of service may be increased or decreased by the Owner or Owner's Representative as deemed necessary for quality control of materials and work.

C. Owner will appoint an Inspector as a representative of the Owner. Alternately, Owner may appoint, employ, and pay an independent firm to provide and/or supplement inspection services.

D. Reports and commentaries by Inspector shall in no way relieve Contractor of his obligation to perform work in full compliance with standards and provisions of the Contract Documents.

E. The Contractor shall not be relieved of his obligation to perform work in full compliance with the standards and provisions of the Contract Documents by reason of the Owner's performance in inspection or refraining from inspecting the work.

F. The Contractor shall not be relieved of his obligation to perform the work safely and with all safety requirements by reason of the owner's performance of inspection or refraining from inspections of the work.

1.3 INSPECTORS DUTIES AND LIMITATIONS OF AUTHORITY

A. Perform inspections, observe tests, and provide other services specified in individual Technical Specifications.

B. Ascertain Contractor's compliance with specifically named standards of the Contract Documents.

C. Produce reports to be submitted to Owner, Engineer, and Contractor, indicating observations and compliance or non-compliance with Contract Documents and quantities installed.

D. Perform additional services as required by Owner.

E. Inspector is not authorized, without approval of Engineer, to:
   1. Revoke, alter, enlarge, or waive requirements of the Contract Documents.
   2. Approve or accept any portion of work.
   3. Perform any duties of Contractor.

F. Inspector has the authority to stop work when work is being performed in an unsafe manner or if other issues arise that he deems necessitate stopping work.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Inspector, provide access to work and to construction and fabrication operations.

B. Furnish copies of mill test reports for the materials being used on the job when requested by Engineer or Inspector.
   1. Mill certificates will be acceptable when it is definite that certified mill test sheets apply to the material being supplied.

C. Furnish labor to provide access to work to be inspected, to obtain and handle samples at site, and to facilitate inspections and tests.

D. Contractor shall sign and acknowledge reports for Inspector.

E. Notify Owner's Representative 24 hrs. prior to expected time for operations requiring services. Notify independent firm when noted.

F. Arrange with Inspector and pay for:
   1. Re-inspecting nonconforming Work.
   2. Insufficient notification of cancelation of work scheduled but not performed if such work required increase inspection services.
   3. Inspection services for work on weekends, City Holidays and after hours that has been approved at the request of the contractor that was not anticipated in and/or provided for in the original contract.

END OF SECTION

SECTION 01430

CONTRACTOR'S QUALITY CONTROL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Quality assurance and control of installation and manufacturer's field services and reports.

1.02 SUBMITTALS

A. Make Submittals required by this section and in accordance with all provisions of these specifications.

1.03 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce the Work of specified quality at no additional cost to the Owner.

B. Comply fully with manufacturers' installation instructions, including each step in sequence.

C. Request clarification from the Owner's Representative before proceeding should manufacturers' instructions conflict with Contract Documents.

D. Comply with specified Standards as a minimum requirements for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce the specified level of workmanship.

F. Obtain copies of Standards and maintain at Project Site when required by individual Technical Specifications.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Technical Specifications, provide material or product suppliers' or manufacturers' technical representative to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, operator training, test, adjust, and balance of equipment as applicable, and to initiate operation, as required. Conform to minimum time requirements for start-up operations and operator training if defined in Technical Specifications.

B. At the Owner's Representative's request, submit qualifications of manufacturer's representative to Owner's Representative fifteen (15) days in advance of required

representative's services. The representative shall be subject to approval of Owner's Representative.

C. Manufacturer's representative shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions. Submit report within one (1) day of observation to Owner's Representative for review.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Temporary facilities and the necessary controls for the project including utilities, telephone, sanitary facilities, field office, storage sheds and building, safety requirements, first aid equipment, fire protection, security measures, protection of the Work and property, access roads and parking, environmental controls, disposal of trash, debris, and excavated material, pest and rodent control, water runoff and erosion control.

1.02 CONTRACTOR'S RESPONSIBILITY

A. The facilities and controls specified in this section are considered minimum for the Project. The Contractor may provide additional facilities and controls for the proper execution of the Work and to meet Contractor's responsibilities for protection of persons and property.

B. Comply with applicable requirements specified in other sections of the Specifications.

1. Maintain and operate temporary facilities and systems to assure continuous service.

2. Modify and extend systems as Work progress requires.

3. Completely remove temporary materials and equipment when their use is no longer required.

4. Restore existing facilities used for temporary services to specified or to original condition.

1.03 TEMPORARY UTILITIES

A. Obtaining Temporary Service.

1. Make arrangements with utility service companies for temporary services.

2. Abide by rules and regulations of the utility service companies or authorities having jurisdiction.

3. Be responsible for utility service costs until the Work is substantially complete. Included are fuel, power, light, heat, and other utility services necessary for execution, completion, testing, and initial operation of the Work.

B. Water

1. Provide water required for and in connection with Work to be performed and for specified tests of piping, equipment, devices, or for other use as required for proper completion of the Work.

2. For water to be drawn from public fire hydrants, obtain special permit or license from the proper City officials. A deposit based on rates established by latest ordinance will be required. Install backflow preventor on fire hydrant supply.

3. Provide and maintain an adequate supply of potable water for domestic consumption by Contractor personnel.

C. Electricity and Lighting

1. Provide electric power service as required for the Work, including testing of Work. Provide power for lighting, operation of the Contractor's equipment, or for any other use by Contractor.

2. Electric power service includes temporary power service or generator to maintain plant operations during any scheduled shutdown.

3. Minimum lighting level shall be 5 foot-candles for open areas; 10-foot-candles for stairs and shops.

D. Temporary Heat and Ventilation

1. Provide temporary heat as necessary for protection or completion of the Work.

2. Provide temporary heat and ventilation to assure safe working conditions; maintain enclosed areas at a minimum of 50°F.

E. Telephone

1. Provide emergency telephone service at the Contractor's field office, or by mobile telephone, for use by Contractor personnel and others performing work or furnishing services at the site.

F. Sanitary Facilities

1. Provide and maintain sanitary facilities for persons on the job site; comply with the regulations of State and local departments of health.

2. Enforce the use of sanitary facilities by construction personnel at the job site. Such facilities shall be enclosed. Pit-type toilets will not be permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause a nuisance or health problem; have sewage and waste hauled off-site and properly disposed in accordance with local regulations.

3. Locate toilets near the Work site and secluded from view insofar as possible. Keep toilets clean and supplied throughout the course of the Work.

1.04 FIELD OFFICE

A. Provision of a field office is not required. If the Contractor chooses to provide one, locate it in a place approved by the Engineer.

1.05 STORAGE OF MATERIALS

A. Provide adequately ventilated, watertight storage facilities with floor above ground level for materials and equipment susceptible to weather damage.

B. Storage of materials not susceptible to weather damage may be on blocks off the ground.

C. Store materials in a neat and orderly manner. Place materials and equipment to permit easy access for identification, inspection and inventory.

1.06 SAFETY REQUIREMENTS

A. Submit and follow a safety program. Include in the safety program documented response to trench safety requirements as specified in Section 01526 - Trench Safety System.

B. Conduct operations in strict accord with applicable Federal, State and local safety codes and statutes and with good construction practice. The Contractor is fully responsible and obligated to establish and maintain procedures for safety of all work, personnel and equipment involved in the Project.

C. Observe and comply with Texas Occupational Safety Act (Art. 5182a, V.C.S.) and with all safety and health standards promulgated by Secretary of Labor under Section 107 of Contract Work Hours and Standards Act, published in 29 CFR Part 1926 and adopted by Secretary of Labor as occupational safety and health standards under the Williams-Steiger Occupational Safety and Health Act of 1970, and to any other legislation enacted for safety and health of Contractor employees. Such safety and health standards apply to subcontractors and their employees as well as to the Contractor and its employees.

D. Observance of and compliance with the regulations shall be solely and without qualification the responsibility of the Contractor without reliance or superintendence of or direction by the Engineer or the Engineer’s representative. Immediately advise the Engineer of investigation or inspection by Federal Safety and Health inspectors of the Contractor or subcontractor's work or place of work on the job site under this Contract, and after such investigation or inspection, advise the Engineer of the results. Submit one copy of accident reports to Engineer within 10 days of occurrence.

E. Protect areas occupied by workmen using the best available devices for detection of lethal and combustible gases. Test such devices frequently to assure their functional

capability. Constantly observe infiltration of liquids into the Work area for visual or odor evidences of contamination, immediate take appropriate steps to seal off entry of contaminated liquids to the Work area.

F. Safety measures, including but not limited to safety personnel, first-aid equipment, ventilating equipment and safety equipment, in the specifications and shown on the Drawings are obligations of the Contractor.

G. Maintain required coordination with the local Police and Fire Departments during the entire period covered by the Contract.

1.07 FIRST AID EQUIPMENT

A. Provide a first aid kit throughout the construction period. List telephone numbers for physicians, hospitals, and ambulance services in each first aid kit.

B. Have at least one person thoroughly trained in first aid procedures present on the site whenever Work is in progress.

1.08 FIRE PROTECTION

A. Fire Protection Standards

1. Conform to specified fire protection and prevention requirements as well as those which may be established by Federal, State, or local governmental agencies.

2. Comply with all applicable provisions of NFPA Standard No. 241, Safeguarding Building Construction and Demolition Operations.

3. Provide portable fire extinguishers, rated not less than 2A or 5B in accordance with NFPA Standard No. 10, Portable Fire Extinguishers, for each temporary building, and for every 3000 square feet of floor area of facilities under construction.

4. Locate portable fire extinguishers within 50 feet maximum from any point in the Project area.

B. Fire Prevention and Safety Measures

1. Prohibit smoking in hazardous areas. Post suitable warning signs in areas which are continuously or intermittently hazardous.

2. Use metal safety containers for storage and handling of flammable and combustible liquids.

3. Do not store flammable or combustible liquids in or near stairways or exits.

4. Maintain clear exits from all points within a structure.

1.09 SECURITY MEASURES

A. Protect all Work materials, equipment, and property from loss, theft, damage, and vandalism. Contractor's duty to protect property includes Owner's property.

B. If existing fencing or barriers are breached or removed for purposes of construction. Provide and maintain temporary security fencing equal to existing.

1.10 PROTECTION OF PUBLIC UTILITIES

A. Prevent damage to existing public utilities during construction. These utilities are shown on the Drawings at their approximate locations. Pre-locate, by whatever means may be required (metal detection equipment, probes, excavation, survey), all underground utilities before excavating in area. All investigative work will be done and all repairs required after investigation will be accomplished by Contractor. Contractor is responsible for damages caused by failure to locate and preserve these underground utilities. Give owners of these utilities at least 48 hours notice before commencing Work in area, for locating utilities during construction and allow adequate time for making adjustments or relocation of the utilities when they conflict with proposed Work. Any temporary relocation of utilities if necessary to accommodate construction will not be paid for separately. Bypassing of sanitary waste to storm drainage facilities is not allowed. Utility service lines are not shown on Drawings. Anticipate that such service lines exist and repair them if damaged due to any construction activity. No separate payment will be made for this repair work.

B. Prior to abandonment of utility, make appropriate arrangements with City and owner of utility to terminate service, remove meters, transformers, and poles as may be required by site conditions.

C. When excavating near pipelines and prior to start of excavation, request a representative of pipeline company to come to construction site(s) to meet representatives of Contractor to discuss actual procedures that will be used. Request pipeline company's representative to probe and locate the pipelines in at least three locations: one at each side of proposed excavation and one at centerline of proposed utility. Representative of pipeline company must be present to observe activities of Contractor at all times when excavation is being conducted within 15 feet of pipeline company's pipeline.

1.11 PROTECTION OF THE WORK AND PROPERTY

A. Preventive Actions

1. Take precautions, provide programs, and take actions necessary to protect the Work and public and private property from damage.

2. Take action to prevent damage, injury or loss, including, but not limited to, the following:

a. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with progress of the Work or the Work of any other contractor, any utility service company, or the Owner's operations.

b. Provide suitable storage for materials which are subject to damage by exposure to weather, theft, breakage, or otherwise.

c. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.

d. Frequently clean up refuse, rubbish, scrap materials, and debris caused by construction operations, keeping the Project site safe and orderly.

e. Provide safe barricades and guard rails to protect pedestrian and vehicular traffic around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways, and other hazardous areas.

3. Obtain written consent from proper parties before entering or occupying with workers, tools, materials or equipment, privately-owned land except on easements provided for construction.

4. Assume full responsibility for the preservation of public and private property on or adjacent to the site. If any direct or indirect damage is done by or on account of any act, omission, neglect, or misconduct in execution of the Work by the Contractor, it shall be restored by the Contractor to a condition equal to or better than that existing before the damage was done.

B. Barricades and Warning Signals.

1. Where work is performed on or adjacent to any roadway, right-of-way, or public place; furnish and erect barricades, fences, lights, warning signs, and danger signals; provide watchmen; and take other precautionary measures for the protection of persons or property and protection of the Work. Barricades shall be painted to be visible at night. From sunset to sunrise, furnish and maintain at least one light at each barricade. Erect sufficient barricades to keep vehicles from being driven and pedestrians from walking on or into Work under construction. Furnish watchmen in sufficient numbers to protect the Work. Responsibility of maintenance of barricades, signs, lights and for providing watchmen shall continue until the Project is accepted by the City. Conform to Section 01570 - Traffic Control and Regulation.

C. Tree and Plant Protection. Conform to requirements of Section 01535 - Tree and Plant Protection.

D. Protection of Existing Structures

1. Underground Structures:

   a. Underground structures are defined to include, but not be limited to, sewer, water, gas, and other piping, and manholes, chambers, electrical and signal conduits, tunnels, and other existing subsurface installations located within or adjacent to the limits of the Work.

   b. Known underground structures, including water, sewer, electric, and telephone services are shown on the Drawings in accordance with the best information available, but is not guaranteed to be correct or complete.

   c. Explore ahead of trenching and excavation work and uncover obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption of utility services. Restore to original condition damages to underground structure at no additional cost to the Owner.

   d. Necessary changes in location of the Work may be made by the Engineer to avoid unanticipated underground structures.

   e. If permanent relocation of an underground structure or other subsurface installations is required and not otherwise provided for in the Contract Documents, the Engineer will direct Contractor in writing to perform the Work, which shall be paid for under the provisions for changes in the Contract Price as described in Document 00700 - General Conditions.

2. Surface Structures:

   a. Surface structures are defined as existing buildings, structures and other constructed installations above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks, guard cables, fencing, mail boxes, and other facilities that are visible above the ground surface.

3. Protection of Underground and Surface Structures:

   a. Support in place and protect from direct or indirect injury to underground and surface structures located within or adjacent to the limits of the Work. Install such supports carefully and as required by the party owning or controlling such structure. Before installing structure supports, Contractor shall satisfy the Engineer that the methods and procedures to be used have been approved by the owner of the structure.

b. Avoid moving or in any way changing the property of public utilities or private service corporations without prior written consent of a responsible official of that service or public utility. Representatives of these utilities reserve the right to enter within the limits of this project for the purpose of maintaining their properties, or of making such changes or repairs to their property that may be considered necessary by performance of this Contract.

c. Notify the owners and/or operators of utilities and pipelines of the nature of construction operations to be performed and the date or dates on which those operations will be performed. When construction operations are required in the immediate vicinity of existing structures, pipelines, or utilities, give a minimum of 5 working days advance notice. Probe and flag the location of underground utilities prior to commencement of excavation. Keep flags in place until construction operations reach and uncover the utility.

d. Assume risks attending the presence or proximity of underground and surface structures within or adjacent to the limits to the Work including but not limited to damage and expense for direct or indirect injury caused by the Work to any structure. Immediately repair damage caused, to the satisfaction of the owner of the damaged structure.

E. Protection of Installed Products

1. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of Work.

2. Control traffic to prevent damage to equipment, materials, and surfaces.

1.12 ROADS AND PARKING

A. Prevent interference with traffic and Owner operations on existing roads.

B. Designate temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking. Locate as approved by Engineer.

C. Minimize use by construction traffic of existing streets and driveways.

D. Do not allow heavy vehicles or construction equipment in existing parking areas.

1.13 ENVIRONMENTAL CONTROLS

A. Provide and maintain methods, equipment, and temporary construction as necessary for controls over environmental conditions at the construction site and adjacent areas.

B. Comply with statutes, regulations, and ordinances which relate to the proposed Work for the prevention of environmental pollution and preservation of natural resources, including but not limited to the National Environmental Policy Act of 1969, PL 91-190, Executive Order 11514.

C. Recognize and adhere to the environmental requirements of the Project. Disturbed areas shall be strictly limited to boundaries established by the Contract Documents. Particularly avoid pollution of "on-site" streams, sewers, wells, or other water sources. The City recognizes that the project area has considerable natural value and that construction of projects should be completed with a minimum of impact to the surrounding environment. Attention is directed to this concept. Adopt construction procedures that do not cause unnecessary excavation and filling of the terrain, indiscriminate destruction of vegetation, air or stream pollution, nor the harassment or destruction of wildlife.

D. Burning of rubbish, debris or waste materials is not permitted.

1.14 POLLUTION CONTROL

A. Provide methods, means, and facilities required to prevent contamination of soil, water or atmosphere by discharge of noxious substances from construction operations.

B. Provide equipment and personnel to perform emergency measures required to contain any spillage, and to remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.

C. Take special measures to prevent harmful substances from entering public waters. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.

D. Provide systems for control of atmospheric pollutants.

1. Prevent toxic concentrations of chemicals.

2. Prevent harmful dispersal of pollutants into the atmosphere.

E. Use equipment during construction that conforms to current Federal, State, and local laws and regulations.

1.15 PEST AND RODENT CONTROL

A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.

B. Employ methods and use materials which will not adversely affect conditions at the site or on adjoining properties.

1.16 NOISE CONTROL

A. Provide vehicles, equipment, and construction activities that minimize noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and City Ordinances and in no case will noise levels be permitted which create a nuisance in the surrounding neighborhoods.

B. Conduct construction operations during daylight hours except as approved by Engineer.

1.17 DUST CONTROL

A. Control objectionable dust caused by operation of vehicles and equipment. Apply water or use other methods, subject to approval of the Engineer, which will control the amount of dust generated.

1.18 WATER RUNOFF AND EROSION CONTROL

A. Provide methods to control surface water, runoff, subsurface water, and water pumped from excavations and structures to prevent damage to the Work, the site, or adjoining properties.

B. Control fill, grading and ditching to direct water away from excavations, pits, and other construction areas; and to direct drainage to proper runoff courses so as to prevent any erosion, sedimentation or damage.

C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

D. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site or to adjoining areas and in conformance with environmental requirements.

E. Retain existing drainage patterns external to the construction site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as needed to control conditions.

F. Plan and execute construction and earth work by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.

1 Keep to a minimum the area of bare soil exposed at one time.

2 Provide temporary control measures, such as berms, dikes, and drains.

G. Construct fills and waste areas by selective placement to eliminate surface silts or clays which will erode.

H. Inspect earthwork periodically to detect any evidence of the start of erosion. Apply corrective measures as required to control erosion.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01526

TRENCH SAFETY SYSTEMS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Trench safety system for the construction of trench excavations.

B. Trench safety system for structural excavations which fall under provisions of State and Federal trench safety laws.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. A trench is defined as a narrow excavation (in relation to its depth) 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 15 feet.

B. The trench safety system requirements apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and the installation to dimensions equivalent to a trench as defined.

C. Trench Safety Systems include both Protective Systems and Shoring Systems but are not limited to sloping, sheeting, trench boxes or trench shields, slide rail systems, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

D. Trench Safety Program is the safety procedures governing the presence and activities of individuals working in and around trench excavations.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit a safety program specifically for the construction of trench excavation. Design the trench safety program to be in accordance with OSHA 29CFR standards governing the presence and activities of individuals working in and around trench excavations, and in accordance with any Special Shoring requirements at locations shown on the Drawings.

C. Have construction and shop drawings for trench safety systems sealed as required by OSHA by a licensed Professional Engineer retained and paid by the Contractor.

D. Review of the safety program by the Engineer will only be in regard to compliance with the Contract Documents and will not constitute approval by the Engineer nor relieve Contractor of obligations under State and Federal trench safety laws.

1.05 REGULATORY REQUIREMENTS

A. Install and maintain trench safety systems in accordance with the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.

B. A reproduction of the OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209 is available upon request to Contractors bidding on Owner's projects. The Owner assumes no responsibility for the accuracy of the reproduction. The Contractor is responsible for obtaining a copy of this section of the Federal Register.

C. Legislation that has been enacted by the Texas Legislature with regard to Trench Safety Systems, is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., ' 756.021 (Vernon 1991).

D. Reference materials, if developed for a specific project, will be issued with the Bid Documents, including the following:

1. Geotechnical information obtained for use in design of the trench safety system.

2. Special Shoring Requirements.

1.06 INDEMNIFICATION

A. Contractor shall indemnify and hold harmless the Owner, 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.

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

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install and maintain trench safety systems in accordance with provisions of OSHA 29CFR.

B. Install specially designed trench safety systems shall be installed in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.

C. Obtain verification from a competent person, as identified in the Contractor's trench excavation safety program, that trench boxes and other premanufactured systems are certified for the actual installation conditions.

3.02 INSPECTION

A. Conduct daily inspections by Contractor or Contractor's independently retained consultant, of the trench safety systems to ensure that the installed systems and operations meet OSHA 29CFR and other personnel protection regulations requirements.

B. If evidence of possible cave-ins or slides is apparent, immediately stop work in the trench and move personnel to safe locations until necessary precautions have been taken to safeguard personnel.

C. Maintain a permanent record of daily inspections.

3.03 FIELD QUALITY CONTROL

A. Verify specific applicability of the selected or specially designed trench safety systems to each field condition encountered on the project.

END OF SECTION

SECTION 01535

TREE AND PLANT PROTECTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Tree and plant protection.

B. Minimum qualifications of Arborist and Urban Forester.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittals.

B. Submit name and experience of qualified Arborist proposed for use of work.

1.04 PROJECT CONDITIONS

A. Preserve and protect existing trees and plants to remain from foliage, branch, trunk, or root damage that could result from construction operations.

B. Prevent following types of damage:

1. Compaction of root zone by foot or vehicular traffic, or material storage.

2. Trunk damage from equipment operations, material storage, or from nailing or bolting.

3. Trunk and branch damage caused by ropes or guy wires.

4. Root or soil contamination from spilled solvents, gasoline, paint, lime slurry and other noxious materials.

5. Branch damage due to improper pruning or trimming.

6. Damage from lack of water due to:

a. Cutting or altering natural water migration patterns near root zones.

b. Failure to provide adequate watering.

7. Damage from alteration of soil pH factor caused by depositing lime, concrete, plaster, or other base materials near roots.

8. Cutting of roots larger than one inch in diameter, other than those called out to be cut with root pruning.

1.05 DAMAGE ASSESSMENT

A. When trees other than those designated for removal are destroyed or badly damaged as a result of construction operations, remove and replace with same size, species, and variety up to and including 8-inches in trunk diameter. Tree larger than 8-inches in diameter shall be replaced with an 8-inch diameter tree of the same species and variety and total contract amount will be reduced by an amount determined from the following formula: $0.7854 \times D^2 \times \$28.00$ where D is diameter in inches of tree or shrub trunk measured 12-inches above grade for that portion of the tree which is greater than 8-inches in diameter. Tree removal and replacement must be approved in writing by the Owner and Project Engineer prior to removing any tree.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Pruning paint: Black latex, water based paint, free of all petroleum products.

B. Fertilizer: Fertilizer shall be a root stimulant that contains at a minimum the following ingredients: Ectomycorrhizal Fungi, VA Mycorrhizal (VAM) Fungi, *Rhizosphere Bacillus spp.*, Kelp Meal, Humic Acid and Soluble Yucca.

C. Tree Protection Fencing: Orange, plastic mesh fencing, 4-feet in height with 6-feet high "T" bar posts installed 10-feet on centers.

D. Plastic Root/Soil Protection: Clear polyethylene sheeting, minimum 6 mil. thickness.

PART 3 E X E C U T I O N

3.01 PROTECTION AND MAINTENANCE OF EXISTING TREES AND SHRUBS

A. Except for trees and shrubs shown on Drawings to be removed, all trees and shrubs within the project area are to remain and be protected from damage.

B. For trees to be removed, as designated on the Drawings, perform the following:

1. Stake right-of-way limits and identify any tree of diameter greater than 4 inches which is to be removed. Mark trees prior to felling with an X in orange paint, clearly visible, on the trunk, and at eye level.

2. After marking trees give a minimum of 48-hours notice in writing to the Engineer of intent to begin felling operations.

3. Trees whose trunks are only partially in the right-of-way shall be protected and preserved as described below.

C. For trees or shrubs to remain, perform the following:

1. Trim trees and shrubs only as necessary.

   a. Trees and shrubs requiring pruning for construction should also be pruned for balance as well as to maintain proper form and branching habit.

   b. Cut limbs at branch collar. No stubs should remain on trees. Branch cuts should not gouge outer layer of tree structure or trunk.

2. Use extreme care to prevent excessive damage to root systems.

   c. Roots in construction areas will be cut smoothly with a trencher before excavation begins. Do not allow ripping of roots with a backhoe or other equipment.

   d. Temporarily cover exposed roots with wet burlap to prevent roots from drying out.

   e. Cover exposed roots with soil as soon as possible.

3. Prevent damage or compaction of root zone (area below dripline) by construction activities.

   a. Do not allow scarring of trunks or limbs by equipment or other means.

   b. Do not store construction materials, vehicles, or excavated material under dripline of trees.

   c. Do not pour liquid materials under dripline.

4. Water and fertilize trees and shrubs that will remain to maintain their health during construction period.

   a. Supplemental watering of landscaping during construction should be done once every 7 days in cold months and once every 4 days in hotter months.

   b. This watering shall consist of saturating soils at least 6 to 8 inches beneath surface.

5. Water areas currently being served by private sprinkler systems while systems are temporarily taken out of service to maintain health of existing landscapes.

6. At option of the Contractor and with the Engineer's permission, trees and shrubs to remain may be temporarily transplanted and returned to original positions under supervision of professional horticulturist.

3.02 PROTECTION

A. Protection of Trees or Shrubs in Open Area:

1. Install steel drive-in fence posts in protective circle, approximately 8 feet on center, not closer than 4 feet to trunk of trees or stems of shrubs.

2. Drive steel drive-in fence posts 3 feet minimum into ground, leaving 5 feet minimum above ground.

3. Mount steel hog-wire on fence posts.

4. For trees or shrubs in paved areas, mount concrete-filled steel pipe 2-1/2 inches in diameter minimum in rubber auto tires filled with concrete (movable posts).

B. Timber Wrap Protection for Trees in Close Proximity of Moving or Mechanical Equipment and Construction Work:

1. Wrap trunk with layer of burlap.

2. Install 2 x 4's or 2 x 6's (5-foot to 6-foot lengths) vertically, spaced 3 inches to 5 inches apart around circumference of tree trunk.

3. Tie in place with 12 to 9 gage steel wire.

3.03 MAINTENANCE OF NEWLY PLANTED TREES

A. Water trees during dry periods.

B. The Contractor guarantees that trees planted for this Project shall remain alive and healthy at least until the end of a one-year warranty period.

1. Within four weeks of notice from Owner, Contractor shall replace, at his expense, any dead trees or any trees that in the opinion of Owner, have become unhealthy or unsightly or have lost their natural shape as a result of additional growth, improper pruning or maintenance, or weather conditions.

2. When tree must be replaced, the guarantee period for that tree shall begin on date of replacement of tree, subject to the Owner's inspection, for no less than one year.

3. Straighten leaning trees and bear entire cost.

4. Dispose of trees rejected at any time by Engineer at Contractor's expense.

3.04 ARBORIST AND URBAN FORESTER QUALIFICATIONS

A. Arborist: All tree pruning, removal, and root stimulation shall be contracted to a qualified Arborist. Arborist shall be normally engaged in the field and have a minimum of 8 years experience. Qualifications of the selected Arborist shall be submitted for review and approval by the Project Engineer and Owner.

B. Urban Forester: An Urban Forestry consultant shall be hired to monitor and assist with field layout (exact locations of fencing, root pruning, and zero curb cutback) of the tree preservation program during demolition and construction to ensure tree protection procedures and techniques are practiced as specified and to address concerns and conditions which occur in the field. At a minimum, the individual responsible for monitoring and field layout of the tree protection shall have a minimum of 5 years of experience as a consultant, and shall not be affiliated with a tree care contractor in the area. Qualifications of the selected Urban Forester shall be submitted for review and approval by the Project Engineer and Owner.

END OF SECTION

SECTION 01563

CONTROL OF GROUND WATER AND SURFACE WATER

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Dewatering, depressurizing, draining, and maintaining trench and structure excavations and foundation beds in dry and stable condition.

B. Protecting work against surface runoff and rising flood waters.

C. Disposing of removed water.

1.02 METHOD OF PAYMENT

A. See Section 01025 - Measurement and Payment for Unit Prices.

B. Subsurface investigation and groundwater control plan preparation and monitoring shall be incidental to the project and shall include subsurface investigation to identify groundwater conditions, design, install, operate, maintain, and monitor ground water control systems.

C. No separate payment will be made for control of ground water and surface water except for well pointing and piezometer as noted. Include the cost to control ground water and surface water in unit price for work requiring such controls. Dewatering required to lower water table, for utility installation, construction of structures, removal of standing water, surface drainage seepage, or to protect against rising waters or floods shall be considered incidental to Work.

1.03 DEFINITIONS

A. Ground water control includes both dewatering and depressurization of water-bearing soil layers.

1. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from slopes or bottoms of excavations and disposing of removed water. The intent of dewatering is to increase stability of excavated slopes; prevent dislocation of material from slopes or bottoms of excavations; reduce lateral loads on sheeting and bracing; improve excavating and hauling characteristics of excavated material; prevent failure or heaving of the bottom of excavations; and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization includes reduction in piezometric pressure within strata not controlled by dewatering alone, as required to prevent failure or heaving of excavation bottom.

B. Excavation drainage includes keeping excavations free of surface and seepage water.

C. Surface drainage includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect the Work from any source of surface water.

D. Equipment and instrumentation for monitoring and control of the ground water control system includes piezometers and monitoring wells, and devices, such as flow meters, for observing and recording flow rates.

1.04 PERFORMANCE REQUIREMENTS

A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems.

B. Design a ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Section 01526 - Trench Safety Systems, to produce the following results:

1. Effectively reduce the hydrostatic pressure affecting excavations.

2. Develop a substantially dry and stable subgrade for subsequent construction operations.

3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities, and other work.

4. Prevent the loss of fines, seepage, boils, quick condition, or softening of the foundation strata.

5. Maintain stability of sides and bottom of excavations.

C. Ground water control systems may include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.

D. Provide drainage of seepage water and surface water, as well as water from any other source entering the excavation. Excavation drainage may include placement of drainage materials, such as crushed stone and filter fabric, together with sump pumping.

E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.

F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and any settlement or resultant damage caused by the ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of the system to protect property as required.

H. Provide an adequate number of piezometers installed at the proper locations and depths as required to provide meaningful observations of the conditions affecting the excavation, adjacent structures, and water wells.

I. Provide environmental monitoring wells installed at the proper locations and depths as required to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into the work area or into the ground water control system.

J. Decommission piezometers and monitoring wells installed during design phase studies and left for Contractors monitoring and use.

1.05 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit a Ground Water and Surface Water Control Plan for review by the Engineer prior to start of any field work. The Plan shall be signed by a Professional Engineer registered in the State of Texas. Submit a plan to include the following:

1. Results of subsurface investigation and description of the extent and characteristics of water bearing layers subject to ground water control.

2. Names of equipment suppliers and installation subcontractors.

3. A description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria, and operation and maintenance procedures.

4. A description of proposed monitoring and control system indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics.

5. A description of proposed filters including types, sizes, capacities and manufacturer's application recommendations.

6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.

7. Operating requirements, including piezometric control elevations for dewatering and depressurization.

8. Excavation drainage methods including typical drainage layers, sump pump application and other necessary means.

9. Surface water control and drainage installations.

10. Proposed methods and locations for disposing of removed water.

C. Submit the following records upon completed initial installation:

1. Installation and development reports for well points, eductors, and deep wells.

2. Installation reports and baseline readings for piezometers and monitoring wells.

3. Baseline analytical test data of water from monitoring wells.

4. Initial flow rates.

D. Submit the following records on a weekly basis during operations:

1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.02, Requirements for Eductor, Well Points, or Deep Wells.

2. Maintenance records for ground water control installations, piezometers, and monitoring wells.

E. Submit the following records at end of work. Decommissioning (abandonment) reports for monitoring wells and piezometers installed by other during the design phase and left for Contractor's monitoring and use.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of agencies having jurisdiction.

B. Comply with Texas Commission on Environmental Quality (TCEQ) and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.

C. Obtain permit from EPA under the Texas Pollutant Discharge Elimination System (TPDES), for storm water discharge from construction sites. Refer to Section 01565 TPDES Permit Requirements.

D. Obtain all necessary permits from agencies with control over the use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Because the review and permitting process may be lengthy, take early action to pursue and submit for the required approvals.

E. Monitor ground water discharge for contamination while performing pumping in the vicinity of potentially contaminated sites.

PART 2 P R O D U C T S

2.01 EQUIPMENT AND MATERIALS

A. Equipment and materials are at the option of Contractor as necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review of the Engineer through submittals required in Paragraph 1.05, Submittals.

B. Eductors, well points, or deep wells, where used, must be furnished, installed and operated by an experienced contractor regularly engaged in ground water control system design, installation, and operation.

C. All equipment must be in good repair and operating order.

D. Sufficient standby equipment and materials shall be kept available to ensure continuous operation, where required.

PART 3 E X E C U T I O N

3.01 GROUND WATER CONTROL

A. Perform a subsurface investigation by borings as necessary to identify water bearing layers, piezometric pressures, and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine the drawdown characteristics of the waterbearing layers. The results shall be presented in the Ground Water and Surface Water Control Plan (See Paragraph 1.05B.1).

B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in a manner compatible with construction methods and site conditions. Monitor effectiveness of the installed system and its effect on adjacent property.

C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Engineer in writing of any changes made to accommodate field conditions and changes to the Work. Provide revised drawings and calculations with such notification.

D. Provide for continuous system operation, including nights, weekends, and holidays. Arrange for appropriate backup if electrical power is primary energy source for dewatering system.

E. Monitor operations to verify that the system lowers ground water piezometric levels at a rate required to maintain a dry excavation resulting in a stable subgrade for prosecution of subsequent operations.

F. Where hydrostatic pressures in confined water bearing layers exist below excavation, depressurize those zones to eliminate risk of uplift or other instability of excavation or installed works. Allowable piezometric elevations shall be defined in the Ground Water and Surface Water Control Plan.

G. Maintain water level below subgrade elevation. Do not allow levels to rise until foundation concrete has achieved design strength.

H. During backfilling, dewatering may be reduced to maintain water level a minimum of 5 feet below prevailing level of backfill. However, do not allow that water level to result in uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement stabilized sand until at least 48 hours after placement.

I. Provide a uniform diameter for each pipe drain run constructed for dewatering. Remove pipe drain when it has served its purpose. If removal of pipe is impractical, provide grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout when pipe is removed from service.

J. Extent of construction ground water control for structures with a permanent perforated underground drainage system may be reduced, such as for units designed to withstand hydrostatic uplift pressure. Provide a means of draining the affected portion of underground system, including standby equipment. Maintain drainage system during operations and remove it when no longer required.

K. Remove system upon completion of construction or when dewatering and control of surface or ground water is no longer required.

L. Compact backfill to not less than 95 percent of the maximum dry density in accordance with ASTM D698.

3.02 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between every eductor well or well point and discharge header so that discharge from each installation can be visually monitored.

B. Install sufficient piezometers or monitoring wells to show that all trench or shaft excavations in water bearing materials are predrained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for Contractor's selected method of work.

C. Install piezometers or monitoring wells not less than one week in advance of beginning the associated excavation.

D. Dewatering may be omitted for portions of underdrains or other excavations, but only where auger borings and piezometers or monitoring wells show that soil is predrained by an existing system such that the criteria of the ground water control plan are satisfied.

E. Replace installations that produce noticeable amounts of sediments after development.

F. Provide additional ground water control installations, or change the methods, in the event that the installations according to the ground water control plan does not provide satisfactory results based on the performance criteria defined by the plan and by the specification. Submit a revised plan according to Paragraph 1.05B.

3.03 EXCAVATION DRAINAGE

A. Contractor may use excavation drainage methods if necessary to achieve well drained conditions. The excavation drainage may consist of a layer of crushed stone and filter fabric, and sump pumping in combination with sufficient wells for ground water control to maintain stable excavation and backfill conditions.

3.04 MAINTENANCE AND OBSERVATION

A. Conduct daily maintenance and observation of piezometers or monitoring wells while the ground water control installations or excavation drainage are operating in an area. Keep system in good condition.

B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedule.

C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make observations, as specified.

D. Remove and grout piezometers inside or outside the excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by the Engineer.

3.05 MONITORING AND RECORDING

A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also monitor and record water level and ground water recovery. These records shall be obtained daily until steady conditions are achieved, and twice weekly thereafter.

B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until the Work is completed or piezometers or wells are removed, except when Engineer determines that more frequent monitoring and

recording are required. Comply with Engineer's direction for increased monitoring and recording and take measures as necessary to ensure effective dewatering for intended purpose.

3.06 SURFACE WATER CONTROL

A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. The requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.

B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by such agencies.

END OF SECTION

SECTION 01564

WASTE MATERIAL DISPOSAL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Disposal of waste material and salvageable material.

1.02 UNIT PRICES

A. No separate payment will be made for waste material disposal under this Section. Include payment in unit price for related sections.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Obtain and submit disposal permits for proposed disposal sites if required by local ordinances.

C. Submit a copy of written permission from property owner, along with description of property, prior to disposal of excess material adjacent to the Project. Submit a written and signed release from property owner upon completion of disposal work.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 SALVAGEABLE MATERIAL

A. Excavated material: When indicated on Drawings, load, haul, and deposit excavated material at a location or locations shown on Drawings outside the limits of Project.

B. Base, surface, and bedding material: Deliver shell, gravel, bituminous, or other base and surfacing material designated for salvage to the location designated by the Engineer.

C. Pipe culvert: Deliver culverts designated for salvage to Owner's storage area.

D. Other salvageable materials: Conform to requirements of individual Specification Sections.

E. Coordinate delivery of salvageable material with Engineer.

3.02 EXCESS MATERIAL

A. Vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage, shall become the property of Contractor and shall be removed from the job site and legally disposed of.

B. Excess soil may be deposited on private property adjacent to the Project when written permission is obtained from property owner. See Paragraph 1.03 C above.

C. Verify the flood plain status of any proposed disposal site. Do not dispose of excavated materials in an area designated as within the 100-year Flood Hazard Area.

D. Waste materials shall be removed from the site on a daily basis, such that the site is maintained in a neat and orderly condition.

END OF SECTION

SECTION 01565

TPDES REQUIREMENTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Documentation to be prepared and signed by Contractor before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000 issued February 15, 2013 (the Construction General Permit) or latest revision.

B. Implementation, maintenance inspection, and termination of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other practices shown on the Drawings or specified elsewhere in the Contract.

C. Review implementation of the Storm Water Pollution Prevention Plan (SW3P or SWPPP) in a meeting with Project Manager prior to start of construction.

1.02 DEFINITIONS

A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavating.

B. Large Construction Activity: Project that:

1. disturbs five acres or more, or
2. disturbs less than five acres but is part of a larger common plan of development that will disturb five acres or more of land.

C. Small Construction Activity: Project that:

1. disturbs one or more acres but less than five acres, or
2. disturbs less than one acre but is part of a larger common plan of development that will ultimately disturb one or more acres but less than five acres.

D. TPDES Operator:

1. Provide the name and contact information for the designated TPDES operator.
2. The TPDES operator is the person or persons who have day-to-day operational control of the construction activities which are necessary to ensure compliance with the SW3P for the site or other Construction General Permit conditions.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N

3.01 SITE SPECIFIC STORM WATER POLLUT1ON PREVENTION PLAN (SW3P)

A. Prepare a SW3P following Part III of the Construction General Permit, if required.

B. Update or revise the SW3P as needed during the construction following Part III, Section E of the Construction General Permit.

C. Submit the SW3P and any updates or revisions to Owner's Representative for review and address comments prior to commencing, or continuing, construction activities.

3.02 NOTICE OF INTENT FOR LARGE CONSTRUCTION ACTIVITY

A. Fill out, sign, and date TCEQ Form 20022 (03/05/2013) "Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR 150000)", **Attachment 1** of this section.

B. Transmit the signed Contractor's copy of TCEQ Form 20022 (03/05/2013), along with a $325.00 check or required fee, made out to Texas Commission on Environmental Quality, and the completed Payment Submittal Form to the Owner's Representative.

C. Owner's Representative will complete a separate TCEQ Form 20022 (03/05/2013) for City's Notice of Intent, and will submit both Notices, along with checks for application fees, to the TCEQ.

D. Submission of the Notice of Intent form by both the City and Contractor to TCEQ is required a minimum of seven days before Commencement of Construction Activities.

E. Fill out, sign, and date the "Large Construction Site Notice", Attachment 2A to TPDES General Permit TXR 150000, "Construction Site Notice", **Attachment 2A** of this section.

F. Transmit the signed Construction Site Notice to Owner's Representative at least seven days prior to Commencement of Construction Activity.

3.03 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY

A. Fill out, sign, and date the "Small Construction Site Notice", Attachment 2B to TPDES General Permit TXR 150000, "Construction Site Notice", **Attachment 2B** of this section.

B. Transmit the signed Construction Site Notice to Owner's Representative at least seven days prior to Commencement of Construction Activity.

3.04 CERTIFICATION REQUIREMENTS

A. Fill out TPDES Operator's Information form, **Attachment 3** of this section, including Contractor's name, address, and telephone number, and the names of persons or firms

responsible for maintenance and inspection of erosion and sediment control measures. Use multiple copies as required to document full information.

B. Contractor and Subcontractors shall sign and date the Contractor's / Subcontractor's Certification for TPDES Permitting, **Attachment 4** of this section. Include this certification with other Project certification forms.

C. Submit properly completed certification forms to Owner's Representative for review before beginning construction operations.

D. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measures read, fill out, sign, and date the Erosion Control Contractor's Certification for Inspection and Maintenance. Use the EPA NPDES Construction Inspection Form, **Attachment 5** of this section; and the Storm Water Pollution Prevention Plan Construction Site Inspection Report, **Attachment 6** of this section to record maintenance inspections and repairs.

3.05 RETENTION OF RECORDS

A. Keep a copy of this document and the SW3P in a readily accessible location at the construction site from the Commencement of Construction Activity until submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR 150000). Contractors with day-to-day operational control over SW3P implementation shall have a copy of the SW3P available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SW3P. Upon submission of the NOT, submit all required forms and a copy of the SW3P with all revisions to the Owner's Representative.

3.06 REQUIRED NOTICES

A. Post the following notices from effective date of the SW3P until date of final site stabilization as defined in the Construction General Permit:

1. Post the TPDES permit number for Large Construction Activity, or a signed TCEQ Construction Site Notice for Small Construction Activity. Signed copies of the Contractor's NOI must also be posted.
2. Post notices near the main entrance of the construction site in a prominent place for public viewing. Post name and telephone number of Contractor's local contact person, brief project description and location of the SW3P.
   a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with Engineer to conform to requirements of the Construction General Permit.
   b. If Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move notice as necessary.
3. Post a notice to equipment and vehicles operators, instructing them to stop, check,

and clean tires of debris and mud before driving onto traffic lanes. Post at each stabilized construction exit area.

4. Post a notice of waste disposal procedures in a readily visible location on site.

3.07 ON-SITE WASTE MATERIAL STORAGE

A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.

B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SW3P.

C. Prepare description of controls to reduce Pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with industrial program best management practices. Keep a copy of the description with the SW3Ps.

3.08 NOTICE OF TERMINATION

A. Submit a NOT, **Attachment 7** of this section, to Engineer within 30 days after:

1. Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or
2. Another operator has assumed control over all areas of the site that have not been stabilized; and
3. All silt fences and other temporary erosion controls have either been removed, scheduled to be removed as defined in the SW3P, or transferred to a new operator in the new operator has sought permit coverage.

B. Contractor will complete NOT and submit Contractor and City's notices to the TCEQ and MS4 entities.

ATTACHMENT 1 (pg. 1 of 20)

TCEQ Office Use Only
Permit No.:
RN:
CN:
Region:

TCEQ Notice of Intent (NOI) for Stormwater Discharges Associated with Construction Activity under TPDES General Permit (TXR150000)

IMPORTANT:

- Use the INSTRUCTIONS to fill out each question in this form.
- Use the CHECKLIST to make certain all you filled out all required information. Incomplete applications **WILL** delay approval or result in automatic denial.
- Once processed your permit can be viewed at: http://www2.tceq.texas.gov/wq_dpa/index.cfm

ePERMITS: Sign up now for online NOI: https://www3.tceq.texas.gov/steers/index.cfm
Pay a $225 reduced application fee by using ePermits.

APPLICATION FEE:

- You must pay the **$325** Application Fee to TCEQ for the paper application to be complete.
- Payment and NOI must be mailed to separate addresses.
- Did you know you can pay on line?
  - Go to https://www3.tceq.texas.gov/epay/index.cfm
  - Select Fee Type: GENERAL PERMIT CONSTRUCTION STORM WATER DISCHARGE NOI APPLICATION
- **Provide your payment information below, for verification of payment:**

☐ Mailed Check/Money Order No.: _____
Name Printed on Check: _____
☐ EPAY Voucher No.: _____
Is the Payment Voucher copy attached? ☐ Yes

RENEWAL: Is this NOI a Renewal of an existing General Permit Authorization? (Note: A permit cannot be renewed after June 3, 2013.)

☐ Yes The Permit number is: TXR15_____
(If a permit number is not provided, a new number will be assigned.)
☐ No

1) OPERATOR (Applicant)

a) If the applicant is currently a customer with TCEQ, what is the Customer Number (CN) issued to this entity? You may search for your CN at: http://www12.tceq.texas.gov/crpub/index.cfm?fuseaction=cust.CustSearch

CN_____

ATTACHMENT 1 (pg. 2 of 20)

b) What is the Legal Name of the entity (applicant) applying for this permit?

_____

(The legal name must be spelled exactly as filed with the Texas Secretary of State, County, or in the legal document forming the entity.)

c) What is the name and title of the person signing the application? The person must be an executive official meeting signatory requirements in TAC 305.44(a).
Prefix (Mr. Ms. Miss): _____
First/Last Name: _____ Suffix: _____
Title: _____ Credential: _____

d) What is the Operator Contact's (Responsible Authority) contact information and mailing address as recognized by the US Postal Service (USPS)? You may verify the address at: http://zip4.usps.com/zip4/welcome.jsp
Phone #: _____ ext: _____ Fax #: _____
E-mail: _____
Mailing Address: _____
Internal Routing (Mail Code, Etc.): _____
City: _____ State: _____ ZIP Code: _____
If outside USA: Territory: _____ Country Code: _____ Postal Code: _____

e) Indicate the type of Customer (The instructions will help determine your customer type):

☐ Individual	☐ Limited Partnership	☐ Sole Proprietorship-DBA
☐ Joint Venture	☐ General Partnership	☐ Corporation
☐ Trust	☐ Estate	☐ Federal Government
☐ State Government	☐ County Government	☐ City Government
☐ Other Government		

f) Independent Operator? ☐ Yes ☐ No
(If governmental entity, subsidiary, or part of a larger corporation, check "No".)

g) Number of Employees:
☐ 0-20; ☐ 21-100; ☐ 101-250; ☐ 251-500; or ☐ 501 or higher

h) Customer Business Tax and Filing Numbers:
(REQUIRED for Corporations and Limited Partnerships. Not Required for Individuals, Government, or Sole Proprietors)
State Franchise Tax ID Number: _____
Federal Tax ID: _____
Texas Secretary of State Charter (filing) Number: _____
DUNS Number (if known): _____

2) APPLICATION CONTACT

If TCEQ needs additional information regarding this application, who should be contacted?

Is the application contact the same as the applicant identified above?

☐ Yes, go to Section 3). ☐ No, complete section below.

Prefix (Mr. Ms. Miss): _____
First/Last Name: _____ Suffix: _____
Title: _____ Credential: _____

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ATTACHMENT 1 (pg. 3 of 20)

Organization Name:_____
Phone No.:_____ ext:_____ Fax Number:_____
E-mail:_____
Mailing Address:_____
Internal Routing (Mail Code, Etc.):_____
City:_____State:_____ZIP Code:_____
Mailing Information if outside USA:
Territory:_____Country Code:_____Postal Code:_____

3) REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

If the site of your business is part of a larger business site or if other businesses were located at this site before yours, a Regulated Entity Number (RN) may already be assigned for the larger site. Use the RN assigned for the larger site. Search TCEQ's Central Registry to see if the larger site may already be registered as a regulated site at:
http://www12.tceq.texas.gov/crpub/index.cfm?fuseaction=regent.RNSearch.

If the site is found, provide the assigned Regulated Entity Reference Number and provide the information for the site to be authorized through this application below. The site information for this authorization may vary from the larger site information.

a) TCEQ issued RE Reference Number (RN): RN_____

b) Name of project or site (the name known by the community where located):
_____

c) In your own words, briefly describe the primary business of the Regulated Entity: (Do not repeat the SIC and NAICS code):
_____

d) County (or counties if > 1) _____

e) Latitude:_____ Longitude: _____

f) Does the site have a physical address?
☐ Yes, complete Section A for a physical address.
☐ No, complete Section B for site location information.

Section A: Enter the physical address for the site.
Verify the address with USPS. If the address is not recognized as a delivery address, provide the address as identified for overnight mail delivery, 911 emergency or other online map tools to confirm an address.

Physical Address of Project or Site:
Street Number: _____ Street Name: _____
City: _____State: Texas ZIP Code: _____

TCEQ 20022 (03/05/2013) Page 3

ATTACHMENT 1 (pg. 4 of 20)

Section B: Enter the site location information.
If no physical address (Street Number & Street Name), provide a written location access description to the site. (Ex.: located 2 miles west from intersection of Hwy 290 & IH35 accessible on Hwy 290 South)

City where the site is located or, if not in a city, what is the nearest city:

State: Texas ZIP Code where the site is located:

4) GENERAL CHARACTERISTICS

a) Is the project/site located on Indian Country Lands?

☐ Yes - If the answer is Yes, you must obtain authorization through EPA, Region 6.

☐ No

b) Is your construction activity associated with a facility that, when completed, would be associated with the exploration, development, or production of oil or gas or geothermal resources?

☐ Yes - If the answer is Yes, you may be under jurisdiction of the Railroad Commission of Texas and may need to obtain authorization through EPA, Region 6.

☐ No

c) What is the Primary Standard Industrial Classification (SIC) Code that best describes the construction activity being conducted at the site?
Primary SIC Code: _____

d) If applicable, what is the Secondary SIC Code(s): _____

e) What is the total number of acres disturbed? _____

f) Is the project site part of a larger common plan of development or sale?

☐ Yes - If the answer is Yes, the total number of acres disturbed can be less than 5 acres.

☐ No - If the answer is No, the total number of acres disturbed must be 5 or more. If the total number of acres disturbed is less than 5 then the project site does not qualify for coverage through this Notice of Intent. Coverage will be denied. See the requirements in the general permit for small construction sites.

g) What is the name of the first water body(s) to receive the stormwater runoff or potential runoff from the site?

_____

h) What is the segment number(s) of the classified water body(s) that the discharge will eventually reach?

_____

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i) Is the discharge into an MS4?

☐ Yes - If the answer is Yes, provide the name of the MS4 operator below.

☐ No

If Yes, provide the name of the MS4 operator:

_____

Note: The general permit requires you to send a copy of the NOI to the MS4 operator.

j) Are any of the surface water bodies receiving discharges from the construction site on the latest EPA-approved CWA 303(d) List of impaired waters?

☐ Yes - If the answer is Yes, provide the name(s) of the impaired water body(s) below.

☐ No

If Yes, provide the name(s) of the impaired water body(s):

_____

k) Is the discharge or potential discharge within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer as defined in 30 TAC Chapter 213?

☐ Yes - If the answer is Yes, complete certification below by checking "Yes."

☐ No

I certify that a copy of the TCEQ approved Plan required by the Edwards Aquifer Rule (30 TAC Chapter 213) is either included or referenced in the Stormwater Pollution Prevention Plan.

☐ Yes

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5) CERTIFICATION

Check Yes to the certifications below. Failure to indicate Yes to ***ALL*** items may result in denial of coverage under the general permit.

a) I certify that I have obtained a copy and understand the terms and conditions of the Construction General Permit (TXR150000). ☐ Yes

b) I certify that the full legal name of the entity applying for this permit has been provided and is legally authorized to do business in Texas. ☐ Yes

c) I understand that a Notice of Termination (NOT) must be submitted when this authorization is no longer needed. ☐ Yes

d) I certify that a Stormwater Pollution Prevention Plan has been developed, will be implemented prior to construction and to the best of my knowledge and belief is compliant with any applicable local sediment and erosion control plans, as required in the general permit TXR150000. Note: For multiple operators who prepare a shared SWP3, the confirmation of an operator may be limited to its obligations under the SWP3 provided all obligations are confirmed by at least one operator. ☐ Yes

Operator Certification:

I,_____ _____

Typed or printed name Title

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I further certify that I am authorized under 30 Texas Administrative Code 305.44 to sign and submit this document, and can provide documentation in proof of such authorization upon request.

Signature: _____ Date:_____

(Use blue ink)

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NOTICE OF INTENT CHECKLIST (TXR150000)

- Did you complete everything? Use this checklist to be sure!
- Are you ready to mail your form to TCEQ? Go to the General Information Section of the Instructions for mailing addresses.

This checklist is for use by the operator to ensure a complete application. Missing information may result in denial of coverage under the general permit. (See NOI process description in the Instructions)

Application Fee:

If paying by Check:

- ☐ Check was mailed **separately** to the TCEQs Cashier's Office. (See Instructions for Cashier's address and Application address.)
- ☐ Check number and name on check is provided in this application.

If using ePay:

- ☐ The voucher number is provided in this application or a copy of the voucher is attached.

PERMIT NUMBER:

- ☐ Permit number provided – if this application is for renewal of an existing authorization.

OPERATOR INFORMATION - Confirm each item is complete:

- ☐ Customer Number (CN) issued by TCEQ Central Registry
- ☐ Legal name as filed to do business in Texas (Call TX SOS 512/463-5555)
- ☐ Name and title of responsible authority signing the application
- ☐ Mailing address is complete & verifiable with USPS. www.usps.com
- ☐ Phone numbers/e-mail address
- ☐ Type of operator (entity type)
- ☐ Independent operator
- ☐ Number of employees
- ☐ For corporations or limited partnerships – Tax ID and SOS filing numbers
- ☐ Application contact and address is complete & verifiable with USPS. http://www.usps.com

REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE - Confirm each item is complete:

- ☐ Regulated Entity Reference Number (RN) (if site is already regulated by TCEQ)
- ☐ Site/project name/regulated entity
- ☐ Latitude and longitude http://www.tceq.texas.gov/gis/sqmaview.html
- ☐ County
- ☐ Site/project physical address. Do not use a rural route or post office box.
- ☐ Business description

GENERAL CHARACTERISTICS - Confirm each item is complete:

- ☐ Indian Country Lands –the facility is not on Indian Country Lands
- ☐ Construction activity related to facility associated to oil, gas, or geothermal resources
- ☐ Standard Industrial Classification (SIC) Code www.osha.gov/oshstats/sicser.html
- ☐ Acres disturbed is provided and qualifies for coverage through a NOI
- ☐ Common plan of development or sale
- ☐ Receiving water body(s)
- ☐ Segment number(s)
- ☐ Impaired water body(s)
- ☐ MS4 operator
- ☐ Edwards Aquifer rule

CERTIFICATION

- ☐ Certification statements have been checked indicating "Yes"
- ☐ Signature meets 30 Texas Administrative Code (TAC) 305.44 and is original.

TCEQ-20022 Checklist (03/05/2013) Page 1

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Notice of Intent (NOI) for Stormwater Discharges Associated with Construction Activity under TPDES General Permit (TXR150000)

General Information and Instructions

GENERAL INFORMATION

Where to Send the Notice of Intent (NOI):

BY REGULAR U.S. MAIL
Texas Commission on
Environmental Quality
Stormwater Processing Center
(MC228)
P.O. Box 13087
Austin, Texas 78711-3087

BY OVERNIGHT/EXPRESS MAIL
Texas Commission on
Environmental Quality
Stormwater Processing Center
(MC228)
12100 Park 35 Circle
Austin, TX 78753

TCEQ Contact List:

Application – status and form questions:	*512/239-3700, swpermit@tceq.texas.gov*
Technical questions:	*512/239-4671, swgp@tceq.texas.gov*
Environmental Law Division:	*512/239-0600*
Records Management - obtain copies of forms:	*512/239-0900*
Reports from databases (as available):	*512/239-DATA (3282)*
Cashier's office:	*512/239-0357 or 512/239-0187*

Notice of Intent Process:

When your NOI is received by the program, the form will be processed as follows:

1) **Administrative Review:** Each item on the form will be reviewed for a complete response. In addition, the operator's legal name must be verified with Texas Secretary of State as valid and active (if applicable). The address(s) on the form must be verified with the US Postal service as receiving regular mail delivery. Never give an overnight/express mailing address.

2) **Notice of Deficiency:** If an item is incomplete or not verifiable as indicated above, a notice of deficiency (NOD) will be mailed to the operator. The operator will have 30 days to respond to the NOD. The response will be reviewed for completeness.

3) **Acknowledgment of Coverage:** An Acknowledgment Certificate will be mailed to the operator. This certificate acknowledges coverage under the general permit.
   -or-
   Denial of Coverage: If the operator fails to respond to the NOD or the response is inadequate, coverage under the general permit may be denied. If coverage is denied, the operator will be notified.

General Permit (Your Permit)

For NOIs submitted **electronically** through ePermits, provisional coverage under the general permit begins immediately following confirmation of receipt of the NOI form by the TCEQ.

For **paper** NOIs, provisional coverage under the general permit begins 7 **days after a completed NOI is postmarked for delivery** to the TCEQ.

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You should have a copy of your general permit when submitting your application. You may view and print your permit for which you are seeking coverage, on the TCEQ web site http://www.tceq.texas.gov. Search using key word TXR150000.

General Permit Forms

The Notice of Intent (NOI), Notice of Termination (NOT), and Notice of Change (NOC) (including instructions) are available in Adobe Acrobat PDF format on the TCEQ web site http://www.tceq.texas.gov.

Change in Operator

An authorization under the general permit is not transferable. If the operator of the regulated entity changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted no later than 10 days prior to the change in Operator status.

TCEQ Central Registry Core Data Form

The Core Data Form has been incorporated into this form. Do not send a Core Data Form to TCEQ. After final acknowledgment of coverage under the general permit, the program will assign a Customer Number and Regulated Entity Number.

You can find the information on the Central Registry web site at http://www12.tceq.texas.gov/crpub/index.cfm. You can search by the Regulated Entity (RN), Customer Number (CN) or Name (Permittee), or by your permit number under the search field labeled "Additional ID". Capitalize all letters in the permit number.

The Customer (Permittee) is responsible for providing consistent information to the TCEQ, and for updating all CN and RN data for all authorizations as changes occur. For General Permits, a Notice of Change form must be submitted to the program area.

Fees associated with a General Permit

Payment of the fee may be made by check or money order, payable to TCEQ, or through EPAY (electronic payment through the web).

Application Fee: This fee is required to be paid at the time the NOI is submitted. Failure to submit payment at the time the application is filed will cause delays in acknowledgment or denial of coverage under the general permit.

Mailed Payments:

Payment must be mailed under separate cover at one of the addresses below using the attached Application Fee submittal form. (DO NOT SEND A COPY OF THE NOI WITH THE APPLICATION FEE SUBMITTAL FORM)

BY REGULAR U.S. MAIL
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
P.O. Box 13088
Austin, TX 78711-3088

BY OVERNIGHT/EXPRESS MAIL
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
12100 Park 35 Circle
Austin, TX 78753

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ePAY Electronic Payment: http://www.tceq.texas.gov/epay

When making the payment you must select Water Quality, and then select the fee category "General Permit Construction Storm Water Discharge NOI Application". You must include a copy of the payment voucher with your NOI. Your NOI will not be considered complete without the payment voucher.

INSTRUCTIONS FOR FILLING OUT THE NOI FORM

Renewal of General Permit. Dischargers holding active authorizations under the expired General Permit are required to submit a NOI to continue coverage. The existing permit number is required. If the permit number is not provided or has been terminated, expired, or denied a new permit number will be issued.

1. Operator (Applicant)

a) Enter assigned Customer Number (CN)
TCEQ's Central Registry will assign each customer a number that begins with CN, followed by nine digits. **This is not a permit number, registration number, or license number.**
If this customer has not been assigned a CN, leave the space for the CN blank.
If this customer has already been assigned this number, enter the permittee's CN.

b) Legal Name
Provide the current legal name of the permittee, as authorized to do business in Texas. The name must be provided exactly as filed with the Texas Secretary of State (SOS), or on other legal documents forming the entity, that is filed in the county where doing business. You may contact the SOS at 512/463-5555, for more information related to filing in Texas. If filed in the county where doing business, provide a copy of the legal documents showing the legal name.

c) Person Signing Application
Provide information about person signing section 5) Certification.

d) Operator Contact's (Responsible Authority) Contact Information and Mailing Address
Provide a complete mailing address for receiving mail from the TCEQ. The address must be verifiable with the US Postal Service at http://www.usps.com for regular mail delivery (not overnight express mail). If you find that the address is not verifiable using the USPS web search, please indicate the address is used by the USPS for regular mail delivery.

The area code and phone number should provide contact to the operator. Leave Extension blank if not applicable.

The fax number and e-mail address are optional and should correspond to the operator.

e) Type of Customer (Entity Type)
Check only one box that identifies the type of entity. Use the descriptions below to identify the appropriate entity type. Note that the selected entity type also indicates the name that must be provided as an applicant for a permit, registration or authorization.

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Sole Proprietorship – DBA

A sole proprietorship is a customer that is owned by only one person and has not been incorporated. This business may:

- be under the person's name
- have its own name (doing business as or d.b.a.)
- have any number of employees

If the customer is a Sole Proprietorship or DBA, the 'legal name' of the individual business 'owner' must be provided. The DBA name is not recognized as the 'legal name' of the entity. The DBA name may be used for the site name (regulated entity).

Individual

An individual is a customer who has not established a business, but conducts an activity that needs to be regulated by the TCEQ.

Partnership

- A customer that is established as a partnership as defined by the Texas Secretary of State Office (TX SOS). A Limited Partnership or Limited Liability Partnership (Partnership) is required to file with the Texas Secretary of State. A General Partnership or Joint Venture is not required to register with the state.
- **Partnership (Limited Partnership or Limited Liability Partnership):** A limited partnership is defined in the Act as a partnership formed by two or more persons under the provisions of Section 3 of the Uniform Limited Partnership Act (Art. 6132a, Revised Civil Statutes of Texas) and having as members one or more general partners and one or more limited partners. The limited partners as such are not bound by the obligations of the partnership. Limited partners may not take part in the day-to-day operations of the business. A Limited Partnership must file with the Texas Secretary of State. A registered limited liability partnership is a general or limited partnership that is registered with the Texas Secretary of State. The partnership's name must contain the words "Registered Limited Liability Partnership" or the abbreviation "L.L.P." as the last words or letters of its name.
- **General Partnership:** A general partner may or may not invest, participates in running the partnership and is liable for all acts and debts of the partnership and any member of it. A General Partnership does not have limited partners. For a General Partnership, there is no registration with the state or even written agreement necessary for a general partnership to be formed. The legal definition of a partnership is generally stated as "an association of two or more persons to carry on as co-owners a business for profit" (Revised Uniform Partnership Act § 101 [1994]).
- **Joint Venture:** A joint venture is but another name for a special partnership. It might be distinguished from a general partnership in that the latter is formed for the transaction of a general business, while a joint venture is usually limited to a single transaction. That is, a joint venture is a special combination of persons in the nature of a partnership engaged in the joint prosecution of a particular transaction for mutual benefit or profit.

Corporation

A customer meets all of these conditions:

- is a legally incorporated entity under the laws of any state or country
- is recognized as a corporation by the Texas Secretary of State

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- has proper operating authority to operate in Texas.
- The corporation's 'legal name' as filed with the Texas Secretary of State must be provided as applicant. An 'assumed' name of a corporation is not recognized as the 'legal name' of the entity.

Government

Federal, state, county, or city government (as appropriate)
The customer is either an agency of one of these levels of government or the governmental body itself. The government agency's 'legal name' must be provided as the applicant. A department name or other description of the organization should not be included as a part of the 'legal name' as applicant.

Trust or Estate

A trust and an estate are fiduciary relationships governing the trustee/executor with respect to the trust/estate property.

Other Government

A utility district, water district, tribal government, college district, council of governments, or river authority. Write in the specific type of government.

f) Independent Entity

Check No if this customer is a subsidiary, part of a larger company, or is a governmental entity. Otherwise, check Yes.

g) Number of Employees

Check one box to show the number of employees for this customer's entire company, at all locations. This is not necessarily the number of employees at the site named in the application.

h) Customer Business Tax and Filing Numbers

These are required for Corporations and Limited Partnerships. These are not required for Individuals, Government, and Sole Proprietors.

State Franchise Tax ID Number

Corporations and limited liability companies that operate in Texas are issued a franchise tax identification number. If this customer is a corporation or limited liability company, enter this number here.

Federal Tax ID

All businesses, except for some small sole proprietors, individuals, or general partnerships should have a federal taxpayer identification number (TIN). Enter this number here. Use no prefixes, dashes, or hyphens. Sole proprietors, individuals, or general partnerships do not need to provide a federal tax ID.

TX SOS Charter (filing) Number

Corporations and Limited Partnerships required to register with the Texas Secretary of State are issued a charter or filing number. You may obtain further information by calling SOS at 512/463-5555.

DUNS Number

Most businesses have a DUNS (Data Universal Numbering System) number issued by Dun and Bradstreet Corp. If this customer has one, enter it here.

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2. APPLICATION CONTACT

Provide the name, title and communication information of the person that TCEQ can contact for additional information regarding this application.

3. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

a) Regulated Entity Reference Number (RN)

A number issued by TCEQ's Central Registry to sites (a location where a regulated activity occurs) regulated by TCEQ. This is not a permit number, registration number, or license number. If this regulated entity has not been assigned an RN, leave this space blank.

If the site of your business is part of a larger business site, a Regulated Entity Number (RN) may already be assigned for the larger site. Use the RN assigned for the larger site. Search TCEQ's Central Registry to see if the larger site may already be registered as a regulated site at: http://www12.tceq.texas.gov/crpub/index.cfm?fuseaction=regent.RNSearch

If the site is found, provide the assigned Regulated Entity Reference Number (RN) and provide the information for the site to be authorized through this application. The site information for this authorization may vary from the larger site information.

An example is a chemical plant where a unit is owned or operated by a separate corporation that is accessible by the same physical address of your unit or facility. Other examples include industrial parks identified by one common address but different corporations have control of defined areas within the site. In both cases, an RN would be assigned for the physical address location and the permitted sites would be identified separately under the same RN.

b) Site/Project Name/Regulated Entity

Provide the name of the site as known by the public in the area where the site is located. The name you provide on this application will be used in the TCEQ Central Registry as the Regulated Entity name.

c) Description of Activity Regulated

In your own words, briefly describe the primary business that you are doing that requires this authorization. Do not repeat the SIC Code description.

d) County

Identify the county or counties in which the regulated entity is located.

e) Latitude and Longitude

Enter the latitude and longitude of the site in degrees, minutes, and seconds or decimal form. For help obtaining the latitude and longitude, go to:
http://www.tceq.texas.gov/gis/sqmaview.html or http://nationalmap.gov/ustopo

f) Site/Project (RE) Physical Address/Location Information

Enter the complete address for the site in Section A if the address can be validated through the US Postal Service. If the physical address is not recognized as a USPS delivery address, you may need to validate the address with your local police (911 service) or through an online map site used to locate a site. Please confirm this to be a complete and valid address. Do not use a rural route or post office box for a site location.

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If a site does not have an address that includes a street (or house) number and street name, enter NO ADDRESS for the street name in Section A. In Section B provide a complete written location description. For example: "The site is located 2 miles west from intersection of Hwy 290 & IH35, located on the southwest corner of the Hwy 290 South bound lane."
Provide the city (or nearest city) and zip code of the facility location.

4. GENERAL CHARACTERISTICS

a) Indian Country Lands

If your site is located on Indian Country Lands, the TCEQ does not have authority to process your application. You must obtain authorization through EPA, Region 6, Dallas. Do not submit this form to TCEQ.

b) Construction activity associated with facility associated with exploration, development, or production of oil, gas, or geothermal resources

If your activity is associated with oil and gas exploration, development, or production, you may be under jurisdiction of the Railroad Commission of Texas and may need to obtain authorization from EPA Region 6. For more information, see:
http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=16&pt=1&ch=3&rl=30

Construction activities associated with a facility related to oil, gas or geothermal resources may include the construction of a well site; treatment or storage facility; underground hydrocarbon or natural gas storage facility; reclamation plant; gas processing facility; compressor station; terminal facility where crude oil is stored prior to refining and at which refined products are stored solely for use at the facility; a carbon dioxide geologic storage facility; and a gathering, transmission, or distribution pipeline that will transport crude oil or natural gas, including natural gas liquids, prior to refining of such oil or the use of the natural gas in any manufacturing process or as a residential or industrial fuel.

Where required by federal law, discharges of stormwater associated with construction activities under the Railroad Commission's jurisdiction must be authorized by the EPA and the Railroad Commission of Texas, as applicable. Activities under Railroad Commission of Texas jurisdiction include construction of a facility that, when completed, would be associated with the exploration, development, or production of oil or gas or geothermal resources, such as a well site; treatment or storage facility; underground hydrocarbon or natural gas storage facility; reclamation plant; gas processing facility; compressor station; terminal facility where crude oil is stored prior to refining and at which refined products are stored solely for use at the facility; a carbon dioxide geologic storage facility under the jurisdiction of the Railroad Commission of Texas; and a gathering, transmission, or distribution pipeline that will transport crude oil or natural gas, including natural gas liquids, prior to refining of such oil or the use of the natural gas in any manufacturing process or as a residential or industrial fuel. The Railroad Commission of Texas also has jurisdiction over stormwater from land disturbance associated with a site survey that is conducted prior to construction of a facility that would be regulated by the Railroad Commission of Texas. Under 33 U.S.C. §1342(l)(2) and §1362(24), EPA cannot require a permit for discharges of stormwater from "field activities or operations associated with {oil and gas} exploration, production, processing, or treatment operations, or transmission facilities, including activities necessary to prepare a site for drilling and for the movement and placement of drilling equipment, whether or not such field activities or operations may be considered to be construction activities" unless the discharge is contaminated by contact with any overburden, raw material, intermediate product, finished product, byproduct, or waste product located on the site of the facility. Under §3.8 of this title (relating to Water Protection), the Railroad

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Commission of Texas prohibits operators from causing or allowing pollution of surface or subsurface water. Operators are encouraged to implement and maintain best management practices (BMPs) to minimize discharges of pollutants, including sediment, in stormwater during construction activities to help ensure protection of surface water quality during storm events.

c) Primary Standard Industrial Classification (SIC) Code
Provide the SIC Code that best describes the construction activity being conducted at this site.

Common SIC Codes related to construction activities include:

- 1521 - Construction of Single Family Homes
- 1522 - Construction of Residential Bldgs. Other than Single Family Homes
- 1541 - Construction of Industrial Bldgs. and Warehouses
- 1542 - Construction of Non-residential Bldgs, other than Industrial Bldgs. and Warehouses
- 1611 - Highway and Street Construction, except Highway Construction
- 1622 - Bridge, Tunnel, and Elevated Highway Construction
- 1623 - Water, Sewer, Pipeline and Communications, and Power Line Construction

For help with SIC Codes, go to:
http://www.osha.gov/pls/imis/sicsearch.html

d) Secondary SIC Code
Secondary SIC Code(s) may be provided. Leave blank if not applicable. For help with SIC Codes, go to:
http://www.osha.gov/pls/imis/sicsearch.html

e) Total Number of Acres Disturbed
Provide the approximate number of acres that the construction site will disturb. Construction activities that disturb less than one acre, unless they are part of a larger common plan that disturbs more than one acre, do not require permit coverage. Construction activities that disturb between one and five acres, unless they are part of a common plan that disturbs more than five acres, do not require submission of an NOI. Therefore, the estimated area of land disturbed should not be less than five, unless the project is part of a larger common plan that disturbs five or more acres. Disturbed means any clearing, grading, excavating, or other similar activities.

If you have any questions about this item, please contact the stormwater technical staff by phone at (512)239-4671 or by email at swgp@tceq.texas.gov.

f) Common Plan of Development
Construction activities that disturb less than five acres do not require submission of an NOI unless they are part of a common plan of development or for sale where the area disturbed is five or more acres. Therefore, the estimated area of land disturbed should not be less than five, unless the project is part of a larger common plan that disturbs five or more acres. Disturbed means any clearing, grading, excavating, or other similar activities.

For more information on "What is a common plan of development?" go to:
www.tceq.texas.gov/permitting/stormwater/common_plan_of_development_steps.html

For further information, go to the TCEQ stormwater construction webpage at:
www.tceq.texas.gov/goto/construction and search for "Additional Guidance and Quick Links". If

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you have any further questions about this item, please call the stormwater technical staff at (512)239-4671.

g) Identify the water body(s) receiving stormwater runoff
The stormwater may be discharged directly to a receiving stream or through a MS4 from your site. It eventually reaches a receiving water body such as a local stream or lake, possibly via a drainage ditch. You must provide the name of the water body that receives the discharge from the site (a local stream or lake).

If your site has more than one outfall you need to include the name of the first water body for each outfall, if they are different.

h) Identify the segment number(s) of the classified water body(s)
Identify the classified segment number(s) receiving a discharge directly or indirectly. Go to the following link to find the segment number of the classified water body where stormwater will flow from the site: www.tceq.texas.gov/waterquality/monitoring/viewer.html

You may also find the segment number in TCEQ publication GI-316:
www.tceq.texas.gov/publications/gi/gi-316

If the discharge is into an unclassified receiving water and then crosses state lines prior to entering a classified segment, select the appropriate watershed:

- 0100 (Canadian River Basin)
- 0200 (Red River Basin)
- 0300 (Sulfur River Basin)
- 0400 (Cypress Creek Basin)
- 0500 (Sabine River Basin)

Call the Water Quality Assessments section at (512)239-4671 for further assistance.

i) Discharge into MS4 – Identify the MS4 Operator
The discharge may initially be into a municipal separate storm sewer system (MS4). If the stormwater discharge is into an MS4, provide the name of the entity that operates the MS4 where the stormwater discharges. An MS4 operator is often a city, town, county, or utility district, but possibly can be another form of government. Please note that the Construction General Permit requires the Operator to supply the MS4 with a copy of the NOI submitted to TCEQ. For assistance, you may call the technical staff at (512)239-4671.

j) Surface Water bodies on list of impaired waters – Identify the impaired water body(s)
Indicate Yes or No if any surface water bodies receiving discharges from the construction site are on the latest EPA-approved CWA 303(d) List of impaired waters. Provide the name(s) of surface water bodies receiving discharges or potential discharges from the construction site that are on the latest EPA-approved CWA 303(d) List of impaired waters. The EPA-approved CWA 303(d) List of impaired waters in Texas can be found at:
www.tceq.texas.gov/waterquality/assessment/305_303.html

NOTE: Do not use any "draft" documents.

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k) Discharges to the Edwards Aquifer Recharge Zone and Certification
See maps on the TCEQ website to determine if the site is located within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer at: www.tceq.texas.gov/field/eapp/viewer.html

If the discharge or potential discharge is within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer, a site specific authorization approved by the Executive Director under the Edwards Aquifer Protection Program (30 TAC Chapter 213) is required before construction can begin. The certification must be answered "Yes" for coverage under the Construction General Permit. The TCEQ approved plan must be readily available for TCEQ staff to review at the time that the NOI is submitted.

The general permit requires the approved Contributing Zone Plan or Water Pollution Abatement Plan to be included or referenced as a part of the Stormwater Pollution Prevention Plan.

For questions regarding the Edwards Aquifer Protection Program, contact the appropriate TCEQ Regional Office. For projects in Hays, Travis and Williamson Counties: Austin Regional Office, 12100 Park 35 Circle, Austin, TX 78753, 512-339-2929. For Projects in Bexar, Comal, Kinney, Medina and Uvalde Counties: TCEQ San Antonio Regional Office, 14250 Judson Rd., San Antonio, TX 78233-4480, 210-490-3096.

5. CERTIFICATIONS

Failure to indicate **Yes** to ALL of the certification items may result in denial of coverage under the general permit.

a) Certification of Understanding the Terms and Conditions of Construction General Permit (TXR150000)
Provisional coverage under the Construction General Permit (TXR150000) begins 7 days after the completed paper NOI is postmarked for delivery to the TCEQ. (Electronic applications submitted through ePermits have immediate provisional coverage). You must obtain a copy and read the Construction General Permit before submitting your application. You may view and print the Construction General Permit for which you are seeking coverage at the TCEQ web site: www.tceq.texas.gov/goto/construction

b) Certification of Legal Name
The full legal name of the applicant as authorized to do business in Texas is required. The name must be provided exactly as filed with the Texas Secretary of State (SOS), or on other legal documents forming the entity, that is filed in the county where doing business. You may contact the SOS at (512)463 5555, for more information related to filing in Texas.

c) Understanding of Notice of Termination
A permittee shall terminate coverage under this Construction General Permit through the submittal of a NOT when the operator of the facility changes, final stabilization has been reached, the discharge becomes authorized under an individual permit, or the construction activity never began at this site.

d) Certification of Stormwater Pollution Prevention Plan
The SWP3 identifies the areas and activities that could produce contaminated runoff at your site and then tells how you will ensure that this contamination is mitigated. For example, in describing your mitigation measures, your site's plan might identify the devices that collect and

ATTACHMENT 1 (pg. 18 of 20)

filter stormwater, tell how those devices are to be maintained, and tell how frequently that maintenance is to be carried out. You must develop this plan in accordance with the TCEQ general permit requirements. This plan must be developed and implemented before you complete this NOI. The SWP3 must be available for a TCEQ investigator to review on request.

Operator Certification:
The certification must bear an original signature of a person meeting the signatory requirements specified under 30 Texas Administrative Code (TAC) §305.44.

IF YOU ARE A CORPORATION:
The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(1) (see below). According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

IF YOU ARE A MUNICIPALITY OR OTHER GOVERNMENT ENTITY:
The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(3) (see below). According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statute(s) under which your government entity was formed. An NOI or similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to §305.44(a)(3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the Texas Commission on Environmental Quality's Environmental Law Division at (512)239-0600.

30 Texas Administrative Code
§305.44. Signatories to Applications

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

ATTACHMENT 1 (pg. 19 of 20)

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

ATTACHMENT 1 (pg. 20 of 20)

Texas Commission on Environmental Quality
General Permit Payment Submittal Form

Use this form to submit your Application Fee only if you are mailing your payment.

- Complete items 1 through 5 below:
- Staple your check in the space provided at the bottom of this document.
- Do not mail this form with your NOI form.
- Do not mail this form to the same address as your NOI.

Mail this form and your check to:

BY REGULAR U.S. MAIL
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
P.O. Box 13088
Austin, TX 78711-3088

BY OVERNIGHT/EXPRESS MAIL
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
12100 Park 35 Circle
Austin, TX 78753

Fee Code: GPA General Permit: TXR150000

1. Check / Money Order No: _____
2. Amount of Check/Money Order: _____
3. Date of Check or Money Order: _____
4. Name on Check or Money Order: _____
5. NOI INFORMATION

   If the check is for more than one NOI, list each Project/Site (RE) Name and Physical Address exactly as provided on the NOI. DO NOT SUBMIT A COPY OF THE NOI WITH THIS FORM AS IT COULD CAUSE DUPLICATE PERMIT ENTRIES.

   See Attached List of Sites (If more space is needed, you may attach a list.)

   Project/Site (RE) Name: _____

   Project/Site (RE) Physical Address:

Staple Check in This Space

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ATTACHMENT 2A

LARGE CONSTRUCTION SITE NOTICE

FOR THE
Texas Commission on Environmental Quality (TCEQ)
Storm Water Program

TPDES GENERAL PERMIT TXR150000

"PRIMARY OPERATOR" NOTICE

This notice applies to construction sites operating under Part II.E.3. of the TPDES General Permit Number TXR150000 for discharges of storm water runoff from construction sites equal to or greater than five acres, including the larger common plan of development. The information on this notice is required in Part III.D.2. of the general permit. This notice shall be posted along with a copy of the signed Notice of Intent (NOI), as applicable. Additional information regarding the TCEQ storm water permit program may be found on the internet at:

http://www.tceq.state.tx.us/nav/permits/sw_permits.html

Site-Specific TPDES Authorization Number:	
Operator Name:	
Contact Name and Phone Number:	
Project Description: *Physical address or description of the site's location, and estimated start date and projected end date, or date that disturbed soils will be stabilized.*	
Location of Storm Water Pollution Prevention Plan:	

ATTACHMENT 2B

SMALL CONSTRUCTION SITE NOTICE

FOR THE
Texas Commission on Environmental Quality (TCEQ)
Storm Water Program

TPDES GENERAL PERMIT TXR150000

The following information is posted in compliance with **Part II.E.2.** of the TCEQ General Permit Number TXR150000 for discharges of storm water runoff from small construction sites. Additional information regarding the TCEQ storm water permit program may be found on the internet at:

http://www.tceq.state.tx.us/nav/permits/wq_construction.html

Operator Name:	
Contact Name and Phone Number:	
Project Description: *Physical address or description of the site's location, estimated start date and projected end date, or date that disturbed soils will be stabilized*	
Location of Storm Water Pollution Prevention Plan:	

For Small Construction Activities Authorized Under Part II.E.2. (Obtaining Authorization to Discharge) the following certification must be completed:

I _____ (Typed or Printed Name Person Completing This Certification) certify under penalty of law that I have read and understand the eligibility requirements for claiming an authorization under Part II.E.2. of TPDES General Permit TXR150000 and agree to comply with the terms of this permit. A storm water pollution prevention plan has been developed and will be implemented prior to construction, according to permit requirements. A copy of this signed notice is supplied to the operator of the MS4 if discharges enter an MS4. I am aware there are significant penalties for providing false information or for conducting unauthorized discharges, including the possibility of fine and imprisonment for knowing violations.

Signature and Title_____ Date _____

_____*Date Notice Removed*
____*MS4 operator notified per Part II.F.3.*

ATTACHMENT 3

TPDES OPERATOR'S INFORMATION

Owner's Name and Address: City of _____

Mr. _____
(City Official)

_____

Address: _____

_____

_____

Phone: _____

Contractors' Names and Addresses:

General Contractor: _____

_____

_____

_____

Telephone: _____

Site Superintendent: _____

_____

_____

_____

Telephone: _____

Erosion Control and
Maintenance Inspection: _____

_____

_____

_____

Telephone: _____

Subcontractors' Names and Addresses:

_____ _____

_____ _____

_____ _____

_____ _____

Phone: _____ Phone: _____

Note: Insert name, address, and telephone number of person or firms

ATTACHMENT 4

CONTRACTOR'S / SUBCONTRACTOR'S

CERTIFICATION FOR TPDES PERMITTING

I certify under penalty of law that I understand the terms and conditions of the general Texas Pollutant Discharge Elimination System (TPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

ATTACHMENT 5

EPA NPDES Construction Inspection Form

The following inspection is being performed in compliance with Part 3.10. of the NPDES Region 6 Storm Water Construction General Permit [68 FR 39087, July 7, 2003]. Qualified personnel (provided by the permittee or cooperatively by multiple permittees) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, placement and effectiveness of structural control measures, and locations where vehicles enter or exit the site. Inspections shall be performed either once every 7 days (this option not available in New Mexico per Part 9.C.1.c.) or once every 14 days and within 24 hours of the end of a storm event of 0.5 inches or greater. Where sites have been temporarily stabilized, runoff is unlikely due to winter conditions, or during seasonal arid periods in arid areas (0-10 inches of rainfall annually) and semi-arid areas (10-20 inches annually) such inspections shall be conducted at least once every month. This form is primarily intended for use with construction projects in New Mexico. Permittees on Indian Country lands in Texas, Oklahoma, Louisiana and Arkansas and some oil and gas facilities in Texas and Oklahoma may use this form if they are eligible for this permit and EPA is their NPDES permitting authority. Other facilities need to check with their NPDES authority before using this form.

If you do not know your NPDES Permit Number, contact the NOI Processing Center at 866-352-7755. This form was prepared as an example and it is not a required form for use with the permit. Alternative forms may be used if they contain all of the required information as set forth in the permit. This form and additional information regarding the NPDES Region 6 storm water program may be found on the Internet at www.epa.gov/region6/6en/w/formsw.htm. Any person with a complaint about the operation of this facility in regards to this permit should contact EPA Region 6 at (214)665-8060.

Permit Number(s) covered by this inspection (e.g., owners, developers, general contractor, builders).	
Signature and Certification in accordance with Appendix G, Section 11 of the permit.	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. (Clean Water Act, 33 U.S.C. 1251 et seq.)
Date of Inspection.	
Inspector Name.	
Is there a copy of the permit language with the SWPPP?	❑ **Yes** ❑ **No**
Is the inspector qualified and are the qualifications documented in the SWPPP?	❑ **Yes** ❑ **No**
Is an NPDES storm water construction sign posted at the entrance for all permittees?	❑ **Yes** ❑ **No**

You may want to use EPA Region 6 construction checklist to assure components of the SWPPP are complete. This form, the construction sign, and the checklist are available on the Region 6 NPDES Storm Water Forms and Documents web page which may be found on the internet at http://www.epa.gov/earth1r6/6en/w/formsw.htm In addition to the checklist, you should provide a narrative (see next page) on the existing Best Management Practices and Structural Controls found during each inspection. Any problems identified in an inspection should be corrected within 7 days. The inspection should cover all components of the SWPPP and all potential pollutants. While eroded soil is the primary pollutant of concern, do not forget to inspect for other pollutant sources such as fuel tanks, paints, solvents, stabilization materials, concrete hardner, batch plants, and construction debris. The inspector will need to update the SWPPP to reflect findings of the inspection. The site map should be updated after an inspection to show controls that have been added or removed, to ensure the site map is kept current in accordance with Part 3.11.A. of the permit.

July 29, 2003

Narrative Findings of the inspection:

Observations should include any findings of Best Management Practices or controls that are not in accordance with the SWPPP. If a control is not in place or failed, observe the reason why. A control removed temporarily for work is not necessarily a violation if properly recorded in the SWPPP. If it has been removed, record why it was removed and, if applicable, when it will be reinstalled. If the control has failed, observe the conditions so a conclusion may be made as to wether the control failed for improper maintenance or improper design. The qualified inspector will know when a failed control is inadequate and should be replaced by an improved control mechanism. Qualified inspectors are to have authority to make changes to the SWPPP to assure compliance. Controls that have not been installed should be given a reason why they are not installed and/or a scheduled date for installation if they are designed for a later phase of construction. After the inspection, the SWPPP and its site map should be updated to reflect current conditions of controls and Best Management Practices at the time of the inspection. This includes removing uninstalled controls from the site map or otherwise denoting on the site map if they are no longer installed if the controls have been removed because they are no longer necessary (e.g., stabilization has been achieved in that area).

Part 3.10.G. of the permit: For each inspection required above, you must complete an inspection report. At a minimum, the inspection report must include: 1. The inspection date; 2. Names, titles, and qualifications of personnel making the inspection; 3. Weather information for the period since the last inspection (or since commencement of construction activity if the first inspection) including a best estimate of the beginning of each storm event, duration of each storm event, approximate amount of rainfall for each storm event (in inches), and whether any discharges occurred; 4. Weather information and a description of any discharges occurring at the time of the inspection; 5. Location(s) of discharges of sediment or other pollutants from the site; 6. Location(s) of BMPs that need to be maintained; 7. Location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location; 8. Location(s) where additional BMPs are needed that did not exist at the time of inspection; and 9. Corrective action required including any changes to the SWPPP necessary and implementation dates.

July 29, 2003

EROSION CONTROL CONTRACTOR'S

CERTIFICATION FOR INSPECTION AND MAINTENANCE

I certify under penalty of law that I understand the terms and conditions of the general Texas Pollutant Discharge Elimination System (TPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

Signature: _____

Name: (printed or typed) _____

Title: _____

Company _____

Address: _____

_____

Date: _____

ATTACHMENT 7

TCEQ

Notice of Termination (NOT) for Authorizations under TPDES General Permit TXR150000

TCEQ Office Use Only
Permit No.:
RN:
CN:

Reset Form

Sign up now for on line NOT at http://www.tceq.state.tx.us/permitting/steers/steers.html
Get your NOT Confirmation letter immediately after submitting the on line NOT form.

What is the permit number to be terminated?
Processing will be delayed without the permit number. TXR15_____

A. OPERATOR (applicant)

1. What is the Customer Number (CN) issued to this entity? **CN**_____
2. What is the full Legal Name of the current permittee?

This must be the current permittee of the permit to be terminated.

3. What is the applicant's mailing address as recognized by the **US Postal Service**?

Address:	Suite No./Bldg. No./Mail Code:	
City:	State:	ZIP Code:
Country Mailing Information (if outside USA).	Country Code:	Postal Code:

4. Phone No.: ( )	Extension:
5. Fax No.: ( )	E-mail Address:

B. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

1. What is the TCEQ Issued RE Reference Number (RN)? **RN**_____
2. Name of Project or Site as currently permitted):

(example: phase and name of subdivision or name of project that's unique to the site)

3. Physical Address of Project or Site as currently permitted: (enter in spaces below)

Street Number:	Street Name:	
City:	ZIP Code:	County (Counties if >1):

4. If no physical address (Street Number & Street Name), provide the written location access description to the site:

C. REASON FOR TERMINATION

Check the reason for termination:

- ☐ Final stabilization has been achieved on all portions of the site that are the responsibility of the Operator and all silt fences and other temporary erosion controls have either been removed, or scheduled for removal as defined in the SWP3.
- ☐ Another permitted Operator has assumed control over all areas of the site that have not been finally stabilized, and temporary erosion controls that have been defined in the SWP3 have been transferred to the new Operator.
- ☐ The activity is now authorized under an alternate TPDES permit.
- ☐ The activity never began at this site that is regulated under the general permit.

D. CERTIFICATION

I, _____ _____
Typed or printed name Title

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I further certify that I am authorized under **30 Texas Administrative Code §305.44** to sign and submit this document, and can provide documentation in proof of such authorization upon request.

Signature:_____ Date:_____
(Use blue ink)

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ATTACHMENT 7

Notice of Termination (NOT) for Authorizations under TPDES General Permit TXR150000 General Information and Instructions

GENERAL INFORMATION

Where to Send the Notice of Intent (NOI):

BY REGULAR U.S. MAIL
Texas Commission on Environmental Quality
Storm Water Processing Center (MC228)
P.O. Box 13087
Austin, TX 78711-3087

BY OVERNIGHT/EXPRESS MAIL
Texas Commission on Environmental Quality
Storm Water Processing Center (MC228)
12100 Park 35 Circle
Austin, TX 78753

TCEQ Contact list:

Application Processing Questions relating to the status and form requirements:	512/239-4671
Technical Questions relating to the general permit:	512/239-4671
Environmental Law Division:	512/239-0600
Records Management for obtaining copies of forms submitted to TCEQ:	512/239-0900
Information Services for obtaining reports from program data bases (as available):	512/239-DATA (3282)
Financial Administration's Cashier's office:	512/239-0357 or 512/239-0187

Notice of Termination Process:

A Notice of Termination is **effective on the date postmarked for delivery to TCEQ**.
When your NOT is received by the program, the form will be processed as follows:

1. **Administrative Review:** The form will be reviewed to confirm the following:
   - the permit number is provided
   - the permit is active and has been approved
   - the entity terminating the permit is the current permittee
   - the site information matches the original permit record
   - the form has the required original signature with title and date

2. **Notice of Deficiency:** If an item is incomplete or not verifiable as indicated above, a phone call will be made to the applicant to clear the deficiency. A letter will not be sent to the permittee if unable to process the form.

3. **Confirmation of Termination:** A Notice of Termination Confirmation letter will be mailed to the operator.

General Permit (Your Permit)
Coverage under the general permit begins **48 hours after a completed NOI is postmarked for delivery to** the TCEQ. You should have a copy of your general permit when submitting your application. You may view and print your permit for which you are seeking coverage, on the TCEQ web site www.tceq.state.tx.us

General Permit Forms
The Notice of Intent (NOI), Notice of Termination (NOT), and Notice of Change (NOC) with instructions are available in Adobe Acrobat PDF format on the TCEQ web site www.tceq.state.tx.us.

Change in Operator
An authorization under the general permit is not transferable. If the operator or owner of the regulated entity changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted not later than 10 days prior to the change in Operator status.

TCEQ Central Registry Core Data Form
The Core Data Form has been incorporated into this form. **Do not send a core data form to TCEQ.**

After final acknowledgment of coverage under the general permit, the program will assign a Customer Number (CN) and Regulated Entity Number (RN). For Construction Permits, a new RN will be assigned for each Notice of Intent filed with TCEQ, since construction project sites can overlap with other Customers. The RN assigned to your construction project will not be assigned to any other TCEQ authorization.

You can find the information on the Central Registry web site at https://www6.tceq.state.tx.us/epay/. You can search by the Regulated Entity (RN), Customer Number (CN) or Name (Permittee), or by your permit number under the search field labeled "Additional ID" Capitalize all letters in the permit number.

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ATTACHMENT 7

The Customer (Permittee) is responsible for providing consistent information to the TCEQ, and for updating all CN and RN data for all authorzations as changes occur. For General Permits, a Notice of Change form must be submitted to the program area.

Annual Water Quality Fee: This fee is assessed to operators with an active authorization under the general permit on September 1 of each year. The operator will receive an invoice for payment of the annual fee in November of each year. The payment will be due 30 days from the invoice date. A 5% penalty will be assessed if the payment is received by TCEQ after the due date. Annual fee assessments cannot be waived as long as the authorization under the general permit is active on September 1.

It's important for the operator to submit a **Notice of Termination** (NOT) when coverage under the general permit is no longer required. A NOT is effective on the postmarked date of mailing the form to TCEQ. It is recommended that the NOT be mailed using a method that documents the date mailed and received by TCEQ.

- Mailed Payments:

You must return your payment with the billing coupon provided with the billing statement.

- ePAY Electronic Payment:

Go to https://www6.tceq.state.tx.us/epay/
You must enter your account number provided at the top portion of your billing statement. Payment methods include Mastercard, Visa, and electronic check payment (ACH). A transaction over $500 can only be made by ACH.

INSTRUCTIONS FOR FILLING OUT THE NOT FORM

A. OPERATOR (current permittee:)

1. TCEQ Issued Customer Number (CN)

2. Legal Name of Operator
The operator must be the same entity as previously submitted on the original Notice of Intent for the permit number provided.

3. Operator Mailing Address
Provide a complete mailing address for receiving mail from the TCEQ. Update the address if different than previously submitted in the Notice of Intent or Notice of Change.

4. Phone Number, Fax Number, and E-mail Address
Provide updated contact information.

B. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

1. Regulated Entity Reference Number (RN)

2. Site/Project Name/Regulated Entity
Provide the name of the site as previously submitted in the Notice of Intent for the permit number provided.

3. Site/Project (RE) Physical Address
Provide the physical address or location access description as previously submitted for the permit number provided.

C. REASON FOR TERMINATION

Indicate the reason for terminating the permit by checking one of the options. If the reason is not listed then provide an attachment that explains the reason for termination.

Please read your general permit carefully to determine when to terminate your permit. Permits will not be reactivated after submitting a termination form. The termination is effective on the date postmarked for delivery to TCEQ.

D. CERTIFICATIONS

The certification must bear an original signature of a person meeting the signatory requirements specified under 30 Texas Administrative Code (TAC) §305.44.

IF YOU ARE A CORPORATION:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(1) (see below). According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

IF YOU ARE A MUNICIPALITY OR OTHER GOVERNMENT ENTITY:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(3) (see below). According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statute(s) under which your government entity was formed. An NOI or similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to

ATTACHMENT 7

§305.44(a)(3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the Texas Commission on Environmental Quality's Environmental Law Division at 512/239-0600.

30 Texas Administrative Code
§305.44. Signatories to Applications.

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

TCEQ-20023 Instructions (02/06/2007) Page 3

END OF SECTION

SECTION 01566

SOURCE CONTROLS FOR EROSION AND SEDIMENTATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Description of erosion and sediment control and other control-related practices which shall be utilized during construction activities.

1.02 UNIT PRICES

A. Unless indicated in the bid proposal as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items of which this work is a component.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than site work specifically directed by the engineer to allow soil testing and surveying.

B. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately by the Contractor.

C. The Contractor shall be responsible for collecting, storing, hauling, and disposing of spoil, silt, and waste materials as specified in this or other Specifications and in compliance with applicable federal, state, and local rules and regulations.

D. Contractor shall conduct all construction operations under this Contract in conformance with the erosion control practices described in the Drawings and this Specification.

E. The Contractor shall install, maintain, and inspect erosion and sediment control measures and practices as specified in the Drawings and in this or other Specifications.

3.02 TOPSOIL PLACEMENT FOR EROSION AND SEDIMENT CONTROL SYSTEMS

A. When topsoil is specified as a component of another Specification, the Contractor shall conduct erosion control practices described in this Specification during topsoil placement operations.

1. When placing topsoil, maintain erosion and sediment control systems, such as swales, grade stabilization structures, berms, dikes, silt fences, and sediment basins.

2. Maintain grades which have been previously established on areas to receive topsoil.

3. After the areas to receive topsoil have been brought to grade, and immediately prior to dumping and spreading the topsoil, loosen the subgrade by discing or by scarifying to a depth of at least 2 inches to permit bonding of the topsoil to the subsoil.

3.03 DUST CONTROL

A. Implement dust control methods to control dust creation and movement on construction sites and roads and to prevent airborne sediment from reaching receiving streams or storm water conveyance systems, to reduce on-site and off-site damage, to prevent health hazards, and to improve traffic safety.

B. Control blowing dust by using one or more of the following methods:

1. Mulches bound with chemical binders.

2. Temporary vegetative cover.

3. Tillage to roughen surface and bring clods to the surface.

4. Irrigation by water sprinkling.

5. Barriers using solid board fences, burlap fences, crate walls, bales of hay, or similar materials.

C. Implement dust control methods immediately whenever dust can be observed blowing on the project site.

3.04 KEEPING STREETS CLEAN

A. Keep streets clean of construction debris and mud carried by construction vehicles and equipment. If necessary to keep the streets clean, install stabilized construction exits at construction, staging, storage, and disposal areas. A vehicle/equipment wash area (stabilized with coarse aggregate) may be installed adjacent to the stabilized construction exit, as needed. Release wash water into a drainage swale or inlet protected by erosion and sediment control measures.

B. In lieu of or in addition to stabilized construction exits, shovel or sweep the pavement to the extent necessary to keep the street clean. Waterhosing or sweeping of debris and mud off of the street into adjacent areas is not allowed.

3.05 EQUIPMENT MAINTENANCE AND REPAIR

A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose. Locate such areas so that oils, gasoline, grease, solvents, and other potential pollutants cannot be washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid as well as solid waste. Clean and inspect maintenance areas daily.

B. On a construction site where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.06 WASTE COLLECTION AND DISPOSAL

A. Contractor shall formulate and implement a plan for the collection and disposal of waste materials on the construction site. In plan, designate locations for trash and waste receptacles and establish a collection schedule. Methods for ultimate disposal of waste shall be specified and carried out in accordance with applicable local, state, and federal health and safety regulations. Make special provisions for the collection and disposal of liquid wastes and toxic or hazardous materials.

B. Keep receptacles and waste collection areas neat and orderly to the extent possible. Waste shall not be allowed to overflow its container or accumulate from day-to-day. Locate trash collection points where they will least likely be affected by concentrated storm water runoff.

3.07 WASHING AREAS

A. Vehicles such as concrete delivery trucks or dump trucks and other construction equipment shall not be washed at locations where the runoff will flow directly into a watercourse or storm water conveyance system. Designate special areas for washing vehicles. Locate these areas where the wash water will spread out and evaporate or infiltrate directly into the ground, or where the runoff can be collected in a temporary holding or seepage basin. Beneath wash areas construct a gravel or rock base to minimize mud production.

3.08 STORAGE OF CONSTRUCTION MATERIALS AND CHEMICALS

A. Isolate sites where chemicals, cements, solvents, paints, or other potential water pollutants are stored in areas where they will not cause runoff pollution.

B. Store toxic chemicals and materials, such as pesticides, paints, and acids in accordance with manufacturers' guidelines. Protect groundwater resources from leaching by placing a plastic mat, packed clay, tar paper, or other impervious materials on any areas where toxic liquids are to be opened and stored.

3.09 DEMOLITION AREAS

A. Demolition activities which create large amounts of dust with significant concentrations of heavy metals or other toxic pollutants shall use dust control techniques to limit transport of airborne pollutants. However, water or slurry used to control dust contaminated with heavy metals or toxic pollutants shall be retained on the site and shall not be allowed to run directly into watercourses or storm water conveyance systems. Methods of ultimate disposal of these materials shall be carried out in accordance with applicable local, state, and federal health and safety regulations.

3.10 SANITARY FACILITIES

A. Provide the construction sites with adequate portable toilets for workers in accordance with Section 01500 - Temporary Facilities and Controls, and applicable health regulations.

3.11 PESTICIDES

A. Use and store pesticides during construction in accordance with manufacturers' guidelines and with local, state, and federal regulations. Avoid overuse of pesticides which could produce contaminated runoff. Take great care to prevent accidental spillage. Never wash pesticide containers in or near flowing streams or storm water conveyance systems.

END OF SECTION

SECTION 01567

FILTER FABRIC FENCE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of erosion and sediment control filter fabric fences used during construction and until final development of the site. The purpose of filter fabric fences is to contain pollutants from overland flow. Filter fabric fences are not for use in channelized flow areas.

1.02 UNIT PRICES

A Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Manufacturer's catalog sheets and other product data on geotextile fabric.

PART 2 P R O D U C T S

2.01 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric shall have a grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140.

C. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.

D. Representative Manufacturer: Mirafi, Inc., or equal.

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. Provide erosion and sediment control systems at the locations shown on Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than site work specifically directed by the Engineer to allow soil testing and surveying.

C. Regularly inspect and repair or replace damaged components of filter fabric fences as specified in this Section. Unless otherwise directed, maintain the erosion and sediment control systems until the project area stabilization is accepted by the Owner. Remove erosion and sediment control systems promptly when directed by the Engineer. Discard removed materials off site.

D. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at a location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

E. Conduct all construction operations under this Contract in conformance with the erosion control practices described in Section 01566 - Source Controls for Erosion and Sedimentation.

3.02 CONSTRUCTION METHODS

A. Provide filter fabric fence systems in accordance with the Drawing detail for Filter Fabric Fences. Filter fabric fences shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the filter fabric to 2-inch by 2-inch wooden stakes spaced a maximum of 3 feet apart and embedded a minimum of 8 inches. If filter fabric is factory preassembled with support netting, then maximum spacing allowable is 8 feet. Install wooden stakes at a slight angle toward the source of anticipated runoff.

C. Trench in the toe of the filter fabric fence with a spade or mechanical trencher as shown on the Drawings. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.

E. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

F. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately. Remove sediment deposits when silt reaches a depth one-third the height of the fence or 6 inches, whichever is less.

END OF SECTION

SECTION 01568

REINFORCED FILTER FABRIC BARRIER

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of reinforced filter fabric barriers for erosion and sediment control used during construction and until the final development of the site. Reinforced filter fabric barriers are used to retain sedimentation in channelized flow areas.

1.02 UNIT PRICES

A. Unless indicated in the Bid Proposal as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items of which this work is a component.

1.03 SUBMITTALS

A. Manufacturer's catalog sheets and other product data on geotextile fabrics.

PART 2 P R O D U C T S

2.01 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric shall have a minimum grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140.

C. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.

D. Representative Manufacturers: Mirafi, Inc., or equal.

2.02 FENCING

A. Provide woven galvanized steel wire fence with minimum thickness of 14 gauge and a maximum mesh spacing of 6 inches.

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. Provide erosion and sediment control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Engineer to allow soil testing and surveying.

C Regularly inspect and repair or replace damaged components of the reinforced filter fabric barrier as specified in this Section. Unless otherwise directed, maintain the erosion and sediment control systems until the project area stabilization is accepted by the Owner. Remove erosion and sediment control systems promptly when directed by the Engineer. Discard removed materials off site.

D. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at a location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

E. Conduct all construction operations under this Contract in conformance with the erosion control practices described in Section 01566 - Source Controls for Erosion and Sedimentation.

3.02 CONSTRUCTION METHODS

A. Provide filter fabric barriers in accordance with the Drawing detail for Reinforced Filter Fabric Barrier. Filter fabric barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the woven wire support to 2-inch by 2-inch wooden stakes spaced a maximum of 6 feet apart and embedded a minimum of 8 inches. Install wooden stakes at a slight angle toward the source of the anticipated runoff.

C. Trench in the toe of the filter fabric barrier with a spade or mechanical trencher as shown on the Drawings. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Securely fasten the filter fabric material to the woven wire with tie wires.

E. Reinforced filter fabric barrier shall have a minimum height of 18 inches.

F. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

G. Inspect the reinforced filter fabric barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately. Remove sediment deposits when silt reaches a depth one-third the height of the barrier or 6 inches, whichever is less.

H. Remove erosion and sediment control systems at end of construction.

END OF SECTION

SECTION 01569

STABILIZED CONSTRUCTION EXIT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of erosion and sediment control for stabilized construction exits used during construction and until final development of the site.

1.02 SUBMITTALS

A. Manufacturer's catalog sheets and other product data on geotextile fabric.

B. Sieve analysis of aggregates conforming to requirements of this Specification.

1.03 UNIT PRICES

A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.

PART 2 P R O D U C T S

2.01 GEOTEXTILE FABRIC

A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric shall have a minimum grab strength of 270 psi in any principal direction (ASTM D-4632), and the equivalent opening size between 50 and 140.

C. Both the geotextile and threads shall be resistant to chemical attack, mildew, and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable life at a temperature range of 0ºF to 120ºF.

D. Representative Manufacturers: Mirafi, Inc., or equal.

2.02 COARSE AGGREGATES

A. Coarse aggregate shall consist of crushed stone, gravel, crushed concrete, or a combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, rebar, shale, soft or flaky materials, or organic and injurious matter.

B. Coarse aggregates shall conform to the following gradation requirements.

Sieve Size (Square Mesh)	Percent Retained (By Weight)
2-1/2”	0
2”	0 – 20
1-1/2”	15 – 50
¾”	60 – 80
No. 4	95 - 100

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. If necessary to keep the street clean of mud carried by construction vehicles and equipment, Contractor shall provide stabilized construction roads and exits at the construction, staging, parking, storage, and disposal areas. Such erosion and sediment controls shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner’s Representative to allow soil testing and surveying.

C. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by the Owner’s Representative to remove and discard the existing system.

D. Regularly inspect and repair or replace components of stabilized construction exits. Unless otherwise directed, maintain the stabilized construction roads and exits until the project is accepted by the City. Remove stabilized construction roads and exits promptly when directed by the Owner’s Representative. Discard removed materials off site.

E. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at a permitted location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

F. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.

G. Conduct all construction operations under this Contract in conformance with the erosion control practices described in the relevant sections of these specifications.

3.02 CONSTRUCTION METHODS

A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.

B. Provide stabilized construction exits, and truck washing areas when approved by Owner's Representative, of the sizes and locations where shown on Drawings or as specified in this Section.

C. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas which drain into a drainage system protected by erosion and sediment control measures.

D. Details for stabilized construction exit may be shown on the Drawings. Construction of all other stabilized areas shall be to the same requirements. Roadway width shall be at least 14 feet for one-way traffic and 20 feet for two-way traffic and shall be sufficient for all ingress and egress. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlaying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of 14 days to minimize damage potential.

E. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering public right-of-way, receiving stream or storm water conveyance system.

F. The stabilized areas shall be inspected and maintained daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged control measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.

G. The length of the stabilized area may be as shown on the Drawings, but not less than 50 feet. The thickness shall not be less than 8 inches. The width shall not be less than full width of all points of ingress or egress.

H. Stabilization for other areas shall have the same coarse aggregate, thickness, and width requirements as the stabilized construction exit, except where shown otherwise on the Drawings.

I. Stabilized area may be widened or lengthened to accommodate truck washing area when authorized by Owner's Representative.

J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by the Owner's Representative. These methods include the following:

1. Cement-Stabilized Soil - Compacted cement-stabilized soil or other fill material in an application thickness of at least 8 inches.

2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge-to-edge and across support wooden beams which are placed on top of existing soil in an application thickness of at least 6 inches.

3. Steel Mats - Perforated mats placed across perpendicular support members.

END OF SECTION

SECTION 01570

TRAFFIC CONTROL AND REGULATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Requirements for signs, signals, control devices, flares, lights and traffic signals, as well as construction parking control, designated haul routes and bridging of trenches and excavations.

B. Qualifications and requirements for use of flagmen.

1.02 SUBMITTALS

A. Make submittals in accordance with Section 01300 - Submittals

1.03 UNIT PRICES

A. Refer to Section 01025 – Measurement and Payment for unit price.

1.04 FLAGMEN

A. Use only flagmen who are off-duty, regularly employed, uniformed peace officers. The Contractor may also utilize certified flagmen at locations approved by the City or Engineer.

B. Use flagmen to control, regulate and direct an even flow and movement of vehicular and pedestrian traffic, for periods of time as may be required to provide for public safety and convenience, where:

1. Where multi-lane vehicular traffic must be diverted into single-lane vehicular traffic.

2. Where vehicular traffic must change lanes abruptly.

3. Where construction equipment either enters or crosses vehicular traffic lanes and walks.

4. Where construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalks.

5. Where traffic regulation is needed due to rerouting of vehicular traffic around the work site.

6. Where construction activities might affect public safety and convenience.

C. The use of flagmen is for the purpose of assisting in the regulation of traffic flow and movement, and does not in any way relieve the contractor of full responsibility for taking such other steps and provide such other flagmen or personnel as the Contractor may deem necessary to protect the work and the public, and does not in any way relieve the Contractor of his responsibility for any damage for which he would otherwise be liable.

Flagmen shall be used and maintained at such points for such periods of time as may be required to provide for the public safety and convenience of travel.

PART 2 P R O D U C T S

2.01 SIGNS, SIGNALS, AND DEVICES

A. Comply with Texas State Manual on Uniform Traffic Control Devices (latest revision).

B. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.

PART 3 E X E C U T I O N

3.01 PUBLIC ROADS

A. Abide by laws and regulations of governing authorities when using public roads. If the Contractor's work requires that public roads be temporarily impeded or closed, approvals shall be obtained from governing authorities and permits paid for before starting any work. Coordinate activities with the Engineer.

B. Give Engineer one-week notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.

C. Notify police department, fire department, and local schools, churches, and businesses in writing a minimum of five business days prior to beginning work.

D. Contractor shall maintain at all times a 10-foot-wide all-weather lane adjacent to work areas which shall be kept free of construction equipment and debris and shall be for the use of emergency vehicles, or as otherwise provided in the traffic control plan.

E. Contractor shall not obstruct the normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by the Engineer.

F. Contractor shall maintain local driveway access to residential and commercial properties adjacent to work areas at all times. Use all-weather materials approved by Engineer to maintain temporary driveway access to commercial and residential driveways. The Contractor shall also give special consideration to maintain access by constructing temporary driveway pavement for schools, apartment complex, day care facilities, hospitals, clinics, retirement and assisted living facilities.

G. Cleanliness of Surrounding Streets:

1. Keep streets used for entering or leaving the job area free of excavated material, debris, and any foreign material resulting from construction operations in compliance with applicable ordinances.

H. Remove existing signage and striping that conflict with construction activities or that may cause driver confusion.

I. Provide safe access for pedestrians along major cross streets.

J. Alternate closures of cross streets so that two adjacent cross streets are not closed simultaneously.

K. Do not close more than two consecutive esplanade openings at a time without prior approval from Engineer.

3.02 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the City's operations.

B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.

C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.03 FLARES AND LIGHTS

A. Provide flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.04 HAUL ROUTES

A. Utilize haul routes designated by authorities or shown on the Drawings for construction traffic.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.05 TRAFFIC SIGNS AND SIGNALS

A. Construct all necessary traffic control devices including but not limited to loop detectors, traffic signal conduits, traffic signal wiring and cross walk signals as shown on the plan drawings.

B. Install traffic control devices at approaches to the site and on site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

C. Relocate traffic signs and appurtenances as Work progresses to maintain effective traffic control.

D. Unless otherwise approved by Engineer, provide driveway signs with the name of business that can be accessed from the particular cross-over. Two signs will be required for each cross-over.

E. Replace existing traffic control devices in the project area.

F. Engineer may direct Contractor to make adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the City.

G. Repair or replace signal control devices, detectors or cables where damage occurred due to Contractors construction efforts or operation of equipment related to paving repairs or removal.

3.06 BRIDGING TRENCHES AND EXCAVATIONS

A. Whenever necessary, bridge trenches and excavation to permit an unobstructed flow of traffic. Provide steel plates that can be laid across construction areas and major drives of commercial businesses.

B. Secure bridging against displacement by using adjustable cleats, angles, bolts or other devices whenever bridge is installed:

1. On an existing bus route;

2. When more than five percent of daily traffic is comprised of commercial or truck traffic;

3. When more than two separate plates are used for the bridge; or

4. When bridge is to be used for more than five consecutive days.

C. Install bridging to operate with minimum noise.

D. Adequately shore the trench or excavation to support bridge and traffic.

E. Extend steel plates used for bridging a minimum of one foot beyond edges of trench or excavation. Use temporary paving materials (premix) to feather edges of plates to minimize wheel impact on secured bridging.

F. Use steel plates of sufficient thickness to support H-20 loading, truck or lane, that produces maximum stress.

3.07 REMOVAL

A. Remove equipment and devices when no longer required.

B. Repair damage caused by installation.

C. Remove post settings to a depth of 2 feet.

3.08 MAINTENANCE OF EQUIPMENT AND MATERIAL

A. Designate individual to be responsible for maintenance of traffic handling around construction area. This individual must be accessible at all times to immediately correct any deficiencies in equipment and materials used to handle traffic, such as missing, damaged, or obscured signs, drums, barricades, or pavement markings. Give name, address and telephone number of designated individual to the Engineer.

B. Make daily inspections of signs, barricades, drums, lamps and temporary pavement markings to verify that these are visible, and in good working order, and in conformance with TxDOT or any other entity. When not in conformance immediately bring equipment and materials into conformance by replacement, repair, cleaning, relocation, and/or realignment.

C. Keep all equipment and materials, especially signs and pavement markings, clean and free of dust, dirt, grime, oil, mud or debris.

END OF SECTION

SECTION 01571

INLET PROTECTION BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnishing, installing, maintaining and removing temporary erosion protection and sediment control inlet protection barriers.

B. The inlet protection barrier consists of a geotextile fabric (filter fabric) supported by a net reinforced face structure around an inlet.

C. Alternate design of the inlet protection barrier, as approved by the Engineer, consists of fiber rolls placed around a frame, staked in place (or weighted down by clean gravel bags) and constructed around an inlet.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

PART 2 PRODUCTS

2.01 GEOTEXTILE FABRIC

A. The geotextile fabric (filter fabric) shall consist of large chain synthetic polymers composed of at least 95 percent by weight of polyolefins in a woven fabric.

B. The geotextile fabric shall meet the following specifications:

(See Following Page for Table)

Table 1 Silt Fence Geotextile Fabric Properties			**Requirements** **Unsupported Silt Fence**	
	Units	Supported Silt Fence	Geotextile Elongation ∃50%	Geotextile Elongation <50%
Grab Strength				
Machine Direction	lbs.	90	123	123
X-Machine Direction	lbs.	90	100	100
Permittivity	sec^{-1}	0.05	0.05	0.05
Apparent Opening Size (maximum average roll value)	mm/sieve	0.6/30	0.6/30	0.6/30
Ultraviolet Stability (Retained Tensile Strength)	%	70 after 500 hrs exposure	70 after 500 hrs exposure	70 after 500 hrs exposure

NOTES:
1. Table 1 adapted from AASHTO M 288 *Geotextile Specification for Highway Applications* Table 6. Temporary Silt Fence Property Requirements.
2. All numeric values in Table 1 except Apparent Opening Size (AOS) represent minimum average roll values (MARV). Values for AOS represent maximum average roll values.

C. Geotextile fabric shall contain stabilizers and/or inhibitors to make the fabric resistant to deterioration resulting from exposure to sunlight or heat and shall be resistant to commonly encountered soil chemicals, mildew, rot and insects.

D. Geotextile fabric shall be free of defects or flaws that affect its physical and/or filtering properties.

E. Geotextile fabric shall provide an expected useable life comparable to the anticipated construction period.

2.02 POST

A. Posts shall be either steel or hardwood, essentially straight, with a minimum length of 4-feet.

B. Support beams shall be either steel or hardwood and essentially straight.

C. Hardwood posts and support beams shall be 2-inch x 2-inch minimum or equivalent.

D. Metal posts and support beams shall be either studded T or U steel type with a minimum weight of 1.28 lbs per linear foot.

E. Fin anchors shall be used to resist post movement as directed by the Engineer.

2.03 FABRIC MESH

A. Net reinforced fence shall be 2-inch by 4-inch welded wire fabric mesh.

B. The mesh support height shall be the equivalent height, or greater, of the geotextile fabric to be attached.

C. Plastic grid mesh or other support mesh may be substituted for welded wire mesh as approved by the Engineer.

2.04 ATTACHMENT

A. Attachment of net reinforced fence and geotextile fabric shall be with wire ties, staples, or shoat rings.

B. Wire ties shall be 14 gage minimum.

C. Staples shall be no. 9 minimum with a 2 inch minimum crown length.

D. Shoat rings shall be galvanized.

2.05 ALTERNATES

A. A prefabricated unit with geotextile fabric, posts, supports and wire mesh meeting the minimum specifications may be used in lieu of a constructed inlet protection barrier.

B. Fiber roll material for inlet protection barrier alternative design shall be as approved by the Engineer.

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

A. No clearing and grubbing or rough cutting, other than specifically directed by the Engineer to allow for soil testing, surveying and installation of erosion protection and sediment control measures, shall be permitted until sediment control and erosion protection systems are in place.

B. Inlet protection barriers shall be installed at locations shown on the drawings and in accordance with the details in the drawings.

C. Inlet protection barriers shall be constructed in accordance with an approved schedule that clearly describes the timing during the construction process that the various erosion control measures will be implemented.

D. Inlet protection barriers shall be installed so surface run-off will percolate through the system and allow sediment to be retained and accumulated.

E. The Contractor shall inspect the inlet protection barriers at least once every fourteen calendar days, within 24 hours of the end of a storm event of 0.5-inches of rainfall or greater and during daily prolonged rainfalls. Contractor shall remove irregularities which will impede normal flow. Erosion protection and sediment control systems shall be maintained by the Contractor until final stabilization. Damage caused to erosion protection and sediment control systems shall be repaired immediately.

F. The Contractor is responsible for removal and proper disposal of sediment and debris from the inlet protection barrier system and as directed by the Engineer. Sediment and debris shall not be allowed to flush into the storm sewer system, waterways and jurisdictional wetlands, or onto adjacent properties. Sediment deposits shall be removed before they reach one-third of the height of the inlet protection barrier.

G. Uncontaminated sediment can be placed at the project spoil site or, if properly handled, spread out to supplement fill requirements. The Engineer will designate how the sediment deposits are to be handled. Uncontaminated sediment shall not be placed in waterways or jurisdictional wetlands. If sediment has been contaminated, then it shall be disposed of in accordance with the applicable federal, state and local regulations. Off-site disposal shall be the responsibility of the Contractor.

H. After final stabilization, at the direction of the Engineer, the Contractor shall be responsible for removing all erosion protection and sediment control systems that are not permanent for the project.

3.02 CONSTRUCTION METHODS

A. Posts
1. Shall be driven a minimum depth of 1-foot into the ground.
2. Shall be a minimum 18" above the ground.
3. Shall be placed with a maximum spacing of 4-feet.
4. Horizontal support beams shall be securely attached from post to post and no higher than the top of the filtering material.

B. Trench
1. Shall be dug along the upstream side of the barrier to anchor at least 8-inches of the

geotextile fabric to prevent underflow.

2. Trench shall be a 6-inch by 6-inch square, or a 4-inch deep V-trench.

C. Net Reinforced Fence
   1. Shall be attached to the posts.
   2. Attachment shall be at the top and mid-section.
   3. Additional ties or staples shall be added to secure the net reinforced fence to the posts as directed by the Engineer.

D. Geotextile Fabric
   1. Shall be placed against the side of the trench with approximately 2-inches across the bottom in the upstream direction.
   2. Shall be attached to the net reinforced fence with wire ties or shoat rings. Fabric shall be attached at the top and mid-section. The horizontal spacing of the attachment shall be every 24-inches or less. Additional ties, shoat rings, or staples shall be added to secure fabric to the net reinforced fence or posts as directed by the Engineer.
   3. Shall be entrenched and attached to posts so as a minimum of 18-inches of the fabric is above ground.
   4. Shall be provided in continuous rolls and cut to the length of the barrier, so as to minimize joints.
   5. When joints of two sections of fabric are necessary, the fabric shall be spliced together only at a support post. The fabric shall be overlapped a minimum of 6-inches at a post, folded and secured at six or more places.

E. After the geotextile fabric has been securely attached, the trench shall be backfilled and hand tamped as approved by the Engineer.

F. For inlet protection barriers with reinforced filter fabric, if the immediately adjacent surface is a hard packed surface, the geotextile fabric shall extend outward away from the inlet protection barrier and upstream along the hard packed surface for at least 12-inches and be weighed down continuously along the perimeter of the structure with at least 4-inches of clean gravel or nylon gravel filled bags.

END OF SECTION

Section 01572

INLET PROTECTION BARRIERS FOR STAGE II INLET

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnishing, installing, maintaining and removing temporary erosion protection and sediment control gravel bag inlet protection barriers for Stage II inlets.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

PART 2 PRODUCTS

2.01 BAGS

A. Provide bags consisting of geotextile fabric (filter fabric) made of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins in a woven fabric.

B. Bag size shall be as follows:
Length: 18 to 24 inches
Width: 12 to 18 inches
Thickness: 6 to 8 inches
Weight: 50 to 125 pounds

C. Bags shall be filled with open-graded gravel. The gravel shall be free from adherent coatings, salt, alkali, dirt, clay, or organic and injurious matter. Clean coarse sand may be substituted only as approved by the Engineer.

D. Nylon rope shall be used to secure the closure of the gravel filled bags.

2.02 GEOTEXTILE FABRIC

A. Geotextile fabric shall meet the following specifications:

Table 1 Silt Fence Geotextile Fabric Properties			**Requirements** **Unsupported Silt Fence**	
	Units	Supported Silt Fence	Geotextile Elongation ∃50%	Geotextile Elongation <50%
Grab Strength				
Machine Direction	lbs.	90	123	123
X-Machine Direction	lbs.	90	100	100
Permittivity	sec^{-1}	0.05	0.05	0.05
Apparent Opening Size (maximum average roll value)	mm/sieve	0.6/30	0.6/30	0.6/30
Ultraviolet Stability (Retained Tensile Strength)	%	70 after 500 hrs exposure	70 after 500 hrs exposure	70 after 500 hrs exposure

NOTES:
1. Table 1 adapted from AASHTO M 288 *Geotextile Specification for Highway Applications* Table 6. Temporary Silt Fence Property Requirements.
2. All numeric values in Table 1 except Apparent Opening Size (AOS) represent minimum average roll values (MARV). Values for AOS represent maximum average roll values.

B. Geotextile fabric shall be free of defects or flaws that affect its physical and/or filtering properties.

C. The fabric shall contain stabilizers and/or inhibitors to make the fabric resistant to deterioration resulting from exposure to sunlight or heat and shall be resistant to commonly encountered soil chemicals, mildew, rot and insects.

D. The fabric shall provide an expected useable life comparable to the anticipated construction period.

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

A. Inlet Protection Barriers for Stage II Inlets shall be installed at locations shown on the drawings or as deemed necessary by the Engineer in accordance with the drawings.

B. Inlet Protection Barriers for Stage II Inlets shall be constructed in accordance with an approved schedule that clearly describes the timing during the construction process that the various erosion control measures will be implemented.

C. No clearing and grubbing or rough cutting, other than as specifically directed by the Engineer to allow for soil testing, surveying and installation of erosion protection and sediment control measures, shall be permitted until sediment control and erosion protection systems are in place.

D. Inlet Protection Barriers for Stage II Inlets shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

E. Gravel bags shall be placed in the gutter on each side of the curb inlet and continuously along the back of the curb inlet. Gravel bags shall be placed in a row with ends tightly abutting the adjacent gravel bag. Gravel bags shall not be placed so the throat of the inlet is blocked.

F. The Contractor shall inspect the inlet protection barrier for stage II inlets at least once every fourteen calendar days, within 24-hours of the end of a storm of 0.5 inches of rainfall or greater, and daily during prolonged rainfalls. Contractor shall remove irregularities which will impede normal flow. Erosion protection and sediment control systems shall be maintained by the Contractor until final stabilization. Damage caused to erosion protection and sediment control systems shall be repaired immediately.

G. The Contractor is responsible for removing and disposing of silt and sediment as directed by the Engineer. Sediment shall not be allowed to flush into the storm sewer system, waterways, jurisdictional wetlands, or onto adjacent properties. Sediment deposits shall be removed before they reach one-third of the height of the gravel bags.

H. Uncontaminated sediment can be placed at the project spoil site or, if properly handled, spread out to supplement fill requirements. The Engineer will designate how the sediment deposits are to be handled. Uncontaminated sediment shall not be placed in waterways or jurisdictional wetlands, unless as approved by the Engineer. If sediment has been contaminated, then it shall be disposed of in accordance with the applicable federal, state, or local regulations. Offsite disposal shall be the responsibility of the Contractor.

I. After final stabilization and at the direction of the Engineer, the Contractor, when required, shall be responsible for removing all erosion protection and sediment control systems, that are not permanent, from the project.

END OF SECTION

SECTION 01573

FILTER DAMS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Furnishing, installing, maintaining and removing filter dams.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 – Submittals.

B. Submit catalog data and mill certificate for geotextile and catalog data for wire to be used.

C. Submit gradation for granular fill shown on the plans.

PART 2 P R O D U C T S

2.01 GRANULAR FILL

A. Provide granular fill as noted on the plans.

B. Refer to Section 02254 - Riprap and Granular Fill.

2.02 WIRE COATING

A. Style 1 - zinc coated prior to being double twisted into mesh in accordance with ASTM A975.

2.03 WIRE MESH FOR REINFORCEMENT

A. Provide 20 gauge galvanized double-twisted hexagonal wire mesh and tie wires or as shown on the plans.

2.04 CONNECTION WIRES AND STIFFENERS

A. Provide spiral binders, lacing wire and stiffeners made of wire having the same coating material and same wire size as the wire mesh for reinforcement.

2.05 GEOTEXTILE SEPARATION FABRIC

A. Provide a geotextile of woven or spunbond nonwoven fibers consisting of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins. Provide geotextile fabric equal to the following average roll values or as directed by the Engineer:

1. Minimum average roll value:

a. Elongation < 50 percent.

b. Grab Strength ≥ 200 pounds.

c. Puncture Strength ≥ 75 pounds.

d. UV Stability (retained strength) ≥ 50 percent after 500 hours of exposure.

2. Maximum average roll value:

a. Apparent Opening Size (AOS) – 0.212 to 0.6 mm (#70 to #30 US sieve).

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install in accordance with the plans.

3.02 MAINTENANCE

A. Sediment Accumulation:

1. Remove accumulated sediment as needed or when directed by the Engineer.

2. Reshape the filter dam as needed or when directed by the Engineer.

3.03 REMOVAL

A. Maintain the filter dam, in place, throughout the duration of the Project. Remove when directed by the Engineer. Sod the exposed earth beneath the filer dam and areas damaged by the removal process in accordance with Section 02935 - Sodding.

3.04 SEDIMENT DISPOSAL

A. Refer to Section 01564 - Waste Material Disposal.

END OF SECTION

SECTION 01630

PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Options for making product or process selections

B. Procedures for proposing equivalent construction products or processes, including preapproved, and approved products or processes

1.02 DEFINITIONS

A. Product: Means, materials, equipment, or systems incorporated into the Project. Product does not include machinery and equipment used for production, fabrication, conveying, and erection of the Work. Products may also include existing materials or components designated for re-use.

B. Process: Any proprietary system or method for installing system components resulting in an integral, functioning part of the Work. For this Section, the word Product includes Processes.

1.03 SELECTION OPTIONS

A. Preapproved Products: Construction products of certain manufacturers or suppliers are designated in the Specifications as “preapproved.” Products of other manufacturers or suppliers will not be acceptable for this Project and will not be considered under the submittal process for approving alternate products.

B. Approved Products: Construction products or processes of certain manufacturers or suppliers designated in the Specifications followed by the words "or approved equal." Approval of alternate products or processes not listed in the Specifications may be obtained through provisions for product options and substitutions in Document 00700 - General Conditions, and by following the submittal procedures specified in Section 01300 - Submittals. The procedure for approval of alternate products is not applicable to preapproved products.

C. Product Compatibility: To the maximum extent possible, provide products that are of the same type or function from a single manufacturer, make, or source. Where more than one choice is available as a Contractor's option, select a product which is compatible with other products already selected, specified, or in use by the Owner.

1.04 CONTRACTOR'S RESPONSIBILITY

A. The Contractor's responsibility related to product options and substitutions is defined in the General Conditions.

B. Furnish information the Engineer deems necessary to judge equivalency of the alternate product.

C. Pay for laboratory testing, as well as any other review or examination costs, needed to establish the equivalency between products in order to obtain information upon which the Engineer can base a decision.

D. If the Engineer determines that an alternate product is not equal to that named in the Specifications, the Contractor shall furnish one of the specified products.

1.05 ENGINEER'S REVIEW

A. Alternate products or processes may be used only if approved in writing by the Engineer. The Engineer's determination regarding acceptance of a proposed alternate product is final.

B. Alternate products will be accepted if the product is judged by the Engineer to be equivalent to the specified product or to offer substantial benefit to the Owner.

C. The Owner retains the right to accept any product or process deemed advantageous to the Owner, and similarly, to reject any product or process deemed not beneficial to the Owner.

1.06 SUBSTITUTION PROCEDURE

A. Collect and assemble technical information applicable to the proposed product to aid in determining equivalency as related to the approved product specified.

B. Submit a written request for a construction product to be considered as an alternate product.

C. Submit the product information after the effective date of the Agreement and within the time period allowed for substitution submittals given in the General Conditions. After the submittal period has expired, requests for alternate products will be considered only when a specified product becomes unavailable because of conditions beyond the Contractor's control.

D. Submit 5 copies of each request for alternate product approval. Include the following information:

1. Complete data substantiating compliance of proposed substitution with Contract Documents

2. For products:

   a. Product identification, including manufacturer's name and address

   b. Manufacturer's literature with product description, performance and test data, and reference standards

   c. Samples, as applicable

   d. Name and address of similar projects on which product was used and date of installation. Include the name of the Owner, Architect/Engineer, and installing contractor.

3. For construction methods:

   a. Detailed description of proposed method

   b. Drawings illustrating methods

4. Itemized comparison of proposed substitution with product or method specified

5. Data relating to changes in construction schedule

6. Relation to separate contracts, if any

7. Accurate cost data on proposed substitution in comparison with product or method specified.

8. Other information requested by the Engineer.

B. Approved alternate products will be subject to the same review process as the specified product would have been for shop drawings, product data, and samples.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Closeout procedures including final submittals such as operation and maintenance data, warranties, and spare parts and maintenance materials.

1.02 CLOSEOUT PROCEDURES

A. Comply with Document 00700 - General Conditions regarding Final Completion and Final Payment when Work is complete and ready for Engineer's final inspection.

B. Provide Project Record Documents in accordance with Section 01720.

C. Complete or correct items on punch list, with no new items added. Any new items will be addressed during warranty period.

D. The Owner will occupy portions of the Work as specified in other Sections.

1.03 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Clean debris from drainage systems.

C. Clean site; sweep paved areas, rake clean landscaped surfaces.

D. Remove waste and surplus materials, rubbish, and temporary construction facilities from the site following the final test of utilities and completion of the work.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operations and maintenance data as noted in Section 01300 - Submittals.

1.05 WARRANTIES

A. Provide one original of each warranty from Subcontractors, suppliers, and manufacturers.

B. Provide Table of Contents and assemble warranties in 3-ring/D binder with durable plastic cover.

C. Submit warranties prior to final Application for Payment.

D. Warranties shall commence in accordance with the requirements in General Conditions.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01710

CLEANING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A Executing cleaning, during progress of work daily, and at completion of work.

B Maintaining premises and public properties (including storage yards) free from accumulations of waste, debris and rubbish caused by operations.

C At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials:

1 Clean all sight-exposed surfaces.

2 Leave project clean and ready for occupancy or use.

1.02 UNIT PRICES

A All items within this section shall be considered incidental to the cost of the project.

PART 2 P R O D U C T S

2.01 MATERIALS

A Use cleaning materials recommended by manufacturer of surface to be cleaned.

B Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

C See each specification section for specific products if applicable.

PART 3 E X E C U T I O N

3.01 DURING CONSTRUCTION

A Execute cleaning to ensure that building, grounds and public properties are maintained free from accumulations of waste materials and rubbish.

B Wet down dry materials and rubbish to lay dust and prevent blowing dust.

C At daily intervals during progress of work, clean site and public properties.

D Dispose of waste materials, debris, and rubbish.

E Provide on-site containers for collection of waste materials, debris and rubbish.

F Remove waste material, debris, and rubbish from site.

G Legally dispose of debris at public or private dumping areas off Owner's property.

H Handle materials in a controlled manner with as few handlings as possible.

3.02 SAFETY REQUIREMENTS

A Hazards Control:

1 Store volatile wastes in covered metal containers.

2 Remove containers from premises daily.

3 Prevent accumulation of wastes which create hazardous conditions.

4 Provide adequate ventilation during use of volatile or noxious substances.

B Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws:

1 Do not burn or bury rubbish and waste materials on project site.

2 Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

3 Do not dispose of wastes into stream or waterways.

4 Cleanup after haul trucks.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Maintenance and Submittal of Record Documents and Samples.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Maintain one record copy of documents at the site in accordance with General Conditions, paragraph 3.02.

B. Store Record Documents and samples in field office if a field office is required by Contract Documents, or in a secure location. Provide files, racks, and secure storage for Record Documents and samples.

C. Label each document "PROJECT RECORD" in neat, large, printed letters.

D. Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.

E. Keep Record Documents and Samples available for inspection by Engineer.

1.03 RECORDING

A. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.

B. Contract Drawings and Shop Drawings: Legibly mark each item to record all actual construction, or "as built" conditions, including:

1. Measured horizontal locations and elevations of underground utilities and appurtenances, referenced to permanent surface improvements.

2. Elevations of underground utilities referenced to bench mark utilized for project.

3. Field changes of dimension and detail.

4. Changes made by modifications.

5. Details not on original contract drawings.

6. References to related shop drawings and Modifications.

C. Record information with a red pen or pencil on a set of blue line opaque drawings, provided by Engineer.

1.04 SUBMITTALS

A. At contract closeout, deliver Project Record Documents to Engineer.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Submittal requirements for manufacturers' operation and maintenance (O&M) data.

B. Submittal requirements for O&M data notebooks.

1.02 UNIT PRICES

A. The value and payment of approved equipment operation and maintenance manuals is incidental to the amount bid for equipment and installation. Project retainage will not be released until O&M manuals have been delivered and accepted by Owner.

1.03 REQUIREMENTS

A. Furnish manufacturers' operation and maintenance data notebooks for equipment and components as required by the individual technical specifications in accordance with all sections and provisions of these specifications.

B. Furnish O&M data notebooks in accordance with the requirements of this Section.

1.04 SUBMITTALS

A. Submit O&M data for manufacturers' equipment and components, as required.

B. For projects which include multiple facilities, provide separate O&M data submittals noted accordingly.

C. Manufacturers' O&M data submittals shall have been reviewed and accepted by the Owner's Representative prior to requesting operational testing.

D. Submit three (3) copies of complete O&M data notebooks and electronic copies on disks meeting the requirements of this Section to the Owner's Representative 14 days prior to the scheduled demonstration testing and facility start-up.

E. Compile the O&M data notebook of all approved manufacturer O&M data submittals previously reviewed and accepted by the Owner's Representative and organize in accordance with the requirements of this Section.

F. Incorporate revisions or additional data required for the O&M data notebook, due to system start-up and demonstration testing, and resubmit as a condition of final payment.

1.05 O&M DATA

A. For each product or system list names, addresses, e-mail addresses and telephone numbers of suppliers and service representatives, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

D. Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

E. Warranties, Guarantees and Bonds: Bind in a copy of each.

1.06 O&M REQUIREMENTS

A. For each item of equipment and each system include a description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include function, normal operating characteristics, and limiting conditions. Include performance curves where applicable, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

B. Data submitted on equipment shall include complete maintenance instructions (including preventive and corrective maintenance) and parts lists in sufficient detail to facilitate ordering replacements.

C. Operating Procedures: Include start-up, and normal operating instructions and sequence. Include regulation, control, stopping, shut-down, and emergency instructions.

D. Provide servicing and lubrication schedule, and list of lubricants required. Cross-reference lubricants to products offered by at least three major lubricant suppliers. Note lubrication points on Drawings.

E. Include manufacturer's printed operation and maintenance instructions.

F. Include sequence of operation by controls manufacturer.

G. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams, and diagrams required for maintenance.

H. Troubleshooting guides.

I. Complete spare parts list with predicted life of parts subject to wear, list of spare parts recommended on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

1.07 O&M DATA NOTEBOOKS

A. The Contractor shall compile O&M data notebooks for each facility consisting of the assembled manufacturer's O&M data submittals which were previously reviewed and accepted by the. Owner's Representative The O&M data notebooks are required before demonstration testing or start-up activities.

B. Submit O&M data notebooks, bound in 8½ x 11 inch text pages, 3-ring/D binder notebooks with durable plastic covers as well as electronic media containing the O&M manuals in acceptable electronic format.

C. Provide binder covers and spines with computer printed title "OPERATION AND MAINTENANCE DATA", title of project, facility name and address.

D. For projects with multiple facilities, provide separate O&M data notebooks specific to each facility.

E. Provide separate binder notebooks based on category of equipment or components submitted. Note as either "Mechanical", "Electrical", or "Instrumentation" on the cover and spine. DO NOT combine these into one binder.

F. All binder notebooks shall be provided with labeled, tabbed, dividers logically arranged, and shall include a Table of Contents noting all sections, drawings, diagrams, vendor data, and other documents.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 02051

ABANDONMENT OF SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Abandonment in place of existing sanitary sewers, manholes, and force mains.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Abandonment. Sanitary sewer abandonment consists of demolition and removal of any portion of manholes existing within the specified depth of the surface, and the abandonment in place of sewer lines and manholes as specified in this Section.

B. Flowable Fill. Flowable fill (abandonment grout) shall be a controlled low-strength material consisting of a fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in sewer pipes or other restricted areas, or as mass placement by chutes or tremie methods in unrestricted locations with open access. The long-term hardened strength shall be within a specified range.

C. Ballast. Large aggregate either replaced with the voids subsequently filled with flowable fill injected by grouting method; or in areas with open access, placed individually and sequentially at the same time as the flowable fill placement.

D. Backgrouting. A secondary stage pressure grouting to ensure that voids have been filled within the abandoned sewer. Back grouting will only be required at critical locations indicated on the Drawings or if there is evidence of incomplete flowable fill placements.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Flowable fill mix design report:

1. Flowable fill type and production method. Describe if the fill will be mixed to final proportions and consistency in batch plant or if constituents will be added in transit mixer at the placement location.

2. Use of ballast. Provide percentage of ballast of the total placement and size limits for the ballast if fill is intended to be used with ballast.

3. Aggregate gradation of fill. The aggregate gradation of the mix (excluding ballast) shall be used as a pilot curve for quality control during production.

4. Fill mix constituents and proportions including materials by weight and volume, and air content but excluding ballast. Give types and amounts of admixtures including air entrainment or air generating compounds.

5. Fill densities and viscosities, including wet density at the point of placement.

6. Initial time of set.

7. Bleeding and shrinkage.

8. Compressive strength.

C. Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.

D. Experience record for the proposed crew, showing a minimum of 100 cubic yards of flowable fill placed using the proposed or similar equipment and methods.

E. At least 60 days prior to commencing any abandonment activities, submit a plan for abandonment, describing the proposed grouting sequence, bypass pumping requirements and plugging, if any, and other information pertinent to completion of the work.

PART 2 P R O D U C T S

2.01 FLOWABLE FILL

A. Design Mix Criteria. Provide design of one or more mixes to meet the design criteria and conditions for placement. Present the information required by Paragraph 1.05B in the mix design report including the following:

1. Cement: ASTM C150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 100 pounds per cubic yard.

2. Fly ash: ASTM C618 Class C or F. Volume and weight per cubic yard of fill. Provide minimum Fly ash content of 200 pounds per cubic yard.

3. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.

4. Aggregate gradation: 100 percent passing the 3/8 inch sieve and not more than 10 percent passing the #200 sieve. The mix design report shall define a pilot gradation based on the following sieve sizes 3/8-inch, Nos. 4, 8, 16, 30, 50, 100 and 200. Do not deviate from the pilot gradation by more than +/-10 percentage points for any sieve for the production material.

5. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, at least 30 percent of natural aggregate shall be added as necessary to provide workability.

6. Admixtures: Use admixtures meeting ASTM C494 and ASTM C107 as needed to improve pumpability, to control time of set, and reduce bleeding.

7. Fluidifier: Use a fluidifier meeting ASTM C397 as necessary to hold the solid constituents in suspension. Add a shrinkage compensator if necessary.

8. Performance additive: Use a flowable fill performance additive, such as Darafill or approved equal, to control the fill properties.

B. Flowable Fill Requirements

1. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for the same placement. Present at least three acceptable strength tests for the proposed mix design in the mix design report.

2. Placement characteristics: self-leveling.

3. Shrinkage characteristics: non-shrink.

4. Water bleeding for fill to be placed by grouting method in sewers: not to exceed 2 percent according to ASTM C940.

5. Minimum wet density: 90 pounds per cubic foot.

2.02 BALLAST

A. Ballast material: natural rock or concrete pieces with a minimum size equal to at least 10 times the maximum aggregate size of the flowable fill and a maximum size of 24 inches. The maximum dimension shall not be more than 20 percent of the minimum dimension of the space to be filled.

B. Ballast composition: free of any regulated waste material.

2.03 PLUGS FOR FORCE MAINS

A. Grout Plugs: Cement-based dry-pack grout conforming to ASTM C1107, Grade B or C.

B. Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with the pipe being abandoned.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Have fill mix design reports and other submittals required by Paragraph 1.05 accepted by the Engineer prior to start of placement. Notify the Engineer at least 24 hours in advance of grouting with flowable fill.

B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at a pressure that will not distort or imperil any portion of the work, new or existing.

C. Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess the condition of the pipe. Locate previously unidentified connections, which have not been redirected and reconnected as a part of this project, and report them to the Engineer. During placement of the fill, compensate for any irregularities in the sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

D. Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and any other substances that may degrade performance of the fill. Do not leave sludge or other debris in place if filling more than 2 percent of the placement volume. Dispose of waste material in compliance with Section 01500 - Temporary Facilities and Controls.

E. Remove free water prior to starting fill placement.

3.02 EQUIPMENT

A. Mix flowable fill in an automated batch plant and deliver it to the site in ready-mix trucks. Performance additives may be added at the placement site if required by mix design.

B. Use concrete or grout pumps capable of continuous delivery at the planned placement rate.

3.03 DEMOLITION OF ABANDONED SANITARY SEWER MANHOLES, PIPELINE STRUCTURES AND FORCE MAINS PRIOR TO ABANDONMENT

A. Remove manhole frames and covers and any castings from other existing pipeline structures. Deliver these castings to the Owner's storage yard. Alternatively, salvaged castings may be used upon approval by the Engineer for construction of new manholes on this project.

B. Demolish and remove precast concrete adjustment rings and corner section, or brick and mortar corbel and chimney, or other pipeline structure, to a minimum depth of 4 feet

below finished grade. The structure may be removed to a greater depth, but not deeper than 18 inches above the crown of the abandoned sewer.

C. If the adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to the manhole in preparation for filling the manhole.

D. Excavate overburden from force mains to be abandoned at the locations indicated on the Drawings, conforming to Section 02227 - Excavation and Backfill for Utilities. Cut the existing force main, if necessary, to provide an end surface perpendicular to the axis of the pipe and suitable for the plug to be installed. Remove any force main piping material remaining outside of the segment to be abandoned.

3.04 INSTALLATION

A. Abandon sewer lines by completely filling the sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, together with ballast as applicable, within the depth of structures left in place.

B. Place flowable fill to fill the volume between the manholes as completely as practicable. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.

C. Have the filling operation performed by experienced crews with equipment to monitor density of the flowable fill and to control pressure.

D. Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep the lines free of flowable fill.

E. Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain the flowable fill in the lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.

F. Place flowable fill under pressure flow conditions into a properly vented open system until flowable fill emerges from the vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill the sewer from the downstream end, to discharge at the upstream end.

G. Inject flowable fill through replaced ballast using grouting equipment and a series of grout pipes discharging at the bottom of the placement, allowing the fill to rise through the ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at the same time as flowable fill is placed. Do not fill with ballast more than 50 percent of the volume at any level to prevent nesting and void formation.

H. Remediate placement of flowable fill which does not fill voids in a sewer, in manhole or other structures, or where voids develop due to excessive shrinkage or bleeding of the fill by using pressure grouting either from inside the sewer or from the surface. Pressure grout shall conform to Section 02330 - Tunnel Grout.

I. Plug each end of force mains being abandoned.

J. Force main abandonment

1. Clean the inside surface of force mains at least 12 inches from the ends, as necessary, to achieve a firm bond and seal the grout plug or manufactured plug to the pipe surface. Similarly, clean and prepare the exterior pipe surface if a manufactured cap is to be used.

2. When using a grout plug, place a temporary plug or bulkhead approximately 12 inches inside the pipe. Fill the pipe end completely with dry-pack grout mixture.

3. When using a manufactured plug or cap, install the fitting, as recommended by the manufacturer's instructions, to form a watertight seal.

K. Backfill to the surface, above the pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 02227 - Excavation and Backfill for Utilities.

L. Collect and dispose of excess flowable fill material and other debris in accordance with Section 01500 - Temporary Facilities and Controls.

3.05 FIELD QUALITY CONTROL

A. Provide batch plant tickets for each truck delivery of flowable fill. Note on the tickets addition of admixtures at the site.

B. Check flow characteristics and workability of the fill as the placement proceeds.

C. Obtain at least three test cylinders for each placement area for determination of 56 day compressive strength and bleeding. The acceptance of the placement will be based on the average strength of the three tests.

D. Record the volume of ballast together with the flowable fill placement for the same space to demonstrate that voids have been filled.

3.06 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the work.

END OF SECTION

SECTION 02052

ABANDONMENT OF STORM SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Abandonment in place of existing storm sewers and manholes.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Abandonment. Strom sewer abandonment consists of demolition and removal of any portion of manholes existing within the specified depth of the surface, and the abandonment in place of sewer lines and manholes as specified in this Section.

B. Flowable Fill. Flowable fill (abandonment grout) shall be a controlled low-strength material consisting of a fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in sewer pipes or other restricted areas, or as mass placement by chutes or tremie methods in unrestricted locations with open access. The long-term hardened strength shall be within a specified range.

C. Ballast. Large aggregate either replaced with the voids subsequently filled with flowable fill injected by grouting method; or in areas with open access, placed individually and sequentially at the same time as the flowable fill placement.

D. Backgrouting. A secondary stage pressure grouting to ensure that voids have been filled within the abandoned sewer. Back grouting will only be required at critical locations indicated on the Drawings or if there is evidence of incomplete flowable fill placements.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Flowable fill mix design report:

1. Flowable fill type and production method. Describe if the fill will be mixed to final proportions and consistency in batch plant or if constituents will be added in transit mixer at the placement location.

2. Use of ballast. Provide percentage of ballast of the total placement and size limits for the ballast if fill is intended to be used with ballast.

3. Aggregate gradation of fill. The aggregate gradation of the mix (excluding ballast) shall be used as a pilot curve for quality control during production.

4. Fill mix constituents and proportions including materials by weight and volume, and air content but excluding ballast. Give types and amounts of admixtures including air entrainment or air generating compounds.

5. Fill densities and viscosities, including wet density at the point of placement.

6. Initial time of set.

7. Bleeding and shrinkage.

8. Compressive strength.

C. Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.

D. Experience record for the proposed crew, showing a minimum of 100 cubic yards of flowable fill placed using the proposed or similar equipment and methods.

E. At least 60 days prior to commencing any abandonment activities, submit a plan for abandonment, describing the proposed grouting sequence, bypass pumping requirements and plugging, if any, and other information pertinent to completion of the work.

PART 2 P R O D U C T S

2.01 FLOWABLE FILL

A. Design Mix Criteria. Provide design of one or more mixes to meet the design criteria and conditions for placement. Present the information required by Paragraph 1.05B in the mix design report including the following:

1. Cement: ASTM C150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 100 pounds per cubic yard.

2. Fly ash: ASTM C618 Class C or F. Volume and weight per cubic yard of fill. Provide minimum Fly ash content of 200 pounds per cubic yard.

3. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.

4. Aggregate gradation: 100 percent passing the 3/8 inch sieve and not more than 10 percent passing the #200 sieve. The mix design report shall define a pilot gradation based on the following sieve sizes 3/8-inch, Nos. 4, 8, 16, 30, 50, 100 and 200. Do not deviate from the pilot gradation by more than +/-10 percentage points for any sieve for the production material.

5. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, at least 30 percent of natural aggregate shall be added as necessary to provide workability.

6. Admixtures: Use admixtures meeting ASTM C494 and ASTM C107 as needed to improve pumpability, to control time of set, and reduce bleeding.

7. Fluidifier: Use a fluidifier meeting ASTM C397 as necessary to hold the solid constituents in suspension. Add a shrinkage compensator if necessary.

8. Performance additive: Use a flowable fill performance additive, such as Darafill or approved equal, to control the fill properties.

B. Flowable Fill Requirements

1. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for the same placement. Present at least three acceptable strength tests for the proposed mix design in the mix design report.

2. Placement characteristics: self-leveling.

3. Shrinkage characteristics: non-shrink.

4. Water bleeding for fill to be placed by grouting method in sewers: not to exceed 2 percent according to ASTM C940.

5. Minimum wet density: 90 pounds per cubic foot.

2.02 BALLAST

A. Ballast material: natural rock or concrete pieces with a minimum size equal to at least 10 times the maximum aggregate size of the flowable fill and a maximum size of 24 inches. The maximum dimension shall not be more than 20 percent of the minimum dimension of the space to be filled.

B. Ballast composition: free of any regulated waste material.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Have fill mix design reports and other submittals required by Paragraph 1.05 accepted by the Engineer prior to start of placement. Notify the Engineer at least 24 hours in advance of grouting with flowable fill.

B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at a pressure that will not distort or imperil any portion of the work, new or existing.

C. Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess the condition of the pipe. Locate previously unidentified connections, which have not been redirected and reconnected as a part of this project, and report them to the Engineer. During placement of the fill, compensate for any irregularities in the sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

D. Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and any other substances that may degrade performance of the fill. Do not leave sludge or other debris in place if filling more than 2 percent of the placement volume. Dispose of waste material in compliance with Section 01500 - Temporary Facilities and Controls.

E. Remove free water prior to starting fill placement.

3.02 EQUIPMENT

A. Mix flowable fill in an automated batch plant and deliver it to the site in ready-mix trucks. Performance additives may be added at the placement site if required by mix design.

B. Use concrete or grout pumps capable of continuous delivery at the planned placement rate.

3.03 DEMOLITION OF ABANDONED STORM SEWER MANHOLES PRIOR TO ABANDONMENT

A. Remove manhole frames and covers and any castings from other existing pipeline structures. Deliver these castings to the Owner's storage yard. Alternatively, salvaged castings may be used upon approval by the Engineer for construction of new manholes on this project.

B. Demolish and remove precast concrete adjustment rings and corner section, or brick and mortar corbel and chimney, or other pipeline structure, to a minimum depth of 4 feet below finished grade. The structure may be removed to a greater depth, but not deeper than 18 inches above the crown of the abandoned sewer.

C. If the adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to the manhole in preparation for filling the manhole.

3.04 INSTALLATION

A. Abandon sewer lines by completely filling the sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, together with ballast as applicable, within the depth of structures left in place.

B. Place flowable fill to fill the volume between the manholes as completely as practicable. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.

C. Have the filling operation performed by experienced crews with equipment to monitor density of the flowable fill and to control pressure.

D. Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep the lines free of flowable fill.

E. Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain the flowable fill in the lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.

F. Place flowable fill under pressure flow conditions into a properly vented open system until flowable fill emerges from the vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill the sewer from the downstream end, to discharge at the upstream end.

G. Inject flowable fill through replaced ballast using grouting equipment and a series of grout pipes discharging at the bottom of the placement, allowing the fill to rise through the ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at the same time as flowable fill is placed. Do not fill with ballast more than 50 percent of the volume at any level to prevent nesting and void formation.

H. Remediate placement of flowable fill which does not fill voids in a sewer, in manhole or other structures, or where voids develop due to excessive shrinkage or bleeding of the fill by using pressure grouting either from inside the sewer or from the surface. Pressure grout shall conform to Section 02330 - Tunnel Grout.

I. Backfill to the surface, above the pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 02227 - Excavation and Backfill for Utilities.

J. Collect and dispose of excess flowable fill material and other debris in accordance with Section 01500 - Temporary Facilities and Controls.

3.05 FIELD QUALITY CONTROL

A. Provide batch plant tickets for each truck delivery of flowable fill. Note on the tickets addition of admixtures at the site.

B. Check flow characteristics and workability of the fill as the placement proceeds.

C. Obtain at least three test cylinders for each placement area for determination of 56 day compressive strength and bleeding. The acceptance of the placement will be based on the average strength of the three tests.

D. Record the volume of ballast together with the flowable fill placement for the same space to demonstrate that voids have been filled.

3.06 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the work.

END OF SECTION

SECTION 02076

REMOVE EXISTING PAVEMENTS AND STRUCTURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Removing concrete paving, asphaltic concrete pavement, and base courses.

B. Removing concrete curbs, concrete curb and gutters, sidewalks and driveways.

C. Removing pipe culverts and sewers.

D. Removing miscellaneous structures of concrete, masonry, or combination of concrete and masonry.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.

B. Coordinate removal work with utility companies.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Obtain advance approval from Engineer for dimensions and limits of removal work.

B. Identify known utilities below grade. Stake and flag locations.

3.02 PROTECTION

A. Protect utilities that remain from damage.

B. Protect trees, other plant growth, and features designated to remain.

C. Protect adjacent public and private property from damage.

D. Protect bench marks, monuments, and existing structures designated to remain from damage or displacement.

3.03 REMOVALS

A. Remove by methods that will not damage underground utilities. Do not use a drop hammer near existing underground utilities.

B. Minimize amount of earth loaded during removal operations.

C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut a minimum depth of 2 inches.

D. Where street and driveway saw cut locations coincide or fall within three feet of existing construction or expansion joints, break-out to existing joint.

E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.

3.04 DISPOSAL

A. Inlet frames, grates, and plates; and manhole frames and covers, may remain Owner property. Disposal shall be in accordance with requirements of Section 01564 - Waste Material Disposal.

B. Remove debris resulting from Work under this section from site in accordance with requirements of Section 01564 - Waste Material Disposal.

END OF SECTION

SECTION 02100

RIGHT OF WAY PREPARATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Clearing and grubbing.

B. Removal of topsoil, stripping and stockpiling.

C. Removal of debris and trash.

D. Removal of obstructions.

E. Removal and replacement of fence section.

F. Temporary Fencing.

G. Excavation and fill.

H. Disposal of waste materials.

I. Disposal of excess materials.

J. Salvaging of designated items.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this section. Include payment in unit price for related work unless stated otherwise in the Bid Proposal.

B. Side streets and utility easements involving any work in this contract will not be measured separately and are considered incidental to the project.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Brought-in fill

1. Sand, gravel, earth or combination, which can be compacted to form stable embankments and fills conforming to select borrow standards:

a. Liquid limit: 45 maximum, ASTM D 4318.

b. Plasticity index: 12 minimum, 20 maximum, ASTM D 4318.

c. Free from trash, vegetation, organic matter, large stones, hard lumps of earth and frozen, corrosive or perishable material.

d. Well broken up, free of clods of hard earth, rocks, and stones greater than 2-inch dimension.

PART 3 E X E C U T I O N

3.01 PRESERVATION OF STAKING

A. Use caution to preserve survey staking, monuments and property corners.

B. Employ a Registered Public Surveyor to reset any missing, disturbed, or damaged monumentation.

3.02 SITE CLEARING

A. Protect trees and shrubs designated to remain in accordance with Section 01535 – Tree and Plant Protection.

B. Protect utilities to remain from damage.

C. Topsoil Removal:

1. Remove growths of grass from areas before stripping.

2. Topsoil is defined as surface soil found of depth of not less than 4 inches.

3. Strip topsoil to depths encountered.

4. Perform stripping in a manner to prevent intermingling of topsoil with underlying sterile subsoil and remove objectionable materials, including clay lumps, stones over 2 inches in diameter, weeds, roots, leave and debris.

5. Where trees are designated by Owner to be left standing, stop topsoil stripping at extreme limits of tree drip line to prevent damage to main root system.

6. Construct storage piles to freely drain surface water.

7. Cover storage piles, if required, to prevent wind-blown dust.

8. At completion, transport topsoil from stockpiles to work site for spreading and final fine grading.

D. Clearing and Grubbing.

1. Clear project site of trees, shrubs, and other vegetation, except for those designated by Owner to be left standing.

2. Completely remove stumps, roots, and other debris protruding through ground surface.

3. Use only hand methods for grubbing inside drip line of trees.

4. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

5. Place fill material in horizontal layers not exceeding 6 inches loose depth and thoroughly compact to density equal to adjacent original ground.

6. On areas required for roadway, channel, or structural excavation, remove stumps and roots to depth of 2 feet below lower elevation of excavation.

7. On areas required for embankment construction, remove stumps and roots to depth of 2 feet below ground surface.

8. Blade entire area to prevent ponding of water and to provide drainage, except in areas to be immediately excavated.

9. Trees and stumps may be cut off as close to natural ground as practicable on areas which are to be covered by at least 3 feet of embankment.

10. Complete operations by bulldozing, blading, and grading so that prepared area is free of holes, unplanned ditches, abrupt changes in elevations and irregular contours, and preserve drainage of area.

3.03 UNSUITABLE MATERIAL

A. Undercut and replace material which Engineer designates as unsuitable for subsequent construction.

B. Material used to replace unsuitable material shall be suitable material from site excavation or “Brought-in Fill” specified in this section.

3.04 EXCAVATION AND FILL

A. Excavate as needed to meet lines and grades as shown on plans and in accordance with Section 02225 – Roadway Excavation.

B. Depressed site areas shall be filled using material from high areas, insofar as practicable.

C. Fill to indicated rough grade elevations with “Brought-in Fill” material, when fill obtained from high areas is exhausted.

D. Place and compact fill in accordance with Section 02221 – Embankment.

3.05 SALVAGEABLE ITEMS AND MATERIALS

A. Items designated by the Engineer to be salvaged are to be carefully removed, so as to cause no damage to the salvaged items and delivered to Owner's storage yard.

3.06 DISPOSAL

A. Removal and dispose of excess material and debris resulting from work under this Section in accordance with requirements of Section 01564 – Waste Material Disposal.

END OF SECTION

SECTION 02221

EMBANKMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Construction of embankments with excess excavated material and borrow.

1.02 UNIT PRICES

A. No separate payment will be made for embankment. Include cost in the unit price for work in related item.

1.03 TESTS

A. Tests and analysis of soil properties will be performed in accordance with ASTM D4318, ASTM D2216, and ASTM D698 under provisions of Section 01410 - Testing Laboratory Services.

1.04 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other features outside of embankment limits.

B. Protect utilities above and below grade, which are to remain.

C. Repair damage.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Topsoil: Conform to requirements of Section 02920.

B. General Backfill: Excavated material, graded free of roots, lumps greater than 6 inches, rocks larger than 3 inches, organic material, and debris.

C. Structural Backfill (under pavement or structures): Select general backfill material from excavation or borrow meeting the following requirements:

1. Plasticity Index: Not less than 12 nor more than 20.

2. Maximum Liquid Limit: 45 unless approved by Engineer.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify borrow and excess excavated materials to be reused are approved.

B. Verify removals, and clearing and grubbing operations, have been completed.

3.02 PREPARATION

A. Fill test pits, or stump holes and other surface irregularities such as small swales: Backfill with embankment materials and compact in proper lift depths to requirements for embankment compaction.

B. Remove and dispose of muck and other unsuitable materials which will not consolidate. Backfill with embankment materials and compact to requirements for embankment.

C. Complete backfill of new utilities below future grade.

3.03 EMBANKMENT

A. Do not conduct placement operations during inclement weather or when existing ground or fill materials exceed 3 percent of optimum moisture content. Contractor may manipulate wet material to facilitate drying, by disking or windrowing at Contractor's expense.

B. Do not place embankment fill until density and moisture content of previously placed material comply with specified requirements.

C. Scarify areas to be filled to a minimum depth of 4 inches to bond existing and new materials. Mix with first fill layer.

D. Spread fill material evenly, from dumped piles or windrows, into horizontal layers approximately parallel to finished grade. Place to meet specified compacted thickness. Break clods and lumps and mix materials by blading, harrowing, discing, or other approved method. Each layer shall extend across full width of fill.

E. Each layer shall be homogeneous and contain uniform moisture content before compaction. Mix dissimilar abutting materials to prevent abrupt changes in composition of fill.

F. Layers shall not exceed the following compacted thickness:

1. Areas indicated to be under future paving or shoulders, to be constructed within 6 months: 6 inches when compacted with pneumatic rollers, or 8 inches when compacted with other rollers.

2. Other areas: 12 inches.

G. Where shown on plans for steep slopes, cut benches into slope and scarify before placing fill. Place increasingly wide horizontal layers of specified depth, to the level of each bench.

H. Build embankment layers on back slopes, adjacent to existing roadbeds, to level of old roadbed. Scarify top of old roadbed to minimum depth of four inches and recompact with next fill layer.

I. Construct to lines and grades shown on drawings.

J. Remove unsuitable material and excess soil not being used for embankment from the site in accordance with requirements of Section 01564 - Waste Material Disposal.

3.04 COMPACTION

A. Maintain moisture content of embankment materials to attain required compaction density.

B. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:

1. Areas under future paving and shoulders: Minimum density of 95 percent of maximum dry density.

2. Other areas: Minimum density of 90 percent of maximum dry density.

3.05 TOLERANCES

A. Top of compacted surface: Plus or minus 1/2 inch in cross section, or in 16 foot length.

3.06 FIELD QUALITY CONTROL

A. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of three tests will be taken for each 1,000 linear feet per lane of roadway or 500 square yards of embankment per lift.

C. If tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

3.07 PROTECTION

A. Conform to protection requirements of Section 02225 - Roadway Excavation.

END OF SECTION

SECTION 02225

ROADWAY EXCAVATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Excavation of materials for roadways.

B. Excavation of materials for roadside ditches and swales.

C. Section 02920 - Topsoil: Topsoil materials and placement.

1.02 UNIT PRICES

A. Refer to Section 01025 – Measurement and Payment for unit price procedures.

1.03 TESTS

A. Tests and analysis of soil materials will be performed in accordance with ASTM D4318, ASTM D2216, and ASTM D698 under provisions of Section 01410 - Testing Laboratory Services.

1.04 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other features outside of grading limits.

B. Protect above and below grade utilities which are to remain.

C. Repair damage caused by Contractor.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Identify required lines, levels, and datum. Coordinate with Section 01050 - Field Surveying.

B. Identify and flag surface and aerial utilities.

C. Notify utility companies to remove or relocate utilities.

D. Identify known utilities below grade. Stake and flag locations. Make temporary or permanent removals and replacements of underground pipes, ducts, or utilities where indicated on Drawings

E. Upon discovery of unknown or badly deteriorated utilities, or concealed conditions, discontinue work. Notify Engineer and obtain instructions before proceeding in such areas.

F. Obtain approval of topsoil quality before excavating and stockpiling.

3.02 TOPSOIL EXCAVATION

A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area designated on site.

B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

3.03 SOIL EXCAVATION

A. Excavate to lines and grades shown on drawings.

B. Remove unsuitable material not meeting specifications. Backfill with embankment materials and compact to requirements of Section 02221 - Embankment.

C. At intersections, grade back at minimum slope of one inch per foot. Produce a smooth riding junction with intersecting street. Maintain proper drainage.

D. Fill over-excavated areas in accordance with requirements of Section 02221 - Embankment, at no cost to the Owner.

E. Remove unsuitable material, and excess soil not being reused, from the site in accordance with requirements of Section 01564 - Waste Material Disposal.

3.04 COMPACTION

A. Maintain optimum moisture content of subgrade to attain required compaction density.

B. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:

1. Areas under future paving and shoulders: Minimum density of 95 percent of maximum dry density.

2. Other areas: Minimum density of 90 percent of maximum dry density.

3.05 TOLERANCES

A. Top of compacted surface: Plus or minus 1/2 inch in cross section, or in 16 foot length.

3.06 FIELD QUALITY CONTROL

A. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of three tests will be taken for each 1,000 linear feet per lane of roadway.

C. If tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

3.07 PROTECTION

A. Prevent erosion at all times. Maintain ditches and cut temporary swales to allow natural drainage in order to avoid damage to roadway. Do not allow water to pond.

B. Distribute construction traffic evenly over compacted areas, where practical, to aid in obtaining uniform compaction. Protect exposed areas having high moisture content from wheel loads that cause rutting.

C. Maintain excavation and embankment areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no cost to the Owner.

END OF SECTION

SECTION 02226

EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Excavation, backfilling, and compaction of backfill for structures.

1.02 UNIT PRICES

A. No payment will be made for structural excavation and backfill under this Section. Include payment in unit price or lump sum for construction of structures.

1.03 DEFINITIONS

A. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that are classified as ML, CL-ML, MH, PT, OH and OL according to ASTM D 2487.

2. Materials that cannot be compacted to the required density due to either gradation, plasticity, or moisture content.

3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.

4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.

C. Select Material: Material as defined in Section 02229 - Utility Backfill Materials.

D. Backfill: Select material meeting specified quality requirements, placed and compacted under controlled conditions around structures.

E. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics, as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for the structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

F. Foundation Base: For foundation base material, use crushed aggregate with filter fabric, as required, cement stabilized sand, or concrete seal slab. The foundation base provides a smooth, level working surface for the construction of the concrete foundation.

G. Foundation Subgrade: Foundation subgrade is the surface of the natural soil which has been excavated and prepared to support the foundation base or foundation backfill, where needed.

H. Ground Water Control Systems: Installations external to the excavation such as well points, eductors, or deep wells. Ground water control includes dewatering to lower the ground water, intercepting seepage which would otherwise emerge from the side or bottom of the excavation, and depressurization to prevent failure or heaving of the excavation bottom. Refer to Section 01563 - Control of Ground Water and Surface Water.

I. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from the excavation. Remove rain water and surface water which accidentally enters the excavation as a part of excavation drainage.

J. Excavation Drainage: Removal of surface and seepage water in the excavation by sump pumping and using French drains surrounding the foundation to intercept the water.

K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below the foundation as shown on Drawings, and backfilled with foundation backfill material.

L. Shoring System: A structure that supports the sides of an excavation to maintain stable soil conditions and prevent cave-ins.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit a work plan for excavation and backfill for each structure with complete written description which identifies details of the proposed method of construction and the sequence of operations for construction relative to excavation and backfill activities. The descriptions, with supporting illustrations, shall be sufficiently detailed to demonstrate to the City Engineer that the procedures meet the requirements of the Specifications and Drawings.

C. Submit excavation safety system plan.

1. The excavation safety system plan shall be in accordance with applicable OSHA requirements for all excavations.

2. The excavation safety system plan shall be in accordance with the requirements of Section 01526 - Trench Safety System, for all excavations that fall under State and Federal trench safety laws.

D. Submit a ground and surface water control plan in accordance with requirements in this Section and Section 01563 - Control of Ground Water and Surface Water.

E. Submit backfill material sources and product quality information in accordance with requirements of Section 02229 - Utility Backfill Materials.

F. Submit project record documents under provisions of Section 01720 - Project Record Documents. Record location of utilities, as installed, referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

1.05 TESTS

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the Owner in accordance with requirements of Section 01410 - Testing Laboratory Services and as specified in this Section.

B. Contractor shall perform embedment and backfill material source qualification testing in accordance with requirements of Section 02229- Utility Backfill Materials.

PART 2 P R O D U C T S

2.01 EQUIPMENT

A. Perform excavation with equipment suitable for achieving the requirements of this Specification.

B. Use equipment which will produce the degree of compaction specified. Backfill within 3 feet of walls shall be compacted with hand-operated equipment. Do not use equipment weighing more than 10,000 pounds closer to walls than a horizontal distance equal to the depth of the fill at that time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

2.02 MATERIAL CLASSIFICATIONS

A. Backfill materials shall conform to the classifications and product descriptions of Section 02229 - Utility Backfill Materials. The classification or product description for backfill applications shall be as shown on the Drawings and as specified.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Conduct an inspection to determine condition of existing structures and other permanent installations.

B. Set up necessary street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01570 - Traffic

Control and Regulation. Maintain barricades and warning devices at all times for streets and intersections where work is in progress, or where affected by the Work, and is considered hazardous to traffic movements.

C. Perform work in accordance with OSHA standards. Employ an excavation safety system as specified in Section 01526 - Trench Safety Systems for excavations over 5 feet deep.

D. Remove old pavements and structures, including sidewalks and driveways, in accordance with requirements of Section 02076 - Removing Existing Pavements and Structures.

E. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01563 - Control of Ground Water and Surface Water.

3.02 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within the grading limits as designated on the Drawings, and in accordance with requirements of Section 01535 - Tree and Plant Protection.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on the Drawings.

D. Prevent erosion of excavations and backfill. Do not allow water to pond in excavations.

E. Maintain excavation and backfill areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no additional cost to the City.

3.03 EXCAVATION

A. Perform excavation work so that the underground structure can be installed to depths and alignments shown on Drawings. Use caution during excavation work to avoid disturbing surrounding ground and existing facilities and improvements. Keep excavation to the absolute minimum necessary. No additional payment will be made for excess excavation not authorized by Engineer.

B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work. Notify Engineer and obtain instructions before proceeding in such areas.

C. Immediately notify the agency or company owning any line which is damaged, broken or disturbed. Obtain approval from Engineer and agency for any repairs or relocations, either temporary or permanent.

D. Avoid settlement of surrounding soil due to equipment operations, excavation procedures, vibration, dewatering, or other construction methods.

E. Provide surface drainage during construction to protect work and to avoid nuisance to adjoining property. Where required, provide proper dewatering and piezometric pressure control during construction.

F. Conduct hauling operations so that trucks and other vehicles do not create a dirt nuisance in streets. Verify that truck beds are sufficiently tight and loaded in such a manner that objectionable materials will not spill onto streets. Promptly clear away any dirt, mud, or other materials that spill onto streets or are deposited onto streets by vehicle tires.

G. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed, replace those which are damaged or destroyed by the Work.

H. Provide sheeting, shoring, and bracing where required to safely complete the Work, to prevent excavation from extending beyond limits indicated on Drawings, and to protect the Work and adjacent structures or improvements. Sheeting, shoring, and bracing used to protect workmen and the public shall conform to requirements of Section 01526 - Trench Safety Systems.

I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, concrete fill, cement stabilized sand, or other material approved by Engineer.

J. After completion of the structure, remove sheeting, shoring, and bracing unless Engineer has approved in writing that such temporary structures may remain. Remove sheeting, shoring and bracing in such a manner as to maintain safety during backfilling operations and to prevent damage to the Work and adjacent structures or improvements.

K. Immediately fill and compact voids left or caused by removal of sheeting with cement stabilized sand or material approved by Engineer.

3.04 HANDLING EXCAVATED MATERIALS

A. Classify excavated materials. Place material which is suitable for use as backfill in orderly piles at a sufficient distance from excavation to prevent slides or cave-ins.

B. Provide additional backfill material in accordance with requirements of Section 02251 - Utility Backfill Materials, if adequate quantities of suitable material are not available from excavation and trenching operations at the site.

3.05 DEWATERING

A. Provide ground water control per Section 01563 - Control of Ground Water and Surface Water.

B. Maintain the ground water surface a minimum of two feet below the bottom of the foundation base.

C. Maintain ground water control as directed by Section 01563 - Control of Ground Water and Surface Water and until the structure is sufficiently complete to provide the required weight to resist hydrostatic uplift with a minimum safety factor of 1.2.

3.06 FOUNDATION EXCAVATION

A. Notify Engineer at least 48 hours prior to planned completion of foundation excavations. Do not place the foundation base until the excavation is accepted by the Engineer.

B. Excavate to elevations shown on Drawings, as needed to provide space for the foundation base, forming a level undisturbed surface, free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or a material as directed by the Engineer. Prior to placing material over it, recompact the subgrade, scarifying, as needed, to 95 percent of the maximum Standard Proctor Density according to ASTM D 698. If the specified level of compaction cannot be achieved, moisture condition the subgrade and recompact until 95 percent is achieved, over-excavate to provide a minimum layer of 24 inches of foundation backfill material, or other means acceptable to the Engineer.

C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by the Engineer.

D. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in a satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement.

E. Soils which become unsuitable due to inadequate dewatering or other causes, after initial excavation to the required subgrade, shall be removed and replaced with foundation backfill material, as directed by Engineer, at no additional cost to the Owner.

F. Place foundation base, or foundation backfill material, where needed, over the subgrade on same day that excavation is completed to final grade. Where base of excavations are left open for longer periods, protect them with a seal slab or cement-stabilized sand.

G. All crushed aggregate, and other free draining Class I materials, shall have a geotextile filter fabric separating it from native soils or select material backfill. The fabric shall overlap a minimum of 12 inches beyond where another material stops contact with the soil.

H. Crushed aggregate, and other Class I materials, shall be placed in uniform layers of 8-inch maximum thickness. Compaction shall be by means of at least two passes of a vibratory compactor.

3.07 FOUNDATION BASE

A. After the subgrade is properly prepared, including the placement of foundation backfill where needed, the foundation base shall be placed. The foundation base shall consist of a

12-inch layer of crushed aggregate or cement stabilized sand. Alternately, a 4-inch minimum seal slab may be placed. The foundation base shall extend a minimum of 12 inches beyond the edge of the structure foundation.

B. Where the foundation base and foundation backfill are of the same material, both can be placed in one operation.

3.08 BACKFILL

A. Complete backfill to surface of natural ground or to lines and grades shown on Drawings. Use existing material that qualifies as select material, unless indicated otherwise. Deposit backfill in uniform layers and compact each layer as specified.

B. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that the concrete has reached a minimum of 85 percent of the specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill operations until the slab or intermediate walls have been placed and concrete has attained sufficient strength.

C. Remove concrete forms before starting backfill and remove shoring and bracing as work progresses.

D. Maintain fill material at no less than 2 percent below nor more than 2 percent above optimum moisture content. Place fill material in uniform 8-inch maximum loose layers. Compaction of fill shall be to at least 95 percent of the maximum Standard Proctor Density according to ASTM D 698 under paved areas. Compact to at least 90 percent around structures below unpaved areas.

E. Where backfill is placed against a sloped excavation surface, run compaction equipment across the boundary of the cut slope and backfill to form a compacted slope surface for placement of the next layer of backfill.

F. Place backfill using cement-stabilized sand in accordance with Section 02252 - Cement Stabilized Sand.

3.09 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Tests will be performed initially on minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is a noticeable change in material gradation or plasticity.

C. In-place density tests of compacted subgrade and backfill will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at the following frequencies and conditions:

1. A minimum of one test for every 100 cubic yards of compacted backfill material.

2. A minimum three density tests for each full work shift.

3. Density tests will be performed in all placement areas.

4. The number of tests will be increased if inspection determines that soil types or moisture contents are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density.

D. At least three tests for moisture-density relationships will be initially performed for each type of backfill material in accordance with ASTM D 698. Additional moisture-density relationship tests will be performed whenever there is a noticeable change in material gradation or plasticity.

E. If tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

3.10 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess materials in accordance with requirements of Section 01564 - Waste Material Disposal.

END OF SECTION

SECTION 02227

EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

1.02 UNIT PRICES

A. No additional payment will be made for trench excavation, embedment and backfill. Include cost in the unit price for installed underground piping, sewer, conduit, or duct work.

B. No separate or additional payment will be made for surface water control or for excavation drainage. Include in the unit price for the installed piping, sewer, conduit, or duct work.

C. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Pipe Foundation: Suitable and stable native soils that are exposed at the trench subgrade after excavation to depth of bottom of the bedding as shown on the Drawings, or foundation backfill material placed and compacted in over-excavations.

B. Pipe Bedding: The portion of trench backfill that extends vertically from top of foundation up to a level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.

C. Haunching: The material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.

D. Initial Backfill: The portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to a level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.

E. Pipe Embedment: The portion of trench backfill that consists of bedding, haunching and initial backfill.

F. Trench Zone: The portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.

G. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that are classified as ML, CL-ML, MH, PT, OH and OL according to ASTM D 2487.

2. Materials that cannot be compacted to required density due to either gradation, plasticity, or moisture content.

3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.

4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

H. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement are considered suitable, unless otherwise indicated.

I. Backfill: Suitable material meeting specified quality requirements, placed and compacted under controlled conditions.

J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Section 01563 - Control of Ground Water and Surface Water.

K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as a part of excavation drainage.

L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using a drainage layer, as defined in ASTM D 2321, placed on the foundation beneath pipe bedding or thickened bedding layer of Class I material.

M. Trench Conditions are defined with regard to the stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.

1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as a result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.

2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.

a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.

b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in the embedment zone in combination with ground water control in predominately sandy or silty soils.

3. Unstable Trench: Unstable trench conditions exist in the pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.

N. Subtrench: Subtrench is a special case of benched excavation. Subtrench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of a subtrench depends upon trench stability and safety as determined by the Contractor.

O. Trench Dam: A placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along the trench.

P. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.

Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics, as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.

R. Trench Safety Systems include both Protective Systems and Shoring Systems as defined in Section 01526 - Trench Safety Systems.

S. Trench Shield (Trench Box): A portable worker safety structure moved along the trench as work proceeds, used as a Protective System and designed to withstand forces imposed on it by cave-in, thereby protecting persons within the trench. Trench shields may be stacked if so designed or placed in a series depending on depth and length of excavation to be protected.

T. Shoring System: A structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movements of the ground affecting adjacent installations or improvements.

U. Special Shoring: A shoring system meeting Special Shoring requirements for locations identified on the Drawings.

1.04 SCHEDULING

A. Schedule work so that pipe embedment can be completed on the same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

1.05 SUBMITTALS

A. Conform to Section 01300 - Submittals.

B. Submit a written description for information only of the planned typical method of excavation, backfill placement and compaction, including:

1. Sequence of work and coordination of activities.

2. Selected trench widths.

3. Procedures for foundation and embedment placement, and compaction.

4. Procedure for use of trench boxes and other premanufactured systems while assuring specified compaction against undisturbed soil.

5. Procedure for installation of Special Shoring at locations identified on the Drawings.

C. Submit a ground and surface water control plan in accordance with requirements in this Section and Section 01563 - Control of Ground Water and Surface Water.

D. Submit backfill material sources and product quality information in accordance with requirements of Section 02229 - Utility Backfill Materials.

E. Submit a trench excavation safety program in accordance with requirements of Section 01526 - Trench Safety System. Include designs for special shoring meeting the requirements defined in Paragraph 1.03.

F. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.

1.06 TESTS

A. Perform backfill material source qualification testing in accordance with requirements of Section 02229 - Utility Backfill Materials.

B. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the Owner in accordance with requirements of Section 01410 - Testing Laboratory Services and as specified in this Section.

1.07 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within the grading limits in accordance with requirements of Section 01535 - Tree and Plant Protection and Section 01500 - Temporary Facilities and Controls.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on the Drawings.

1.08 SPECIAL SHORING DESIGN REQUIREMENTS

A. Have Special Shoring designed or selected by the Contractor's Professional Engineer to provide support for the sides of the excavations, including soils and hydrostatic ground water pressures, as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a premanufactured system selected by the Contractors Professional Engineer to meet the project site requirements based on the manufacturer’s standard design.

PART 2 P R O D U C T S

2.01 EQUIPMENT

A. Perform excavation with hydraulic excavator or other equipment suitable for achieving the requirements of this Section.

B. Use only hand-operated tamping equipment until a minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.

C. Use trench shields or other Protective Systems or Shoring Systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.

D. Use Special Shoring systems, where required, which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting the Special Shoring design requirements.

2.02 MATERIAL CLASSIFICATIONS

A. Embedment and Trench Zone Backfill materials: Conform to the classifications and product descriptions of Section 02229 - Utility Backfill Materials.

B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Section 03305 - Concrete for Utility Construction.

C. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

D. Timber Shoring Left in Place: Untreated oak.

PART 3 E X E C U T I O N

3.01 STANDARD PRACTICE

A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between the standard practice and the requirements of this Section, this Section governs.

B. Install rigid pipe to conform to standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between the standard practice and the requirements of this Section, this Section governs.

3.02 PREPARATION

A. Establish traffic control to conform to requirements of Section 01570 - Traffic Control and Regulation. Maintain barricades and warning lights for streets and intersections where Work is in progress or where affected by the Work, and is considered hazardous to traffic movements.

B. Perform Work to conform to applicable safety standards and regulations. Employ a trench safety system as specified in Section 01526 - Trench Safety Systems.

C. Immediately notify the agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from the Engineer and agency for any repairs or relocations, either temporary or permanent.

D. Remove existing pavements and structures, including sidewalks and driveways, to conform to requirements of Section 02076 - Removing Existing Pavements and Structures, as applicable.

E. Install and operate necessary dewatering and surface water control measures to conform to Section 01563 - Control of Ground Water and Surface Water.

F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Section 01050 - Field Surveying.

3.03 EXCAVATION

A. Except as otherwise specified or shown on the Drawings, install underground utilities in open cut trenches with vertical sides.

B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on the Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.

C. Determine trench excavation widths using the following schedule as related to pipe outside diameter (O.D.). Maximum trench width shall be the minimum trench width plus 24 inches.

Nominal Pipe Size, Inches	Minimum Trench Width, Inches
Less than 18	O.D. + 18
18 to 30	O.D. + 24
Greater than 30	O.D. + 36

D. Use sufficient trench width or benches above the embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from the surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.

E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal or concealed conditions, discontinue work at that location. Notify the Engineer and obtain instructions before proceeding.

F. Shoring of Trench Walls.

1. Install Special Shoring in advance of trench excavation or simultaneously with the trench excavation, so that the soils within the full height of the trench excavation walls will remain fully laterally supported at all times.

2. For all types of shoring, support trench walls in the pipe embedment zone throughout the installation. Provide trench wall supports sufficiently tight to prevent washing the trench wall soil out from behind the trench wall support.

3. Unless otherwise directed by the Engineer, leave sheeting driven into or below the pipe embedment zone in place to preclude loss of support of foundation and embedment materials. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and the trench wall in the vicinity of the pipe zone.

4. Employ special methods for maintaining the integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.

5. If sheeting or other shoring is used below top of the pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into the embedment zone 1 inch. Fill voids left on removal of supports with compacted backfill material.

G. Use of Trench Shields. When a trench shield (trench box) is used as a worker safety device, the following requirements apply:

1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to the trench sidewalls.

2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor the degree of compaction reduced.

3. When required, place, spread, and compact pipe foundation and bedding materials beneath the shield. For backfill above bedding, lift the shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.

4. Maintain trench shield in position to allow sampling and testing to be performed in a safe manner.

3.04 HANDLING EXCAVATED MATERIALS

A. Use only excavated materials which are suitable as defined in this Section and conforming to Section 02229 - Utility Backfill Materials. Place material suitable for backfilling in stockpiles at a distance from the trench to prevent slides or cave-ins.

B. When required, provide additional backfill material conforming to requirements of Section 02229 - Utility Backfill Materials.

C. Do not place stockpiles of excavated materials on streets and adjacent properties. Maintain site conditions in accordance with Section 01500 - Temporary Facilities and Controls.

3.05 GROUND WATER CONTROL

A. Implement ground water control according to Section 01563 - Control of Ground Water and Surface Water. Provide a stable trench to allow installation in accordance with the Specifications.

3.06 TRENCH FOUNDATION

A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.

B. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams, as needed, to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.07 PIPE EMBEDMENT PLACEMENT AND COMPACTION

A. Immediately prior to placement of embedment materials, the bottoms and sidewalls of trenches shall be free of loose, sloughing, caving, or otherwise unsuitable soil.

B. Place geotextile to prevent particle migration from the in-situ into open-graded (Class I) embedment materials or drainage layers.

C. Place embedment including bedding, haunching and initial backfill to meet requirements indicated on Drawings.

D. For pipe installation, manually spread embedment materials around the pipe to provide uniform bearing and side support when compacted. Do not allow materials to free-fall from heights greater than 24 inches above top of pipe. Perform placement and compaction directly against the undisturbed soils in the trench sidewalls, or against sheeting which is to remain in place.

E. Do not place trench shields or shoring within height of the embedment zone unless means to maintain the density of compacted embedment material are used. If moveable supports are used in embedment zone, lift the supports incrementally to allow placement and compaction of the material against undisturbed soil.

F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.

G. Place haunching material manually around the pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside the pipe with sand bags or other suitable means.

H. Place electrical conduit directly on foundation without bedding.

I. Shovel pipe embedment material in place and compact it using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of the next lift.

1. Class I embedment materials.

a. Maximum 6-inches compacted lift thickness.

b. Systematic compaction by at least two passes of vibrating equipment. Increase compaction effort, as necessary, to effectively embed the pipe to meet the deflection test criteria.

c. Moisture content as determined by Contractor for effective compaction without softening the soil of trench bottom, foundation or trench walls.

2. Class II embedment and cement stabilized sand.

a. Maximum 6-inches compacted thickness.

b. Compaction by methods determined by Contractor to achieve a minimum of 95 percent of the maximum dry density as determined according to ASTM D 698 for Class II materials and according to ASTM D 558 for cement stabilized materials.

c. Moisture content of Class II materials within 3 percent of optimum as determined according to ASTM D 698. Moisture content of cement stabilized sands on the dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.

J. Place trench dams in Class I embedments in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams, as needed, to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.08 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only the minimum length of trench open as necessary for construction.

B. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave the sheeting in place. Cut off sheeting 1.5 feet or more above the crown of the pipe. Remove trench supports within 5 feet from the ground surface.

C. For sewer pipes, use backfill materials as shown on the drawings and as specified in Section 02229 - Utility Backfill materials.

D. For water lines, use backfill materials as shown on the drawings and as specified in Section 02229 - Utility Backfill materials.

E. For trench excavations under pavement, place trench zone backfill in lifts and compact by methods indicated below. Fully compact each lift before placement of the next lift.

1. Bank run sand.

a. Maximum 9-inches compacted lift thickness.

b. Compaction by vibratory equipment to a minimum of 95 percent of the maximum dry density determined according to ASTM D 698.

c. Moisture content within 3 percent of optimum determined according to ASTM D 698.

2. Cement-stabilized sand.

a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but not exceeding 12 inches.

b. Compaction by vibratory equipment to a minimum of 95 percent of the maximum dry density determined according to ASTM D 558.

c. Moisture content on the dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.

3. Select fill.

a. Maximum 6-inches compacted thickness.

b. Compaction by equipment providing tamping or kneading impact to a minimum of 95 percent of the maximum dry density determined according to ASTM D 698.

c. Moisture content within 2 percent of optimum determined according to ASTM D 698.

4. Random fill.

a. If the required density is not achieved, the Contractor, at his option and at no additional cost to the Owner, may use lime stabilization to achieve compaction requirements or use a different suitable material.

b. Maximum 9-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.

c. Compact to a minimum of 90 percent of the maximum dry density determined according to ASTM D 698, or to same density as adjacent soils.

d. Moisture content, as necessary, to achieve density.

3.09 MANHOLES, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES

A. Meet the requirements of adjoining utility installations for backfill of pipeline structures, as shown on the Drawings.

3.10 FIELD QUALITY CONTROL

A. Test for material source qualifications as defined in Section 02229 - Utility Backfill Materials.

B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction.

C. Tests will be performed on a minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is a noticeable change in material gradation or plasticity.

D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Additional moisture-density relationship tests will be performed whenever there is a noticeable change in material gradation or plasticity.

E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at the following frequencies and conditions:

1. A minimum of one test for every 20 cubic yards of compacted embedment and for every 50 cubic yards of compacted trench zone backfill material.

2. A minimum of three density tests for each full shift of Work.

3. Density tests will be distributed among the placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.

4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.

5. Density tests may be performed at various depths below the fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.

6. Two verification tests will be performed adjacent to in-place tests showing density less than the acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.

7. Recompacted placement will be retested at the same frequency as the first test series, including verification tests.

F. Recondition, recompact, and retest at Contractor's expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor's expense.

G. Acceptability of crushed rock compaction will be determined by inspection.

3.11 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess materials in accordance with requirements of Section 01564 - Waste Material Disposal.

3.12 CRITICAL LOCATION INVESTIGATION

A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water mains, gas lines, storm sewers, sanitary sewers, telephone lines, electric lines or power ducts, pipelines (petrochemical or petroleum product), concrete and debris, are based on best information available but are only approximate locations. At Critical Locations shown on Drawings, field verify horizontal and vertical locations of such lines within a zone 2 feet vertically and 4 feet horizontally of proposed main. Verify location of existing utilities prior to commencing construction. Use extreme caution and care when uncovering these lines. Any damage to known or unknown utilities or obstructions occurring during "Critical Location Investigation" will be full responsibility of Contractor. No separate payment shall be made for performing such efforts.

B. Prior to actual field verification phase, notify all utility companies involved and request that their respective utility lines be marked in field. If any utility or pipeline company requires their line be excavated, or exposed prior to construction, comply with that request and utilize a methodology approved by the said company in locating or exposing their lines. Provide Engineer with 48 hours notice prior to any field excavation or related work.

C. Once known, unknown or potential obstructions have been uncovered, survey vertical and horizontal locations relative to project baseline and datum and plot on 11" X 17" copy of Drawings.

D. Submit 11" X 17" copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to Engineer before or simultaneous with pipe shop drawing submittal.

E. Engineer will promptly review "Critical Location Report" and approve construction of proposed main as designed or modify design if necessary. Contractor will be promptly notified of any design modifications.

END OF SECTION

SECTION 02229

UTILITY BACKFILL MATERIALS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Material Classifications

B. Utility Backfill Materials

1. Concrete sand.

2. Gem sand.

3. Pea gravel.

4. Crushed stone.

5. Crushed concrete.

6. Bank run sand.

7. Select backfill.

8. Random backfill.

C. Material handling and quality control requirements.

1.02 UNIT PRICES

A. No payment will be made for backfill material unless specifically listed in the bid proposal. Include payment in unit price for applicable utility installation.

B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Backfill: Suitable material meeting specified quality requirements for the designated application as embedment or trench zone backfill.

B. Embedment: Material placed under controlled conditions within the embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.

C. Trench Zone Backfill: Material meeting specified quality requirements and placed under controlled conditions in the trench zone from top of embedment zone to base course in paved areas or to the surface grading material in unpaved areas.

D. Foundation: Either suitable soil of the trench bottom, or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.

E. Source: A source selected by the Contractor for supply of embedment or trench zone backfill material. A selected source may be the project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.

F. Refer to Section 02227 - Excavation and Backfill for Utilities, for other definitions regarding utility installation by trench construction.

1.04 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittals.

B. Submit a description of source, material classification and product description, production method, and application of backfill materials.

C. Submit test results for samples of off-site backfill materials to comply with Paragraph 3.03, Material Quality Control.

D. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that the Engineer may obtain samples for verification testing.

E. Before stockpiling materials, submit a copy of temporary easement or approval from landowner for stockpiling backfill material on private property.

1.05 TESTS

A. Perform tests of sources for backfill material in accordance with Paragraph 3.03A.

B. Verification tests of backfill materials may be performed by the Owner in accordance with Section 01410 - Testing Laboratory Services and in accordance with Paragraph 3.03B.

C. Random fill obtained from the Project excavation as source is exempt from prequalification requirements by Contractor, but must be inspected for unacceptable materials based on ASTM D 2488.

PART 2 P R O D U C T S

2.01 MATERIAL CLASSIFICATIONS

A. Materials for backfill shall be classified for the purpose of quality control in accordance with the Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.

B. Class Designations Based on Laboratory Testing:

1. Class I: Well graded sands and gravels, gravel-sand mixtures, crushed well graded rock, little or no fines (GW, SW)

   a. Plasticity Index: Nonplastic

   b. Gradation: D_{60}/D_{10} - greater than 4 percent. Amount passing No. 200 Sieve - less than or equal to 5 percent

2. Class II: Poorly graded gravels and sands, silty sands and gravels, little to moderate fines (GM, GP, SP, SM)

   a. Plasticity Index: Nonplastic to 4

   b. Gradation (GP, SP): Amount passing No. 200 Sieve - less than 5 percent

   c. Gradation (GM, SM): Amount passing No. 200 Sieve - between 12 percent and 50 percent

3. Class III: Clayey gravels and sands, poorly graded mixtures of sand, gravel, and clay (GC, SC)

   a. Plasticity Index: greater than 7

   b. Gradation: Amount passing No. 200 Sieve - between 12 percent and 50 percent

4. Class IV: Lean clays (CL)

   a. Plasticity Index: greater than 7

   b. Liquid Limit: less than 50

   c. Gradation: Amount passing No. 200 Sieve - greater than 50 percent

   d. Inorganic

5. Use soils with dual class designation according to ASTM D 2487 according to the more restrictive class.

2.02 PRODUCT DESCRIPTIONS

A. Soils classified as silt (ML), silty clay (CL - ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Engineer. Soils classified as fat clay (CH) may be used as backfill materials where allowed by the applicable backfill installation specification. Refer to Section 02226 - Excavation and Backfill for Structures and Section 02227 - Excavation and Backfill for Utilities.

B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to the following limits for deleterious materials:

1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.

2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.

3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.

C. Manufactured materials may be substituted for natural soil or rock products where indicated in the product specification, and approved by Engineer, provided that the physical property criteria are determined to be satisfactory by testing.

D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by the Unified Soil Classification System (ASTM D 2487) meeting the following requirements:

1. Less than 15 percent passing the number 200 sieve when tested in accordance with ASTM C 136. The amount of clay lumps or balls not exceeding 2 percent.

2. Material passing the number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318:

a. Liquid limit not exceeding 25.

b. Plasticity index not exceeding 7.

E. Concrete Sand: Natural sand, manufactured sand, or a combination of natural and manufactured sand conforming to the requirements of ASTM C 33 and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8”	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

F. Gem Sand: Sand conforming to the requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8”	95 to 100
No. 4	60 to 80
No. 8	15 to 40

G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
2”	100
3/8”	85 to 100
No. 4	10 to 30
No. 8	0 to 10
N0. 16	0 to 5

H. Crushed Aggregates: All crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. All materials of one product delivered for the same construction activity from a single source.

2. Non-plastic fines.

3. Los Angeles abrasion test wear not exceeding 40 percent when tested in accordance with ASTM C 131.

4. Gradations, as determined in accordance with TEX-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment By Ranges of Nominal Pipes Sizes		
	>15”	15” – 8”	<8”
1”	95 - 100	100	-
3/4"	60 – 90	90 – 100	100
2”	25 – 60	-	90 – 100
3/8”	-	20 – 55	40 – 70
No. 4	0 – 5	0 – 10	0 - 15
No. 8	-	0 – 5	0 - 5

5. Crushed stone: Produced from oversize quarried aggregate, sized by crushing from a naturally occurring single source. Crushed gravel or uncrushed gravel are not acceptable materials for utility embedment.

6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are the same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, base course material, reinforcing steel fragments, soil, debris, or deteriorated concrete fragments.

I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Section 02570 - Pavement Repair and Resurfacing, to meet plasticity criteria.

J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by the applicable backfill installation specification. Refer to

Section 02226 - Excavation and Backfill for Structures and Section 02227 - Excavation and Backfill for Utilities.

K. Cement Stabilized Sand: Conform to requirements of Section 02252 - Cement Stabilized Sand.

L. Concrete Backfill: Conform to Class B concrete as specified in Section 03305 - Concrete for Utility Construction or Section 03310 - Concrete for Structures.

M. Pavement Restoraton: Conform to requirements of Section 02570 - Pavement Repair and Resurfacing.

PART 3 E X E C U T I O N

3.01 SOURCES

A. Use of material encountered in the trench excavations is acceptable, provided applicable specification requirements are satisfied. If excavation material is not acceptable, provide from other source.

B. Obtain approval for each material source by the Engineer before delivery is started. If sources previously approved do not produce uniform and satisfactory products, furnish materials from other approved sources. All materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet the requirements of the specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once a material is approved by the Engineer, expense for sampling and testing required to change to a different material will be credited to the Owner through a change order.

C. Bank run sand, select backfill, and random backfill, if available in the Project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete the work from off-site sources.

D. The Owner does not represent or guarantee that any soil found in the excavation work will be suitable and acceptable as backfill material.

3.02 MATERIAL HANDLING

A. When backfill material is obtained from either a commercial or non-commercial borrow pit, have that pit opened to expose the vertical faces of the various strata of acceptable material to be used. Excavate the material by vertical cuts extending through the exposed strata to achieve uniformity in the product.

B. Establish temporary stockpile locations for practical material handling and control, and verification testing by the Engineer in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.

C. When stockpiling backfill material near the Project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering the drainage system.

D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.03 MATERIAL QUALITY CONTROL

A. Ensure that material selected, produced and delivered to the Project meets applicable specifications and is of sufficient uniform properties to allow practical construction and quality control. Responsibilities include:

1. Source or Supplier Qualification. Perform testing, or obtain representative tests by suppliers, for selection of material sources and products. Provide test results for a minimum of three samples for each source and material type. Test samples of processed materials from current production representing material to be delivered. Tests shall verify that the materials meet specification requirements. Repeat qualification test procedures each time the source characteristic changes or there is a planned change in source location or supplier. Qualification tests shall include, as applicable:

a. Gradation. Complete sieve analyses shall be reported regardless of the specified control sieves. The range of sieves shall be from the largest particle through the No. 200 sieve.

b. Plasticity

c. Los Angeles abrasion

d. Clay lumps

e. Light weight pieces

f. Organic impurities

2. Production Testing. Establish a program to provide assurance that backfill materials delivered from the sources and placed in the Work meet applicable specification requirements. Report results to the Engineer.

3. Assist the Engineer in obtaining material samples for verification testing at the source or at the production plant.

4. Notify the Engineer in the field when non-conforming material is detected.

B. Quality Control

1. The Engineer may sample and test backfill at:

a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.

b. On-site stockpiles.

c. Materials placed in the Work.

2. The Engineer may resample material at any stage of work or location if changes in characteristics are apparent.

3. The Engineer will notify Contractor at the Project site about non-conforming materials and will, as appropriate, resample materials to verify results.

C. Tolerances

The following tolerances apply to production quality control testing.

1. Embedment Material and Select Backfill: The Engineer may accept material provided that not more than one out of the most recent five consecutive tests are out of the specification limits for:

a. Gradation: Not more than 5 percentage points on any individual sieve.

b. Plasticity: Not more than 2 percentage points.

2. Trench Zone Backfill Material: Except for select and random backfill, the Engineer may accept the material provided that not more than one out of the most recent three consecutive tests are out of the specification limits for:

a. Gradation: Not more than 8 percentage points on any individual sieve.

b. Plasticity: Not more than 5 percentage points.

3. Select and Random Backfill: No quantified tolerances. Remove non-conforming material identifiable by visual-manual procedure.

END OF SECTION

SECTION 02231

CRUSHED STONE FLEXIBLE BASE COURSE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of crushed concrete or stone.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit samples of flexible base course and soil binder for testing.

1.04 TESTS

A. Tests and analysis of soil materials will be performed in accordance with ASTM C131, ASTM D1557, ASTM D4318, Tex-101-E, and Tex-110-E under provisions of Section 01410 - Testing Laboratory Services.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stockpiles shall be made up of layers of processed aggregate materials. Load material by making successive vertical cuts through entire depth of stockpile.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Crushed Stone or Concrete: Material retained on the No. 40 Sieve meeting the following requirements:

1. Durable particles of crusher-run broken limestone, sandstone, granite or crushed concrete obtained from an approved source.

2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C131.

3. Recycled crushed concrete must be free from reinforcing steel and other objectionable material.

B. Soil Binder: Material passing the No. 40 Sieve meeting the following requirements when tested in accordance with ASTM D4318:

1. Maximum Liquid Limit: 40.

2. Maximum Plasticity Index: 12.

3. Maximum Lineal Shrinkage: 7 (when calculated from volumetric shrinkage at liquid limit).

C. Mixed Materials shall meet the following requirements:

1. Minimum compressive strength of 35 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure using triaxial testing procedures.

2. Grading in accordance with Tex-101-E and Tex-110-E within the following limits:

Sieve	Percent Retained
1-3/4 inch	0 to 10
No. 4	45 to 75
No. 40	60 to 85

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Prepare subgrade in accordance with requirements of Section 02221 and Section 02225 or Sections 02241.

C. Correct subgrade deviations in excess of plus or minus 1/2 inch in cross section, or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

D. Prepare sufficient subgrade in advance of base course operations.

3.03 PLACEMENT

A. Spread and shape in lifts to compacted thickness not to exceed 8 inches. Complete spreading, shaping, and compacting on same day material is deposited.

B. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Secure a firm bond between reinforcement and base.

C. Start rolling operations as soon as possible after placement. Use sheepfoot, steel, or pneumatic rollers as approved. Roll longitudinally with subgrade starting from sides. Overlap successive strips by one-half width of each rear wheel.

D. Maintain moisture between optimum and 3 percent above optimum moisture.

E. Compact to 95 percent of Modified Proctor density in accordance with ASTM D1557, unless otherwise indicated on the Drawings.

F. Finish to grade and compact lift before placing successive lift.

G. Maintain shape by grading throughout operation.

H. Provide total thickness indicated on Drawings.

3.04 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top surface of embankment: Plus or minus 1/4 inch in cross section, or in 16 foot length.

3.05 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one core will be taken at random locations per 1,000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no additional cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 at a random location near each depth determination core. Rework and recompact areas that do not conform to compaction requirements.

E. Fill cores and density test sections with new compacted crushed stone flexible base.

3.06 PROTECTION

A. Sprinkle to prevent excessive loss of moisture.

B. Restrict construction traffic on finished base to equipment required to complete the work.

END OF SECTION

SECTION 02238

HOT MIX ASPHALTIC BASE COURSE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of compacted a mixture of coarse and fine aggregates, and asphaltic material.

1.02 UNIT PRICES

A. No separate payment will be made for hot mix asphaltic base course under this Section. Include payment in unit price for asphaltic concrete pavement.

B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

C. Refer to paragraph 3.10 for unit price adjustments.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit certificates that asphaltic materials and aggregates meet requirements of paragraph 2.01.

C. Submit proposed design mix and test data for each type and strength of base course in Work.

D. Submit manufacturer's description and characteristics of mixing plant for approval.

E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Coarse Aggregate: Gravel or crushed stone, or combination thereof that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic, or other injurious matter occurring either free or as coating on aggregate. Aggregate shall conform to ASTM C33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C131.

B. Fine Aggregate: Sand or stone screenings, or combination thereof, passing No. 10 sieve. Aggregate shall conform to ASTM C33 except for gradation. Use sand composed of

sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by Tex-106-E. Sand equivalent shall have a minimum value of 45 when tested by Tex-203-F.

C. Composite Aggregate: Conform to the grading limits of TxDOT Item 340 for the paving type indicated on the Drawings.

D. Asphaltic Material: Moisture-free homogeneous material which will not foam when heated to 347 degrees F, meeting the following requirements:

VISCOSITY GRADE				
TEST	AC-10		AC-20	
	MIN	MAX	MIN	MAX
Viscosity, 140°F stokes	1000	200	2000	400
Viscosity, 275°F stokes	1.9	-	2.5	-
Penetration, 77°F, 100 g, 5 sec.	85	-	55	-
Flash Point, C.E.C., F.	450	-	450	-
Solubility in trichloroethylene, percent	99.0	-	99.0	-
Tests on residues from thin film oven tests:				
Viscosity, 140°F stokes	-	3000	-	6000
Ductility, 77°F, 5 cms per min., cms	70	-		
Spot tests	Negative for all grades			

1. Material shall not be cracked.

2. Engineer will designate grade of asphalt to use after design tests have been made. Use only one grade of asphalt after grade is determined by test design for project.

2.02 EQUIPMENT

A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuously mixtures meeting specifications. Plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.

Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:

1. Cold aggregate bins and proportioning device
2. Dryer
3. Screens
4. Aggregate weight box and batching scales
5. Mixer
6. Asphalt storage and heating devices
7. Asphalt measuring devices
8. Truck scales

B. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix.

2.03 MIXES

A. Employ and pay certified testing laboratory to prepare design mixes. Test in accordance with Tex-126-E, Tex-204-F, Tex-208-F, and Tex-227-F.

B. Density and Stability Requirements:

Percent Density		Percent	HVEEM Stability Percent
Min	Max	Optimum	Not Less Than
95	99	97	35

C. Proportions for Asphaltic Material: As specified in TxDOT Item 340 for the mix type shown on the Drawings.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Prepare subgrade in accordance with requirements of Section 02221 and Section 02225 or Section 02241.

C. Correct subgrade deviations in excess of plus or minus 1/2 inch in cross section, or in 16-foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

D. Prepare sufficient subgrade in advance of base course for efficient operations.

3.03 PRIME COAT

A. Conform to requirements of Section 02511.

3.04 TACK COAT

A. Conform to requirements of Section 02512.

3.05 PLACEMENT

A. Do not place asphaltic base when air temperature is below 50 degrees F and falling. Base may be placed when air temperature taken in shade and away from artificial heat is above 40 degrees F and rising.

B. Haul prepared and heated asphaltic concrete mixture to project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.

C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type. Use track-mounted finish machine to place base course directly on earth subgrade.

D. Place base courses 4 inches or greater in thickness in two or more layers, each having compacted thickness of not greater than 4 inches. Spread all lifts. Attain smooth course of uniform density to section, line and grades as indicated on Drawings.

E. Place courses as nearly continuously as possible. Pass roller over unprotected ends of freshly laid mixture only when mixture has become cooled. When work is resumed, cut back laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.

F. When new asphalt is laid against existing asphalt, existing asphalt shall be saw cut full depth to provide straight smooth joint.

G. In restricted areas where use of paver is impractical, spread and finish asphalt by mechanical compactor. Use wood or steel forms, rigidly supported to assure correct grade and cross section. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove any lumps that do not break down readily. Place asphalt courses in same sequence as if placed by machine.

3.06 COMPACTION

A. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hair cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water.

B. Compress surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing from 8 to 10 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and all rolling marks are eliminated. Complete all rolling before mixture temperature drops below 175 degrees F.

C. Along walls, curbs, headers and similar structures, and in all locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.

D. Compact base course to density not less than 92 percent of maximum possible density of voidless mixture composed of same materials in like proportions.

3.07 TOLERANCES

A. Furnish templates for checking surface of finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.

B. Completed surface, when tested with 10-foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct any surface not meeting this requirement.

3.08 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Minimum of one core will be taken at random locations per 1000 feet per lane of roadway or 500 square yards of base to determine in-place depth and density.

C. In-place density will be determined in accordance with Tex-207-F and Tex-227-F from cores or sections of asphaltic base located near each core. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by the Engineer.

D. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

E. Fill cores and density test sections with new compacted asphaltic base.

3.09 NONCONFORMING PAVEMENT

A. Recompact pavement sections not meeting specified densities or replace them with new asphaltic concrete material. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute.

B. Remove and replace areas of asphaltic base found deficient in thickness by more than 10 percent. Use new asphaltic base of thickness shown on Drawings.

C. Nonconforming pavement sections shall be replaced at no additional cost to Owner.

3.10 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to lower limit of 90 percent of unit price bid.

3. Average depth below 90 percent may be rejected by the Engineer.

3.11 PROTECTION

A. Do not open base to traffic until 12 hours after completion of rolling, or as shown on Drawings.

B. Maintain asphalt base in good condition until completion of Work.

C. Repair defects immediately by replacing base to full depth.

END OF SECTION

SECTION 02241

LIME STABILIZED SUBGRADE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of lime stabilized natural subgrade material.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit certificates stating that hydrated lime, quicklime, or commercial lime slurry complies with these specifications.

C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.

D. Submit manufacturer's description and characteristics for rotary speed mixer and compaction equipment for approval.

1.04 TESTS

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.

C. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.

D. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.

E. Soil will be evaluated to establish percent of hydrated lime, quicklime, or lime slurry to be applied to subgrade material.

F. Moisture-density relationship will be established on material sample from roadway, after stabilization with lime, in accordance with ASTM D698.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Bagged lime shall bear manufacturer's name, product identification, and certified weight. Bags varying more than 5 percent of certified weight may be rejected; average weight of 50 random bags in each shipment shall not be less than certified weight.

B. Store lime in weatherproof enclosures. Protect lime from ground dampness.

C. Quicklime can be dangerous; exercise extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

PART 2 P R O D U C T S

2.01 WATER

A. Water shall be clean; clear; and free from oil, acids, alkali, or organic matter.

2.02 LIME

A. Type A - Hydrated lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide and magnesium hydroxide.

B. Type B - Commercial lime slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.

C. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:

1. Grade DS: Pebble quicklime of a gradation suitable for use in the preparation of a slurry for wet placing.

2. Grade S: Finely-graded quicklime for use in the preparation of a slurry for wet placing. Do not use grade S quicklime for dry placing.

D. Lime shall conform to following requirements:

CHEMICAL COMPOSITION	TYPE		
	A	B	C
Active lime content, % by weight $Ca(OH)_2$+CaO	90.0 min[1]	87.0 min[2]	-
Unhydrated lime content, % by weight CaO	5.0 max	-	87.0 min
Free water content, % by weight H_2O:	5.0 max	-	-
SIZING			
Wet Sieve, as % by weight residue retained:			
No. 6	0.2 max	0.2 max[2]	8.0 max[3]
No. 30	4.0 max	4.0 max[2]	-
Dry sieve, as % by weight residue retained:			
1 – inch	-	-	0.0
3/4-inch	-	-	10.0 max

Notes:

1. Maximum 5.0% by weight CaO shall be allowed in determining total active lime content.
2. Maximum solids content of slurry.
3. Total active lime content, as CaO, in material retained on the No. 6 sieve shall not exceed 2.0% by weight of original Type C lime.

E. Lime slurry may be delivered to the job site as commercial lime, or may be prepared at the job site by using hydrated lime or quicklime. The slurry shall be free of liquids other than water and shall be of a consistency that can be handled and uniformly applied without difficulty.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify subgrade lines and grades are correct.

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Cut material to bottom of subgrade using an approved cutting and pulverizing machine meeting following requirements:

1. Cutters accurately provide a smooth surface over entire width of cut to plane of secondary grade.

2. Visible indication that cut is to proper depth.

C. Alternatively, scarify or excavate to bottom of stabilized subgrade. Remove material or windrow to expose secondary grade. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting. Obtain uniform stability.

D. Proof roll subgrade prior to lime application.

3.03 LIME SLURRY APPLICATION

A. Mix hydrated lime or quicklime with water to form a slurry of the solids content specified. Commercial lime slurry shall have dry solids content as specified. Conform to cautionary requirements of Paragraph 1.05C concerning use of quicklime.

B. Apply slurry with a distributer truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on the same working day.

C. Apply so that dry subgrade will contain a minimum lime content of 5 percent by weight of dry subgrade unless otherwise instructed by Testing Laboratory.

3.04 PRELIMINARY MIXING

A. Do not mix and place material when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.

B. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.

C. Shape mixed subgrade to final lines and grades.

D. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.05C can be met during preliminary mixing:

1. Seal subgrade as a precaution against heavy rainfall by rolling lightly with light pneumatic rollers.

2. Cure soil-lime material for 1 to 4 days. Keep subgrade moist during cure.

3.05 FINAL MIXING

A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.

B. Add water to bring moisture content of soil mixture to a minimum of optimum or above.

C. Mix and pulverize until all material passes a 1-3/4-inch sieve; a minimum of 85 percent, excluding nonslacking fractions, passes a 3/4-inch sieve; and a minimum of 60 percent excluding nonslacking fractions passes a No. 4 sieve.

D. Shape mixed subgrade to final lines and grades.

E. Do not expose hydrated lime to open air for 6 hours or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

3.06 COMPACTION

A. Aerate or sprinkle to attain optimum moisture content as determined by Testing Laboratory. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.

B. Start compaction immediately after final mixing, unless approved by Engineer.

C. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches.

D. Compact with approved heavy pneumatic or vibrating rollers, or a combination of tamping rollers and light pneumatic rollers. Begin compaction at the bottom and continue until entire depth is uniformly compacted.

E. Do not allow stabilized base to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.

F. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:

1. Areas to receive pavement without subsequent base course: Minimum density of 98 percent of maximum dry density.

2. Areas to receive subsequent base course: Minimum density of 95 percent of maximum dry density.

G. Seal with approved light pneumatic tired rollers: Prevent surface hair line cracking. Rework and recompact at areas where hairline cracking develops.

3.07 CURING

A. Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. Time may be adjusted as approved by Engineer. Subgrade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

B. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

C. Place base, surface, or seal course within 14 days after final mixing and compaction unless prior approval is obtained from Engineer.

3.08 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16-foot length.

3.09 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one phenolphthalein test will be made at random locations per 1000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017 at a random location near depth determination tests. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.

E. Fill test sections with new compacted lime stabilized subgrade.

3.10 PROTECTION

A. Maintain stabilized subgrade to lines and grades and in good condition until placement of base or surface course. Protect the asphalt membrane, if used, from being picked up by traffic.

B. Repair defects immediately by replacing material to full depth.

END OF SECTION

SECTION 02242

LIME FLY ASH STABILIZED SUBGRADE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of lime-fly ash stabilized natural subgrade material.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit certificates stating that fly ash, hydrated lime, quicklime, or commercial lime slurry complies with these specifications.

C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.

D. Submit manufacturer's description and characteristics for rotary speed mixer and compaction equipment for approval.

1.04 TESTS

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.

C. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.

D. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.

E. Soil will be evaluated to establish percent of fly ash and hydrated lime, quicklime, or lime slurry to be applied to subgrade material.

F. Moisture-density relationship will be established on material sample from roadway, after stabilization with lime-fly ash, in accordance with ASTM D698.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Conform to requirements of Section 02241 - Lime Stabilized Subgrade.

B. Quicklime can be dangerous: exercise extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Water shall be clean; clear; and free from oil, acids, alkali, or vegetable matter.

B. Type A - hydrated lime, Type C - quicklime, and Type B - commercial lime slurry shall conform to requirements of Section 02241 - Lime Stabilized Subgrade.

C. Fly Ash: Residue or ash remaining after burning finely pulverized coal at high temperatures conforming to the requirements of ASTM C618, Class C, and the following:

1. Have a minimum CaO content of 20 percent.

2. Loss on ignition shall not exceed 3 percent.

3. Contain no lignite ash.

D. Asphaltic seal cure: Conform to requirements of Section 02241.

PART 3 E X E C U T I O N

3.01 Conform to execution requirements in Part 3 of Section 02241 - Lime Stabilized Subgrade with the following exceptions and additions:

A. All references to lime or lime slurry shall include fly ash as appropriate for application, mixing, and compaction.

B. Contractor shall conduct operations to minimize elapsed time between mixing and compacting fly-ash stabilized subgrade in order to take advantage of rapid initial set characteristics. Complete compaction within 2 hours of commencing compaction, and not more than 6 hours after adding and mixing the fly-ash.

C. Application of Fly Ash. Unless otherwise approved by the Engineer, fly ash shall be distributed in the dry form only by a distributor approved by the Engineer. Application of fly ash shall begin within four (4) calendar days after the lime mixing operation has been completed, unless approved by the Engineer. Fly ash shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing fly ash becomes objectionable to adjacent property owners or dangerous to traffic. The mixture shall be sprinkled as approved by the Engineer. Fly ash shall be uniformly spread only on that area where the mixing and compacting operations can be completed during the same working day. A motor grader shall not be used to spread fly ash. Initial mixing after the

addition of fly ash shall be accomplished dry or with a minimum of water to prevent fly ash balls.

END OF SECTION

SECTION 02243

CEMENT STABILIZED SUBGRADE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of cement stabilized natural subgrade material.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit certificates stating that cement slurry complies with these specifications.

C. Submit weight tickets, certified by supplier, with each bulk delivery of cement to work site.

1.04 TESTS

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.

C. Soil will be evaluated to establish percent of cement slurry to be applied to subgrade material in accordance with Test Method Tex-120-E.

D. Moisture-density relationship will be established on material sample from roadway, after stabilization with cement, in accordance with ASTM D558.

PART 2 P R O D U C T S

2.01 WATER

A. Water shall be clean; clear; and free from oil, acids, alkali, or vegetable matter.

2.02 PORTLAND CEMENT

A. Portland Cement shall meet minimum material requirements for ASTM C150 Type I.

B. Provide cement slurry free of objectionable materials and with a uniform consistency that can be easily applied.

C. Slurry shall meet the following requirements:

Mix Property	Test Procedure	Requirement
Percent Solids	TEX-103-E, Part I	55% (Min.)
Viscosity*	TEX-130-E, Part IV	1 minute (Min.)

*Note: Perform test 30 minutes after batching with a min. 60 second flow rate.

PART 3 E X E C U T I O N

3.01 EQUIPMENT

A. Provide approved mixing equipment capable of mixing the subgrade material and cement slurry to the required depth to a homogeneous mixture free of clods and lumps.

B. Cement Slurry Equipment - Provide a mixing plant, tools and equipment necessary for proper mixing and delivery of slurry.

1. Storage Facility - Store all components, except water, in weatherproof containers.

2. Slurry Plant - Provide a pneumatic/hydraulic mixing plant with monitoring devices to regulate flow rates and line pressures. Regulate slurry proportions by calibrated scales. Include all storage silos, weather protection, sheds, scales, pumps, mixers, valves, gauges and regulating devices required to continuously measure and mix cementitious slurry at the batch plant. The plant should provide safe and easy access for the QC personnel so they may obtain samples. All mechanical mixing must be pump driven and cannot rely on lime slaking tanks, paddle driven mixers or other similar technology.

3. Delivery equipment - Deliver slurry to the project site in a non-baffle tank. Do not stir or agitate with any form of mechanical device. Application of the slurry shall be through a gravity fed spreader type bar or tube that expels the slurry in a uniform manner behind the vehicle.

3.02 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify subgrade lines and grades are correct.

3.03 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Proof roll subgrade prior to cement slurry application and correct identified weak areas as directed by the Engineer.

3.04 PLACEMENT

A. Do not mix and place cement when temperature is below 40 degrees F and falling. Suspend application when the Engineer determines that weather conditions are unsuitable.

B. Pulverize or scarify existing material after shaping so that 100% passes a 2-1/2-inch sieve. If the material cannot be uniformly processed to the required depth in a single pass, excavate and windrow the material to expose a secondary grade to achieve process to plan depth.

C. Cement content shall be selected by the Engineer based on compressive strength tests on soil samples of the natural subgrade material. The mix design shall be performed in accordance with Test Method Tex-120-E. The cement content shall be selected so the subgrade material, when placed as described in this Section, shall have a minimum compressive strength of 100 psi at 48 hours when tested in accordance with Tex-120-E.

D. Cement shall be uniformly applied on the prepared subgrade (as described above) using slurry placement only in that area where the mixing, compacting, and finishing operations can be completed during the same working day.

E. Slurry Placement: Mix the required quantity of cement with water, as approved. Provide slurry free of objectionable materials and with a uniform consistency that can be easily applied. Apply slurry within 2 hours of adding water. Distribute slurry uniformly by making successive passes over a measured section of the roadway until the specified content is reached.

F. Thoroughly mix the material and slurry using approved equipment. Mix until a homogeneous mixture is obtained. Sprinkle the treated materials during the mixing operation to maintain optimum mixing moisture within two percentage points. Spread and shape the completed mixture in a uniform layer to final lines and grades.

G. After mixing, the Engineer will sample the mixture at roadway moisture and test in accordance with Tex-101-E, Part III, to determine compliance with the gradation requirements as follows: all material passes a 1-3/4-inch sieve; a minimum of 85 percent passes a 3/4-inch sieve; and a minimum of 60 percent passes a No. 4 sieve.

3.05 COMPACTION

A. Compact the mixture to a minimum of 95% of the maximum dry density as determined by ASTM D698. Complete compaction within 2 hours after the initial application of cement slurry.

B. Finish the compacted subgrade by skinning or blading with a maintainer, removing all loose material from the surface. The surface shall be sprinkled with small amounts of water as needed while rolling with a pneumatic tired roller. The pneumatic tired roller used for finish rolling shall be light enough to prevent surface cracking. Rework and recompact those areas where cracking develops.

C. Maintain a smooth surface conforming to the lines, grades, and cross sections shown on the plans.

3.06 CURING

A. Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. Time may be adjusted as approved by Engineer. Subgrade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

B. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

3.07 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16-foot length.

3.08 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one core will be taken at random locations per 1,000 linear feet per lane of roadway or 500 square yards of subgrade to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D6938 at a random location near each depth determination core. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.

E. Fill test sections with new compacted cement stabilized subgrade.

END OF SECTION

SECTION 02244

CEMENT STABILIZED BASE COURSE (ROAD MIXED)

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of cement treated base constructed by in-place pulverization and blending of the existing flexible pavement, including existing base material, and the introduction of additives.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ASTM C131 - Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

B. ASTM C150 - Specification for Portland Cement.

C. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil using Standard Effort.

D. ASTM D1556 - Test Methods for Density and Unit Weight of Soil in Place by the Sand Cone Method.

E. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

F. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

G. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.

H. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.

I. TxDOT Tex-120-E - Soil-Cement Testing.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit Samples of pulverized road base and new aggregate for testing at least 14 days prior to start of construction.

C. Submit manufacturer's mill certificates for all additives, such as portland cement, proposed for use.

D. Submit weight tickets, certified by supplier, with each bulk delivery of cement to work site.

1.05 TESTS

A. Testing shall be performed under the provisions of Section 01410 - Testing Laboratory Services.

B. Laboratory and field tests shall be performed in accordance with the applicable ASTM and TxDOT standard test methods as described in this Section.

PART 2 P R O D U C T S

2.01 PORTLAND CEMENT

A. Portland Cement shall meet minimum material requirements for ASTM C150 Type I.

B. Provide cement slurry free of objectionable materials and with a uniform consistency that can be easily applied.

2.02 WATER

A. Water shall be clean, potable, and free from oil, acids, alkali, or vegetable matter.

2.03 NEW AGREGATE

A. New Aggregate shall meet the material requirements of TxDOT Item 247, Type A or Type D, Grade 1 Flexible Base.

2.04 ASPHALT SEAL CURE

A. Cutback asphalt or emulsified petroleum resin meeting the material and applications requirements as per Section 02511 - Prime Coat.

2.05 SLURRY PHYSICAL REQUIREMENTS

A. Slurry shall meet the following requirements:

Mix Property	Test Procedure	Requirement
Percent Solids	TEX-103-E, Part I	55% (Min.)
Viscosity*	TEX-130-E, Part IV	1 minute (Min.)

*Note: Perform test 30 minutes after batching with a min. 60 second flow rate.

PART 3 E X E C U T I O N

3.01 EQUIPMENT

A. Pulverization of the existing pavement shall be accomplished with a self-propelled machine capable of pulverizing and mixing the existing materials to the plan depth in one pass. Provide pulverization equipment that cuts and pulverizes material uniformly to the proper depth with cutters that will plane to a uniform surface over the entire width of the cut, provides a visible indication of the depth of cut at all times, and uniformly mixes the material.

B. The mixing equipment shall be capable of mixing the pulverized material, any required new aggregate and additives to obtain a homogeneous mixture.

C. Proof roller - Pneumatic tired roller with at least four wheels on axles carrying not more than two wheels. The proof roller shall have a rolling width of from 8 ft. to 10 ft. and having an operating gross load of from 25 to 50 tons.

D. Cement Slurry Equipment - Provide a mixing plant, tools and equipment necessary for proper mixing and delivery of slurry.

1. Storage Facility - Store all components, except water, in weatherproof containers.

2. Slurry Plant - Provide a pneumatic/hydraulic mixing plant with monitoring devices to regulate flow rates and line pressures. Regulate slurry proportions by calibrated scales. Include all storage silos, weather protection, sheds, scales, pumps, mixers, valves, gauges and regulating devices required to continuously measure and mix cementitious slurry at the batch plant. The plant should provide safe and easy access for the QC personnel so they may obtain samples. All mechanical mixing must be pump driven and cannot rely on lime slaking tanks, paddle driven mixers or other similar technology.

3. Delivery equipment - Deliver slurry to the project site in a non-baffle tank. Do not stir or agitate with any form of mechanical device. Application of the slurry shall be through a gravity fed spreader type bar or tube that expels the slurry in a uniform manner behind the vehicle.

3.02 PREPARATION

A. Complete backfill of underground utilities, as required, below future grade.

B. When directed by the Engineer, proof roll the existing flexible pavement to identify weak base or subgrade conditions. Weak areas shall be corrected as directed by the Engineer.

3.03 PLACEMENT

A. When new aggregate is required, it shall be spread on the existing pavement evenly across the entire section before pulverization begins. Manipulate and thoroughly mix new aggregate with existing material to provide a uniform mixture to the specified depth before the addition of cement.

B. Should the existing subgrade be exposed during the mixing process, it shall be firm and able to support, without displacement, the construction equipment. Soft or yielding subgrade shall be corrected as directed by the Engineer prior to replacement of base materials.

C. The existing flexible pavement shall be pulverized to the depth specified and mixed to obtain a homogeneous mixture. After mixing, the pulverized material shall be spread and shaped to conform to the lines, grades, and cross-sections shown in the plans.

D. Pulverize or scarify existing material after shaping so that 100% passes a 2-1/2-inch sieve. If the material cannot be uniformly processed to the required depth in a single pass, excavate and windrow the material to expose a secondary grade to achieve process to plan depth.

E. Cement content shall be selected by the Engineer based on compressive strength tests on pulverized samples of the existing pavement. The mix design shall be performed in accordance with Test Method Tex-120-E. The cement content shall be selected so the base material, when placed as described in this Section, shall have a minimum compressive strength of 300 psi at 7 days when tested in accordance with Tex-120-E.

F. Do not mix and place cement when temperature is below 40 degrees F and falling. Suspend application when the Engineer determines that weather conditions are unsuitable.

G. Cement shall be uniformly applied on the prepared base (as described above) using slurry placement only in that area where the mixing, compacting, and finishing operations can be completed during the same working day.

H. Slurry Placement: Mix the required quantity of cement with water, as approved. Provide slurry free of objectionable materials and with a uniform consistency that can be easily applied. Apply slurry within 2 hours of adding water. Distribute slurry uniformly by making successive passes over a measured section of the roadway until the specified content is reached.

I. Thoroughly mix the material and slurry using approved equipment. Mix until a homogeneous mixture is obtained. Sprinkle the treated materials during the mixing operation to maintain optimum mixing moisture within two percentage points. Spread and shape the completed mixture in a uniform layer to final lines and grades.

J. After mixing, the Engineer will sample the mixture at roadway moisture and test in accordance with Tex-101-E, Part III, to determine compliance with the gradation requirements in Table 1.

Table 1
Gradation Requirements Minimum % Passing

Sieve Size	Base	Subgrade
1-3/4 in.	100	100
3/4 in.	85	85
No. 4	-	60

3.04 COMPACTION

A. Compact the mixture to a minimum of 95% of the maximum dry density as determined by ASTM D698. Complete compaction within 2 hours after the initial application of cement slurry.

B. Finish the compacted base course by skinning or blading by a maintainer, removing all loose material from the surface. The surface shall be sprinkled with small amounts of water as needed while rolling with a pneumatic tired roller. The pneumatic tired roller used for finish rolling shall be light enough to prevent surface cracking. Rework and recompact those areas where cracking develops.

C. Maintain a smooth surface conforming to the lines, grades, and cross sections shown on the plans.

3.05 MICROCRACKING

A. After compaction of the stabilized base, moist cure for a minimum of 48 hours prior to microcracking. If performing construction during winter months with average daily temperatures below 60 degrees Fahrenheit, moist cure the base for a minimum of 96 hours prior to microcracking.

B. Microcracking should be performed using the same (or equivalent tonnage) vibratory steel wheel roller used for compaction. A minimum 12-ton roller should be used.

C. Perform three (3) full passes (one pass is down and back) over the entire section traveling 2 to 3 mph with the roller vibrating on maximum amplitude, unless otherwise directed by the Engineer.

3.06 CURING

A. After satisfactory completion of microcracking, the base should moist cured by sprinkling for a total cure time of at least three (3) days after the day of placement or prevented from drying by addition of an asphalt material following the requirements of Section 02511 - Prime Coat in these specifications.

B. Completed sections may be opened immediately to local traffic and construction equipment only after the curing period, or as directed by the Engineer, provided the material has hardened sufficiently to prevent damage to the base course by equipment or traffic.

3.07 MAINTENANCE

A. The Contractor is required to maintain the base course in good condition until all work has been completed and accepted. Maintenance shall include immediate repairs to any defects that may occur. Repairs shall be performed for the full depth of the base. The addition of thin layers for any reason will not be permitted. This work shall be done by the Contractor at his own expense.

3.08 TOLERANCES

A. Completed surface of the road base shall be smooth and conform to the specified cross section and established lines and grades.

B. Top surface of base course shall be within plus or minus ¼ inch in cross section, or in 16-ft. length.

3.09 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one core will be taken at random locations per 500 linear feet per lane of roadway or 500 square yards of base, whichever is less, to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D6938 and ASTM D3017 at a random location near each depth determination core. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.

E. Fill core holes with new compacted crushed stone flexible base.

END OF SECTION

SECTION 02249

GEOTEXTILE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Geotextile fabric, also called filter fabric, in applications such as a pipe embedment wrap and around the foundations of structures.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this Section. Include the cost of such work in unit prices for work requiring geotextile, such as pipe embedment, sewer line in tunnel, or placement of manhole foundations, as appropriate.

1.03 SUBMITTALS

A. Conform to Section 01300 - Submittals.

B. Submit the standard manufacturer's catalog sheets and other pertinent information, for approval, prior to installation.

C. Submit installation methods, as a part of the work plan for tunneling or for excavation and backfill for utilities. Obtain approval from Engineer for geotextile material and the proposed installation method prior to use of the geotextile.

PART 2 P R O D U C T S

2.01 GEOTEXTILE

A. Provide a geotextile (filter fabric) designed for use in geotechnical applications which forms a permeable layer or media while retaining the soil matrix.

B. Use a fabric which meets the physical requirements for Class A Subsurface Drainage installation conditions as defined in AASHTO M288 and as specified in paragraph 2.02.

2.02 PROPERTIES

A. Material: Nonwoven, nonbiodegradable, fabric consisting only of continuous chain polymer filaments or yarns, at least 85 percent by weight polyolefins, polyesters or polyamide, formed into a dimensionally stable network.

B. Acceptable products for geotextile filter fabrics shall be Supac N-4NP by Phillips 66, Trevira No. 1115 as manufactured by Hoechst, Mirafi No. 160N, or equal.

C. Chemical Resistance: Inert to commonly encountered chemicals and hydrocarbons over a pH range of 3 to 12.

D. Physical Resistance: Resistant to mildew and rot, ultraviolet light exposure, insects and rodents.

E. Minimum Test Values:

Property	Value (Min.)	Test Method
Grab Strength	180 lbs.	ASTM D 4632
Trapezoidal Tear Strength	50 lbs.	ASTM D 4533
Puncture Strength	80 lbs.	ASTM D 4833
Mullen Burst Strength	290 psi.	ASTM D 3786
Apparent Opening Size(1)	0.21 mm	ASTM D 4751
Permittivity (sec^{-1})	0.2	ASTM D 4491

(1) Maximum average roll value.

PART 3 E X E C U T I O N

3.01 LINE WORK

A. Use geotextile with backfill for utilities in conformance with Section 02227 - Excavation and Backfill for Utilities.

END OF SECTION

SECTION 02252

CEMENT STABILIZED SAND

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cement stabilized sand for bedding and backfill.

1.02 UNIT PRICES

A. No payment will be made for cement stabilized sand bedding and backfill under this Section. Include payment for cement stabilized sand in unit price for applicable utility or structure installation.

B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit material qualification and mix design tests to include:
   i. Three series of tests of sand or fine aggregate material from the proposed source. Tests shall include procedures defined in Paragraph 2.01.
   ii. Three moisture-density relationship tests prepared using the material qualified by the tests of Paragraph 1.03B.1. Blends of fine aggregate from crushed concrete and bank run sand shall be tested at the ratio to be used for the mix design testing.
   iii. Mix design report to meet the design requirements of Paragraph 1.04. The mix design shall include compressive strength tests after 48-hours and 7 days curing.

1.04 DESIGN REQUIREMENTS

A. Design sand-cement mixture to produce a minimum unconfined compressive strength of 100 pounds per square inch in 48 hours when compacted to 95 percent in accordance with ASTM D558 and when cured in accordance with ASTM D1632, and tested in accordance with ASTM D1633. Mix for general use shall contain a minimum of 1.5 sacks of cement per cubic yard. Mix for use as sanitary sewer embedment within 9 feet of waterlines shall contain 2 sacks of cement per cubic yard. Compact mix with a moisture content on the dry side of optimum.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Cement: Type I Portland cement conforming to ASTM C150.

B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C33, or requirements for Bank Run Sand of Section 02229 - Utility Backfill Materials, and the following requirements:

1. Classified as SW, SP or SM by the United Soil Classification System of ASTM D2487.
2. Deleterious materials:
   a. Clay lumps, ASTM C142; less than 0.5 percent.
   b. Lightweight pieces, ASTM C123; less than 5.0 percent.
   c. Organic impurities, ASTM C40; color no darker than the standard color.
3. Plasticity index of 4 or less when tested in accordance with ASTM D4318.

C. Fine aggregate manufactured from crushed concrete meeting the quality requirements for crushed rock material of Section 02229 - Utility Backfill Materials, may be used as a complete or partial substitute for bank run sand. The blending ratio of fine aggregate from crushed concrete and bank run sand shall be defined in the mix design report.

D. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C94.

2.02 MIXING MATERIALS

A. Thoroughly mix sand, cement and water in proportions of the mix design using a pugmill-type mixer. The plant shall be equipped with automatic weight controls to ensure correct mix proportions.

B. Stamp batch ticket at plant with time of loading directly after mixing. Material not placed and compacted within 4 hours after mixing shall be rejected.

PART 3 E X E C U T I O N

3.01 PLACING

A. Place sand-cement mixture in 12-inch-thick loose lifts and compact to 95 percent of ASTM D558, 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.

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

3.02 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Mixing plant inspections will be performed periodically. Material samples will be obtained and tested in accordance with Paragraph 2.01, Materials, if there is evidence of change in material characteristic.

C. Random samples of delivered product will be taken in the field at point of delivery for each day of placement in a work area. Specimens will be prepared in accordance with ASTM C31 and tested for 48-hour compressive strength in accordance with ASTM D1633.

D. The cement content will be checked on samples obtained in the field whenever there are apparent changes in the mix properties.

3.03 ACCEPTANCE

A. Strength level of material will be considered satisfactory if:

1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.

2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.

B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.04 Adjustment for Deficient Strength.

C. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.

D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.

E. Testing laboratory shall notify Contractor, Project Manager, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.

F. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03.A.

G. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less that 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.04 ADJUSTMENT FOR DEFICIENT STRENGTH

A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.

B. When mixture produces 7-day compressive strength less than 100 psi and greater than or equal to 70 psi, material shall be accepted contingent on credit in payment. Compute credit by the following formula:

$$\text{Credit per Cubic Yard} = \frac{\$30.00 \times 2\ (100\ \text{psi} - \text{Actual psi})}{100}$$

C. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to the City.

END OF SECTION

SECTION 02254

RIPRAP AND GRANULAR FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section includes requirements for furnishing and installing riprap and granular fill and filling and burying riprap, when required.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DELIVERY, STORAGE AND HANDLING

A. Keep the storage area clean, firm, smooth and well drained in order that the product can be placed with a minimum of foreign matter.

B. Stockpile and handle riprap and granular fill to minimize segregation of particle sizes either in the stockpile or while loading, hauling and handling.

PART 2 PRODUCTS

2.01 RIPRAP

A. Provide riprap consisting of broken concrete or stone. Provide riprap that is dense, durable and hard material free from cracks, seams and other defects which would increase deterioration from handling and natural causes.

B. Shape and Dimensions.

1. Provide riprap in cubic form, rather than elongated (flat) shapes.
2. Provide riprap with a minimum thickness of 6 inches.
3. No more than 25 percent shall have a length greater than 2-1/2 times the width or thickness. No length shall exceed 3 times the width or thickness.

C. Do not provide spalls, fragments and chips exceeding 5 percent by weight. The dimension and shape limitations do not apply to this portion of the riprap.

D. Where broken concrete is used, cut exposed metal flush with the surface prior to placing the riprap.

E. Provide riprap conforming to the following tables:

TABLE 1

RIPRAP GRADATION NO. 1

Percent Lighter by Weight	Stone Weight Lbs. Lower Limit	Stone Weight Lbs. Upper Limit	Volume Cubic Ft (2) Lower Limit	Volume Cubic Ft (2) Upper Limit	Cubical Shape Ft (Each Side) Lower Limit	Cubical Shape Ft (Each Side) Upper Limit	Spherical Shape Ft (Dia.) Lower Limit	Spherical Shape Ft (Dia.) Upper Limit
100	180	265	1.20	1.77	1.06	1.21	1.31	1.50
50	80	110	0.53	0.73	0.81	0.90	1.01	1.12
15	40	60	0.27	0.40	0.64	0.74	0.80	0.91

Notes:

1. The theoretical cube and sphere size is presented for guidance only. Paragraph 2.1 shall control riprap shape and dimensions.
2. Volume is based on 150 pcf, unit weight.
3. Riprap Gradation No. 1 is to be used where an 18 inch thick riprap mat is note on the Plans.

TABLE 2

RIPRAP GRADATION NO. 2

Percent Lighter by Weight	Stone Weight Lbs. Lower Limit	Stone Weight Lbs. Upper Limit	Volume Cubic Ft (2) Lower Limit	Volume Cubic Ft (2) Upper Limit	Cubical Shape Ft (Each Side) Lower Limit	Cubical Shape Ft (Each Side) Upper Limit	Spherical Shape Ft (Dia.) Lower Limit	Spherical Shape Ft (Dia.) Upper Limit
100	260	640	1.73	4.27	1.20	1.62	1.49	2.01
50	130	200	0.87	1.33	0.95	1.10	1.18	1.37
15	40	150	0.27	1.00	0.64	1.00	0.80	1.24

Notes:

1. The theoretical cube and sphere size is presented for guidance only. Paragraph 2.1 shall control riprap shape and dimensions.
2. Volume is based on 150 pcf, unit weight.
3. Riprap Gradation No. 2 is to be used where a 24 inch thick riprap mat is noted on the Plans.

2.02 GRANULAR FILL

A. Provide granular fill consisting of concrete or stone. Provide granular fill that is dense, durable and hard material.

B. Provide granular fill, as shown on the Plans or as directed by the Engineer, to the following dimensions:

1. Provide 3 inch to 5 inch granular fill with no material diameter less than 3 inches and no material diameter greater than 5 inches.
2. Provide 4 inch to 8 inch granular fill with no material diameter less than 4 inches and no material diameter greater than 8 inches.
3. Provide riprap Gradation No. 1 and Gradation No. 2 as shown on the Plans or as directed by the Engineer.

C. Do not provide spalls, fragments and chips exceeding 5 percent by weight.

D. Where broken concrete is used, cut exposed metal flush with the surface prior to placing granular fill.

2.03 GEOTEXTILE

A. Refer to Section 02249 - Geotextile.

PART 3 EXECUTION

3.01 GRADE PREPARATION

A. Refer to Section 01563 - Control of Ground Water and Surface Water.

B. Trim and dress the channel bottom and side slopes to proper lines and grade prior to placing riprap or granular fill. Where shown on the Plans, place geotextile in accordance with Section 02249 - Geotextile.

C. The Engineer will inspect prepared section prior to placing geotextile, riprap or granular fill.

3.02 RIPRAP OR GRANULAR FILL PLACEMENT

A. Place the riprap or granular fill to the slopes, lines and grades as shown on the Plans.

B. To establish a well-graded mass of riprap with minimal voids, fill voids between larger riprap blocks with spalls and smaller blocks of the largest feasible size to form a compact mass. Do not place spalls and small blocks in place of larger size riprap or granular fill.

C. Install riprap and granular fill mat to the thickness as shown on the Plans. Riprap shall have minimum mat thickness as shown on the gradation tables.

D. Place the riprap and granular fill to avoid displacement or damage to the prepared surface or geotextile and in a manner to avoid segregation of particle sizes.

E. Fill riprap voids and bury riprap a minimum of 6 inches with topsoil on side slopes as directed by the Engineer.

END OF SECTION

SECTION 02255

TIMBER BENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section includes requirements for installing timber bents on outfall pipes.

1.02 MEASUREMENT AND PAYMENT

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Refer to Section 01300 - Submittals

B. Provide manufacturer's product specifications and certification that timber members meet or exceed the standards referenced in this Section.

PART 2 PRODUCTS

2.01 TIMBER PILES

A. Provide southern pine wood poles for use as timber bent piles that meet the requirements of ANSI O5.1.

1. Provide a minimum diameter of 12 inches at the pile tip.

B. Provide southern pine wood poles that are pressure preservative treated in accordance with AWPA C4 using one of the following methods:

1. Creosote conforming to AWPA P1/P13 to 9.0 pounds per cubic foot (pcf) by assay.
2. Chromated copper arsenate (CCA - Type C) oxide preservative to produce a retention assay of 0.6 pounds per cubic foot.

2.02 TIMBER MEMBERS

A. Provide southern pine timber members meeting SPIB Section 300 - National Grading Rule for Dimension Lumber, Select Structural (SEL STR) Grade No. 2 or better.

B. Provide pressure preservative members treated per AWPA C2 for Soil and Fresh Water Use with one of the following methods:

1. Creosote conforming to AWPA P1/P13 to 10.0 pounds per cubic foot by assay.
2. Chromated copper arsenate (CCA - Type C) oxide preservative to produce a retention assay of 0.6 pounds per cubic foot.

2.03 HARDWARE

A. Provide bolts conforming to ASTM A 307.

B. Provide hot dipped galvanized hardware in accordance with ASTM A 153.

PART 3 EXECUTION

3.01 INSTALLATION

A. Drive piles to the depths shown on the Plans.

B. Bolts:

1. Drill holes no more than 3/16 inch larger in diameter than the bolts being used. Drill holes straight and true. Drill bolt holes in center of the pile and timber member.
2. Use washers under bolt head and nut to prevent direct bearing of head or nut on wood.

END OF SECTION

Section 02308

TUNNEL SHAFTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Construction, maintenance, and backfilling requirements of tunnel shafts.

1.02 UNIT PRICE

A. No separate payment will be made for work performed under this Section. Include payment in unit price for related work.

1.03 SUBMITTALS

A. Make submittals in accordance with Section 01300 – Submittals.

B. Shaft design submittals by the Contractor shall be signed and sealed by a Professional Engineer licensed in the State of Texas.

C. Submit shaft construction drawings to the Engineer. Include:

1. Shaft dimensions, design criteria, and details for ground support system, such as sheeting, shoring, bracing, and stabilization, protection of the excavation, special requirements for shaft penetrations, tunnel "eye", starter and back tunnels, and seal slabs. Allowable surcharge loads and any restrictions on surcharge capacity, including live loads, shall be clearly shown on the shaft construction drawings. Thrust blocks or other reactions required for pipe jacking shall be shown, if applicable.
2. Location of shafts by station and limits of working sites.
3. Description of site security arrangements in conformance with paragraph 3.03, Shaft Construction.
4. Description of method of extending the shaft above the flood level in compliance with paragraph 3.03, Shaft Construction.
5. Any geotechnical / borings undertaken by the Contractor for whatever purpose connected to the work.

D. Shaft Monitoring Plan: Submit for review prior to construction, a shaft monitoring plan that includes a schedule of instrumentation design, layout of instrumentation parts, equipment installation details, manufacturer's catalog literature, and monitoring report forms.

E. Structures Assessment. Preconstruction and post-construction assessment reports shall be provided for critical structures located within a radius of the shaft center equal to the shaft depth plus the shaft radius, measured in plan. Photographs or a video of any existing damage to structures in the vicinity of shafts shall be included in the assessment reports.

F. Submit a shaft surface settlement monitoring plan for review and concurrence by the Engineer prior to construction. The plan shall identify the location of settlement monitoring points, reference benchmarks, survey frequency and procedures, and reporting formats.

G. The readings of all monitoring to be submitted to the Engineer as soon as the readings have been taken.

H. Contractor shall submit shaft temporary deck drawings and calculations to the Engineer, signed and sealed by Contractor's Professional Engineer in the event that a shaft is not needed for immediate construction activity, in conformance with paragraph 3.03, Shaft Construction.

1.04 PERFORMANCE REQUIREMENTS

A. Shaft design must include allowance for contractor's equipment and stored material and spoil stockpile as appropriate. Design must also allow for H-20 highway loading if located in the vicinity of a paved area or Cooper E-80 loading if located in the vicinity or railroad.

B. Shaft shall be designed not to fail under full hydrostatic head.

C. Shaft located within the 100-year flood plain shall be designed with a water retaining liner extending 2 feet above the 100-year flood elevation. It is acceptable if liner is stored at the site for immediate installation in lieu of it being installed at the shaft, provided that the shaft liner extends at least 2 feet above existing ground elevation.

D. Shaft cover shall be designed for a minimum 25 pounds per square foot distributed load plus a 300 pound point load.

E. Steel plate deck, if such is required, shall be designed for H-20 loading.

PART 2 P R O D U C T S (Not Used)

PART 3 E X E C U T I O N

3.01 LOCATION OF ACCESS SHAFTS

A. Contractor shall have sole responsibility for selection of shaft sites any additional shafts needed for construction operations. Location will be subject to Engineer's approval.

B. Locate shafts and associated work areas to avoid blocking driveways and cross streets, and to minimize disruption to business and commercial interests.

C. Plan shaft locations to minimize interference with storm drainage channels, ditches,

water mains, sanitary sewers, storm water sewers or culverts, which, if damaged, could result in ground washout or flooding of shafts and tunnels.

3.02 UTILITY RELOCATION

A. Locate shafts in such a manner that utility relocation will not be necessary. Protect and support utilities, petrochemical or product pipelines, gas lines, telephone lines, power lines, within (or in close proximity to) the shaft area. Meet all pertinent requirements outlined by the utility company. Provide support systems for their protection as designated by the utility company.

3.03 SHAFT CONSTRUCTION

A. Ground support systems shall be in accordance with the following:

1. Liner elements, bracing and shoring structural members shall be installed at the locations and in the method sequence and tolerances defined on shaft construction drawings as the excavation progresses.

2. The bracing and shoring shall be in contact with the liner to provide full support. All liner, bracing and shoring shall be evaluated, checked and approved by Contractor's Professional Engineer, and submitted to the Engineer.

3. A seal slab shall be installed as soon as final depth and stable bottom conditions have been reached and accepted by the Engineer. The seal slab shall be capable of withstanding the full piezometric pressure, either by pressure relief using under drains, or in the case of more permeable ground condition, by the use of a structural reinforced slab. In either case, the seal slab shall be constructed in accordance with the design provided by the Contractor’s Professional Engineer.

4. The entire shaft shall be designed and constructed to appropriate factors of safety against yield, deformation, or instability as determined by Contractor's Professional Engineer, and shall withstand a full hydrostatic head without failure.

5. Special framing, bracing or shoring required around tunnel "eyes" or other penetrations shall be in-place according to shaft construction drawings before the liner or any bracing or shoring at the penetration is cut or removed.

6. Securely breast and shore face of starter or back tunnels to resist both soil and hydrostatic pressure.

7. Immediately pressure grout any voids or seepage paths around shafts and adjoining tunnels in accordance with Section 02330-Tunnel Grout. Pressure grout bolted steel liner plates as they are installed, unless otherwise approved by Engineer. Perform secondary or ‘back grouting’ as ground measurement, voids or deformation of shaft liner are detected.

B. Install suitable thrust or reaction blocks as required for pipe jacking equipment.

C. Provide drainage from shafts while work is in progress and until adjacent pipe joints have been sealed and the shaft is backfilled. Conform to the requirements of Section 01563 - Control of Ground Water and Surface Water.

D. Surface Water Control. Divert surface water runoff and discharge from dewatering system away from the shaft and protect the shafts from infiltration or flooding.

E. Each surface work site is to be surrounded by a security fence meeting the requirements of Section 01500 - Temporary Facilities and Controls, which shall be secure at any time the site is unattended by Contractor's personnel.

F. In addition to the above, the shaft, when not in use shall be protected by a second security fence at the perimeter of the shaft, or alternatively by a cover designed in accordance with Paragraph 1.04, Performance Requirements.

G. Portable concrete traffic barriers must be provided at all locations where a work site is situated adjacent to a highway, road, driveway, or parking lot. Traffic barriers shall be angled in the direction of lane flow, and shall not be placed perpendicular to on-coming traffic.

H. Traffic control system shall be provided and maintained in accordance with the provision of Section 01570 - Traffic Control and Regulation.

I. A shaft which is constructed more than 60 days in advance of its intended need shall be covered by a steel plate deck designed by the Contractor's Professional Engineer, and the surface restored to permit full traffic flow during the time the shaft is not in use. All other Contractor's material including portable concrete traffic barriers, traffic control system, fencing and other materials and equipment must be removed from the site and reinstalled at the time the shaft is re-opened for use.

J. Construct a suitable guardrail barrier around the periphery of the shaft, meeting applicable safety standards. Properly maintain the barrier throughout the period the shaft remains open. Repair broken boards, supports, and structural members. Provide ladder with safety cage in each shaft. In addition, provide a full cover or other security barrier for each access shaft in which there is no construction activity or which is unattended by the Contractor's personnel.

K. Size of Shafts: Make size adequate for construction of any permanent structures indicated on the Drawings and to provide adequate room to meet operational requirements for tunnel construction and backfill.

3.04 BACKFILL

A. Cement stabilized sand shall be provided to a minimum depth of 10 feet above the crown of the line but where shaft is located in a paved area, cement stabilized sand shall be used to within 1 foot of the pavement subgrade elevation. Cement stabilized sand shall be in accordance with Section 02000 - Cement Stabilized Sand. Compaction shall be in accordance with Section 02221 - Excavating, Trenching and

Backfilling for Pipe. In locations where the backfill is not subject to traffic loading, the depth above the initial cement stabilized sand may be backfilled with select backfill in accordance with Section 02221. Grouting of manhole or structure annular space will be permitted in cases where insufficient work space exists, in accordance with Section 02221 - Embankment.

B. Remove the shaft liner above the level of 8 feet below ground surface, unless otherwise indicated on the Drawings. The Contractor must maintain sufficient ground support to meet excavation safety requirements while removing the shaft structure.

3.05 MONITORING

A. Monitoring Instrumentation. The Contractor shall provide a plan of the proposed monitoring and associated instrumentation pertaining to the monitoring for review by the Engineer. The instrumentation recommended for the monitoring includes but is not limited to Piezometers and Inclinometers. The Contractor shall utilize the services of a Registered Professional Engineer to design and implement the instrumentation necessary for monitoring the ground movement during excavation and tunneling, monitoring of ground water pressure, horizontal movement, and settlement. Instrumentation and the readings shall be accessible at all times to the Engineer.

1. Install and maintain an instrumentation system to monitor and detect movement of the ground surface and adjacent structures. Establish vertical survey control points at a distance from the construction areas that avoids disturbance due to ground settlement. Establish settlement points as recommended by the Contractor's, Registered Professional Engineer.
2. Installation of the instrumentation shall not preclude the Engineer, through an independent contractor or consultant, from installing instrumentation in, on, near, or adjacent to the construction work. Access shall be provided to the work by the Contractor for such independent installations.
3. Instruments shall be installed in accordance with the manufacturer's recommendations.

B. Surface Settlement Monitoring: Submit a settlement monitoring plan for review by the Engineer prior to installation. The plan shall identify the location of settlement monitoring point reference, bench marks, survey frequency, procedures and reporting format.

1. Establish monitoring points on all critical structures.
2. Record location of settlement monitoring points with respect to construction baselines and elevations. Record elevations to an accuracy of 0.01 feet for each monitoring point location. Monitoring points should be established at locations and by methods that protect them from damage by construction operations, tampering, or other external influences.

3. Monitoring points to measure ground elevation are required at a distance of 10 feet and 20 feet from the perimeter of the shaft on each of four radial lines, the radial lines being at 90 degrees to each other.
4. Railroads. Monitor ground settlement of track subbase at centerline of each track if within the zone of potential settlement.

C. Reading Frequency and Reporting. The Contractor shall submit to the Engineer, records of readings from the various instruments and survey points.

1. Record all shaft monitoring readings at least once per week starting prior to shaft construction and continuing until shaft has been backfilled and until no more detectable movement occurs.
2. Immediately report to the Engineer any movement, cracking, or settlement which is detected.
3. Following substantial completion but prior to final completion, make a final survey of all shaft related monitoring points.

D. Pre Monitoring Activity:

The subject area including all critical structures should undergo a pre-construction assessment. This includes detailed observations of the surface features, structures, including photographs or video, to identify any document previously existing distress and repairs.

3.06 DISPOSAL OF EXCESS MATERIAL

A. Remove spoil in accordance with Section 01564 – Waste Material Disposal.

END OF SECTION

SECTION 02315

PIPE AND CASING AUGERING FOR SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of casing or sewer pipe by dry augering or slurry boring methods.

B. Installation of sewer pipe by slurry boring methods. Construction casing may be used at the Contractor's option.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Augering means either "dry augering" or "slurry boring".

B. Dry augering is jacking a casing or pipe while excavating the soil at the heading and transporting the spoil back through the casing or pipe.

C. Slurry boring is installing a casing or pipe by drilling a small diameter pilot hole, followed by reaming the bore to full diameter with the assistance of slurry or drilling fluids.

1.04 SUBMITTAL

A. Make submittals in conformance with Section 01300 - Submittals.

B. For installation by augering, submit for review:
1. Description of mechanized excavating equipment.
2. Method of controlling line and grade.
3. Grouting techniques to be used for filling annular void between sewer pipe and casing, and void between sewer pipe or casing and the ground, including equipment, pumping and injection procedures, pressure grout types, and mixes.
4. Locations and dimensions of pits.
5. Pit design and construction drawings.
6. Identification of casings required and paid under the Contract and casings installed at the Contractor's option.
7. Design of casings.

C. Prepare auger pit and casing design submittals that are site specific. Have auger pit and casing design submittals signed and sealed by a qualified Professional Engineer registered in the State of Texas.

D. Construction phase submittals shall include:
   1. Daily logs of augering and boring operations.
   2. Settlement monitoring data to meet the requirements of paragraph 3.05, Settlement Monitoring.
   3. Submit daily logs and settlement monitoring data within 5 days after the day of observation.

1.05 CRITERIA FOR DETERMINING CASING INSTALLATION LOADS

A. Select and design casing pipe and pipe joints to carry the thrust of jacks or loads due to the pulling mechanism in combination with overburden, earth and hydrostatic loads. Select casings for dry augering to withstand the action of the auger without damage.

B. Have a Professional Engineer determine design stresses, design deflections and factors of safety for design of casing. Present such determination as a part of the design submittal. Apply the following maximum casing pipe stresses and deflections to casings shown on the Drawings:
   1. Design stress in the pipe wall: 50 percent of the minimum yield point of the steel or 18,000 psi, whichever is less, when subjected to the applicable loading conditions.
   2. Wall thickness: maximum allowable deflection which does not exceed 3 percent of nominal casing diameter.

C. Use Cooper E-80 locomotive loading distributions as criteria for all crossings in accordance with AREA's specifications for culverts.

E. When not specifically indicated on the Drawings, select casing diameter to permit practical installation (including casing spacers if applicable) and grouting.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Provide casing pipe which is straight, circular in section, uncoated, welded steel pipe, manufactured in accordance with AWWA C 200.

B. Provide sewer pipe in accordance with Section 02730 - Gravity Sanitary Sewers.

C. Provide restrained-joint sewer pipe when installing sewer pipe in slurry bored holes by a pull-back method.

D. Provide low density (cellular) grout or sand-cement mortar mix for annular grouting.

PART 3 E X E C U T I O N

3.01 LOCATION AND SIZE OF AUGER PITS OR SHAFTS

A. Show the location of auger pits or shafts on the auger construction drawings. Locate auger pits or shafts for slurry boring so that the distance between pits or shafts is no greater than 80 feet; and for dry augering not more than 120 feet apart.

B. Where possible, locate auger pits or shafts and associated work areas to avoid blocking driveways and cross streets and to minimize disruption to business and commercial interests. Avoid auger pit or shafts locations near areas identified as potentially contaminated.

C. Make size adequate for construction of any structures indicated on the Drawings. Provide adequate room to meet Contractor's operational requirements for augering.

D. Provide a portable concrete traffic barrier around the periphery of the pit or shaft, meeting applicable safety standards. Properly maintain the barrier throughout the period the pit remains open. Angle traffic barriers in the direction of the lane flow; do not place barriers perpendicular to on-coming traffic.

E. Provide a full cover or other security fencing for each access pit in which there is no construction activity or which is unattended by Contractor’s personnel.

3.02 DRY AUGERING OF CASING OR PIPE

A. Provide jacks, mounted on a frame or against a backstop, of a capacity suitable for forcing the excavating auger and casing or pipe through the soil conditions to be encountered. Operate jacks so that even pressure is applied to the casing or pipe.

B. Provide steerable front section of casing or pipe to allow vertical grade adjustments. Provide a water level or other means to allow monitoring of the grade elevation of the auger casing or pipe.

C. Bentonite slurry may be used to lubricate the casing or pipe during installation. The use of water to facilitate removal of spoil is permitted; however, water jetting for excavation of the soil is not allowed when jacking casing or pipe.

D. Tolerances from lines and grades shown on the Drawings for gravity sewer pipe or casing are plus or minus 6 inches in horizontal alignment, and plus or minus 1-1/2 inches in elevation.

3.03 SLURRY BORING OF CASING OR PIPE

A. Drill a small diameter pilot hole and check for line and grade at the receiving end. Redrill the pilot hole if the bored pipe does not meet specified tolerances.

B. Using the pilot hole as a guide, bore a larger diameter hole of sufficient size for pipe or casing installation. Water jetting is not permitted.

C. Bentonite slurry may be used to maintain a stable hole and furnish lubrication for pipe or casing installation.

D. Tolerances from lines and grades shown on the Drawings for the installed sewer pipe are plus or minus 6 inches in horizontal alignment and plus or minus 1-1/2 inches in elevation.

E. Completely fill the annular space between the sewer pipe and the surrounding soil or casing with grout, without displacing the pipe during the grouting operation.

3.04 SEWER PIPE IN CASING

A. Grout the annular void between sewer pipe and any casing from end to end of the casing. Block and brace the sewer pipe to prevent movement during grout placement and to maintain specified line and grade. Grout as specified in Section 02330 - Tunnel Grout.

3.05 SETTLEMENT MONITORING

A. Monitor the ground surface elevation along the length of the augering operation. Locate and record settlement monitoring points with respect to construction baseline and elevations. Record elevations to an accuracy of 0.01 feet for each monitoring point location. Establish monitoring points at locations and by methods that protect them from damage by construction operations, tampering, or other external influences. As a minimum, locate survey points as follows:
   1. For road crossings: Centerline and each shoulder.
   2. Utilities and Pipelines: Directly above and 10 feet before and after the utility or pipeline intersection.
   3. Long bores under improved areas such as pavements: Ground surface elevations must be recorded on the centerline ahead of augering operations at locations not to exceed 50 feet apart (including points located for roads, railroads, utilities and pipelines), or at least three locations per augering drive.

B. Reading Frequency and Reporting. Take settlement survey readings:
   1. Prior to the auger excavation reaching the point.
   2. After the auger reaches the monitoring point in plan.
   3. After grouting of the ground supporting pipe or casing is complete.

C. Immediately report to the Engineer any movement, cracking, or settlement which is detected.

D. Following substantial completion but prior to final completion, make a final survey of all monitoring points.

3.06 DISPOSAL OF EXCESS MATERIAL

A. Remove and dispose of spoil from the job site in accordance with Section 01564 - Waste Material Disposal.

3.07 LEAKAGE TESTING

A. Test for leakage by low pressure air methods in accordance with Section 02732 - Acceptance Testing for Sanitary Sewer.

END OF SECTION

SECTION 02317

AUGERING PIPE FOR WATER LINES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installing water service pipe by methods of augering or casing by jacking and boring.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submit product data in accordance with requirements of Section 01300 - Submittals.

B. Submit product data for casing spacers and end seals for approval.

C. Prior to commencement of work, furnish for the Engineer's approval, a plan showing pit locations. Approval of this plan will not relieve Contractor from responsibility to obtain specified results.

D. Show actual pit locations dimensioned on as-built drawings so that they can be identified in field.

1.04 CONTRACTOR QUALIFICATIONS

A. The General Contractor shall submit qualifications of his tunneling subcontractor for approval prior to construction. It shall include but not limited to:

1. Minimum experience of at least ten (10) projects of similar nature and type involving successful trenchless installation of water lines in similar conditions (i.e. Railroad, TxDOT, and County right-of-ways).

2. Each superintendent or crew chief directing the tunneling operations in the field shall have a minimum of two years' experience in tunneling work with the present company and verifiable experience with other companies.

3. The City reserves the right to direct the Contractor to utilize another tunneling subcontractor if such requirements are not met.

1.05 DEFINITIONS

A. Dry Auger Method (Bore and Jack): Installation of steel casing by excavating soil at advancing end of casing and transporting spoil through casing, while advancing casing by jacking at same rate as auger excavation progresses.

B. Slurry Auger Method: Installation of casing or pipe by first drilling a small diameter pilot hole from pit to pit along the desired line and grade, followed by removing excess soil and installing pipe by pull-back or jacking method into the open hole.

1.06 REGULATORY REQUIREMENTS

A. Conform to Texas Department of Transportation for installations under state highways. Owner will obtain required permits for State Highway crossings.

B. Installations under railroads:

1. Secure and comply with requirements of right-of-entry for crossing railroad company's easement or right-of-way from railroad companies affected. Comply with railroad permit requirements. Submit copy to the Engineer.

2. Use dry auger method only.

3. No extra compensation for damages due to delays caused by the railroad requesting work to be done at hours which will not inconvenience the railroad.

4. Maintain minimum 35-foot clearance from centerline of tracks.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Piping and Fittings: As required by Specification or Drawings.

B. Casings: Where required by Drawings, in accordance with Section 02611 - Steel Pipe and Fittings. Provide casing with smooth, continuous interior surface.

C. Casing Spacers (For Pipe Diameters 12 inches and Smaller): Where casings are shown on Drawings, use casing spacer width 8 inches for pipe sizes 4 to 12 inches. Wood skids or concrete "donuts" are not acceptable.

1. For welded steel pipe, use Pipeline Seal & Insulator Model PE, Raci High Density Polyethylene Spacers or approved equal.

2. For other pipe materials, use Pipeline Seal & Insulator Model C8G-2, Raci High Density Polyethylene Spacers or approved equal.

3. Obtain approval for equal product in writing from Engineer prior to bidding.

4. Use ISO-9002 registered casing spacer manufacturer or supplier. Submit copy of current certificate with submittal package.

D. Casing Spacers (For Pipe Diameters 16 inches or Greater): Where casings are shown on Drawings, use casing spacer width 12 inches for pipe sizes larger than 12 inches. Bolt-on style with shell made of two sections of 14-gauge carbon steel, hot rolled, cleaned, and

lined with PVC liner, 0.090 inch thick with Durometer A 85-90 overlapping edges to secure liner to spacer; deep embossed flanges for added strength; coated prior to installation of liner and runner with fusion-bonded PVC powder of 14 to 20 mils thickness; electroplated studs, nuts, and washers.

1. Runners (For Pipe Diameters 16 inches or Greater): Supported by 10-gauge carbon steel MIG risers welded to shell. Total length of weld beads shall be at least 50 percent of the length of the runner. Fill bolt holes with caulk or approved equal to provide a water-tight seal. Minimum requirements: Glass reinforced plastic conforming to the following tests:
   a. Tensile Strength: ASTM D 638; 17,600 psi
   b. Flexural Strength: ASTM D 790; 25,300 psi
   c. Compression Strength: ASTM D 695; 18,000 psi
   d. Deflection Temperature at 264 psi: ASTM D 648; 405 F
   e. Polyethylene runners are not acceptable

E. Casing End Seals: Provide Pipeline Seal and Insulator Model C, or approved equal.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Do not exceed 100 feet for length of auger hole for PVC pipe less than 12 inches in diameter without intermediate pit.

B. Do not exceed 75 feet for length of auger hole for PVC pipe 12 inches to 16 inches in diameter without intermediate pit.

C. Do not exceed 40 feet for length of auger hole for PVC pipe greater than 16 inches in diameter without intermediate pit.

3.02 PREPARATION

A. Conform to applicable provisions of Section 01015 - Contractor’s Use of Premises.

3.03 TRAFFIC CONTROL

A. Conform to applicable provisions of Section 01570 - Traffic Control and Regulation.

B. Secure right-of-entry for crossing railroad company's easement or right-of-way.

C. During construction operations, furnish and maintain barricades and lights to safeguard traffic and pedestrians as directed by the Engineer, until such time as backfill has been completed and removed from site.

3.04 PITS

A. Locate auger pits where there is minimum interference with traffic or access to property.

B. Pit Size: Provide minimum 6-inch space between pipe and walls of bore pit. Maximum allowable width of pit shall be 5 feet unless otherwise approved by the Engineer. Width of pit at surface shall not be less than at bottom. Maximum allowable length of pit shall be no more than 5 feet longer than one full joint of pipe and shall not exceed 25 feet unless otherwise approved by the Engineer.

C. Excavate bore pits to finished grade at least 6 inches lower than grade indicated by stakes or as approved by the Engineer.

D. Backfill in accordance with Section 02227 - Excavation and Backfill for Utilities.

E. Install sheeting, lining, shoring, and bracing required for protection of workmen and public in accordance with Section 01526 - Trench Safety System for all pits, access shafts, end trenches and other excavations relating to work required by this specification.

3.05 SLURRY AUGER

A. Auger from approved pit locations. Excavate for pits and install shoring as outlined above under Paragraph 3.04, "Pits." Auger mechanically with use of a pilot hole entire length of crossing and check for line and grade on opposite end of bore from work pit. The large hole is to be no more than 2 inches larger than diameter of pipe bell. Place excavated material outside working pit and dispose of as required. Use water or other fluids in connection with boring operation only to lubricate cuttings; jetting will not be permitted.

B. In unconsolidated soil formations, a gel-forming colloidal drilling fluid may be used. Fluid is to consist of at least 10 percent of high-grade processed bentonite and shall consolidate cuttings of bit, seal walls of hole, and shall furnish lubrication for subsequent removal of cuttings and installation of pipe.

C. Depending on character of soil encountered during augering operation, conduct operations without interruption, insofar as practical, to prevent hole from collapsing or pipe from seizing up in hole before installation is complete.

D. Allowable variation from line and grade shall be as specified under Paragraph 3.06, “Dry Auger (Jacking).”

E. Remove and replace any pipe damaged during augering operations.

3.06 DRY AUGER (JACKING)

A. Comply with Section 01526 - Trench Safety System for all pits, access shafts, end trenches and other excavations relating to work required by this specification.

B. If grade of pipe at jacking end is below ground surface, excavate suitable pits or trenches for conducting jacking operations and for placing end joints of pipe. Wherever end trenches are cut in sides of embankment or beyond it, sheath securely and brace such work to prevent earth caving.

C. No more than one joint shall be made-up in pit or trench prior to jacking.

D. Construction shall not interfere with operation of railroad, street, highway, or other facility, nor weaken or damage embankment or structure.

E. Provide heavy-duty jacks suitable for forcing casing pipe through embankment. Use suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head and suitable jacking frame or backstop so that jacking pressure will be applied to casing pipe uniformly around ring of pipe.

F. Set casing pipe to be jacked on guides, properly braced together, to support section of casing pipe and to direct it in proper line and grade. Place jacking assembly in line with direction and grade of casing pipe. Provide steerable front section of casing to allow vertical grade adjustments. Provide water level or other means to allow monitoring of grade elevation of auger casing. Excavate embankment material just ahead of casing pipe and remove material through pipe. Force casing pipe through embankment with jacks, into space thus provided.

G. Conform excavation for underside of casing pipe to contour and grade of pipe, for at least one third of circumference of pipe. Provide clearance of not more than 2 inches for upper half of casing pipe. Taper off upper clearance to zero at point where excavation conforms to contour of casing pipe.

H. Bentonite slurry may be used to lubricate casing pipe during installation. Use of water to facilitate removal of spoil and to lubricate exterior casing is permitted; however, water jetting for excavation of soil is not allowed when jacking casing pipe.

I. Distance that excavation shall extend beyond end of casing pipe depends on character of material, but it shall not exceed 2 feet in any case. Decrease distance on instructions from the Engineer, if character of material being excavated makes it desirable to keep advance excavation closer to end of casing pipe.

J. Jack casing pipe from low or downstream end. Tolerances from lines and grades shown on the plan drawings for pipe installed in casing are plus or minus 6 inches in horizontal alignment and plus or minus 1-1/2 inches in elevation unless otherwise approved by the Engineer.

K. Use cutting edge of steel plate around head end of casing pipe extending short distance beyond end of pipe with inside angles or lugs to keep cutting edge from slipping back onto pipe.

L. Once jacking of casing pipe is begun, carry on without interruption, insofar as practicable, to prevent casing pipe from becoming firmly set in embankment.

M. Remove and replace any casing pipe damaged in jacking operations.

N. Backfill pits or trenches excavated to facilitate jacking operations immediately after completion of jacking of casing pipe.

O. Grout annular space when loss of embankment occurs or when clearance of two inches is exceeded.

3.07 SPACER INSTALLATION

A. There must be no inadvertent metallic contact between casing and carrier pipe. Spacing of spacers should ensure that carrier pipe is adequately supported throughout its length, particularly at ends, to offset settling and possible electrical shorting. End spacer must be within 6 inches of end of casing pipe, regardless of size of casing and carrier pipe or type of spacer used. Casing spacers are designed to withstand much greater loads than can be safely applied to most coatings. Therefore, spacing between spacers depends largely on load bearing capabilities of pipe coating and flexibility of pipe.

B. Bottom of trench adjacent to each end of casing should be graded to provide firm, uniform and continuous support for carrier pipe. If trench requires some backfill to establish final trench bottom grade, backfill material should be placed in 6-inch lifts and each layer properly compacted.

C. Casing spacers shall be installed in accordance with manufacturer's instructions. Special care shall be taken to ensure that all subcomponents are correctly assembled and evenly tightened, and that no damage occurs during tightening of spacers or carrier pipe insertion.

D. Annulus between carrier pipe and casing should be sealed with casing end seals at each end of casing.

E. Spacing for Casing Spacers:

1. Spacing shall be as shown on Drawings with maximum distance between spacers to be 10 feet for PVC pipe sizes 4 to 14 inches and 6 feet for PVC pipe sizes 16 to 30 inches. Maximum spacing shall be 6 feet for all Ductile Iron pipe sizes.

2. For ductile iron pipe, flanged pipe, or bell-and-spigot pipe, spacers should be installed within one foot on each side of bell or flange and one in center of joint when 18 to 20-foot long joints are used.

3. If casing or carrier pipe is angled, bent or dented, spacing should be reduced.

3.08 CLEANUP

A. Conform to applicable provisions of Section 01564 - Waste Material Disposal.

3.09 FILLING ANNULAR SPACE

A. Allowable variation from line and grade shall be as specified under "Jacking." Block void space around pipe in augered hole with approximately 12 inches of packed clay or similar material approved by the Engineer, to prevent bedding or backfill from entering the void around the pipe in the augered hole when compacted. For pipe diameters 4

inches through 8 inches use minimum 1/2 cubic foot clay for pipe diameters 12 inches through 16 inches use minimum 3/4 cubic foot clay.

END OF SECTION

SECTION 02400

HORIZONTAL DIRECTIONAL DRILLING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Provide and install underground water and sewer line using the horizontal directional drilling (HDD) method of installation, also commonly referred to as directional boring, guided horizontal boring. This work shall include all services, equipment, materials, and labor for the complete and proper installation, testing, restoration of underground utilities and erosion and sedimentation control and restoration.

1.02 UNIT PRICES

A. Refer to Section 01025 – Measurement and Payment for unit price procedures.

1.03 QUALITY CONTROL

A. The requirements set forth in this document specify a wide range of procedural precautions necessary to provide the very basic, essential aspects of a proper directional bore installation and are adequately controlled. Strict adherence shall be required under specifically covered conditions outlined in this specification. Adherence to the specifications contained herein, or the Owner's Representative approval of any aspect of any directional bore operation covered by this specification, shall in no way relieve the Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under the Contract.

1 Installer's Qualifications: Installation shall be by a competent, experienced contractor or sub-contractor. The installation contractor shall have a satisfactory experience record of at least 3 years engaged in similar work of equal scope. The installer must have successfully completed at least five horizontal directional drilling projects of similar nature and type. If patented processes are involved based on the pipe selection, the installer shall be licensed, trained and in good standing with the pipe manufacturer.

2 Performance Requirements: Lateral or vertical variation in the final position of the carrier pipe from the line and grade established by the plans shall be permitted only to the extent of 4 percent for water lines and horizontal deflections for sewer lines, provided that such variation shall be regular and only in the direction that will not detrimentally affect the function of the carrier pipe. Vertical deflections for sewer lines may be permitted as long as the slope is continuous (no sags), meets Texas Commission on Environmental Quality minimum slope requirements, and will flow by gravity with no surcharge and into existing or proposed downstream improvements.

3 Certification: Pipe products shall have been tested and approved by an independent third-party laboratory for continuous use at rated pressures. Pipe and couplings intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF Standard 61 by an acceptable certifying organization.

4 Design Criteria: The maximum allowable load for PVC pipe installations shall produce a maximum deflection of 4 percent. The maximum allowable load for HDPE piping used for sanitary sewer shall produce a maximum long term 50 year deflection of 4.2 percent.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 – Submittals.

B. Work Plan: Prior to beginning work, the Contractor shall submit to the Owner's Representative a work plan as record data detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience (including back-up personnel in the event that an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), traffic control plan (if applicable), all excavation locations, interfering utilities, and flow bypass, an erosion and sedimentation control plan and contingency plans for possible problems. Work plan should be comprehensive, realistic and based on actual working conditions for the project.

C. Equipment: Contractor will submit specifications on directional drilling equipment as record data. Equipment shall include but not be limited to: drilling rig, butt fusion welding apparatus, mud system, mud motors (if applicable), down-hole tools, guidance system, rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that Contractor intends to use or might use will be submitted.

D. Material: Provide shop drawings of the pipe with material specifications, including size, type, diameter and manufacturer's data and certifications on piping and jointing methods. The shop drawing shall include a Certificate of Adequacy of Design stating the pipe and fittings are satisfactory for the loads which will be imposed during for all loading conditions.

E. Contractor shall maintain a daily project log of drilling operations and a guidance system log along with a fusion report for all butt fused welding of joints with a copy given to Owner's Representative at completion of project.

1.05 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1 American National Standards Institute (ANSI) *I* NSF Standards:

a. ANSI/NSF 61 -Drinking Water System Components Health Effects

2 American Society for Testing and Materials (ASTM) Standards:

a. ASTM D2241 -Standard Specification for Poly (Vinyl Chloride) PVC Pressure Rated Pipe

b. ASTM D3034 - Standard Specification for type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

c. ASTM D1784- Standard Specification for Rigid PVC Compounds and Chlorinated PVC Compounds

d. ASTM D2837- Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

e. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

f. ASTM F477- Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pressure Pipe

g. ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

h. ASTM D1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials

i. ASTM D3350- Specification for Polyethylene Plastics Pipe and Fittings Material

j. ASTM Fl804 - Standard Practice for Determining Allowable Tensile Load for Polyethylene (PE) Gas Pipe During Pull-In Installation

3 American Water Works Associations (AWWA) Standards:

a. AWWA C901 - Standard Specification for Polyethylene (PE) Pressure Pipe and Tubing, 1/2 through 3 Inches, for Water Service

b. AWWA C900-Standard for PVC Pressure Pipe and Fabricated Fittings, 4 through 12 inches, for Water Distribution

c. AWWA C905 -Standard for PVC Pressure Pipe and Fabricated Fittings, 14 through 48 inches, for Water Distribution

d. AWWA C906 - Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 through 63 inches, for Water Distribution and Transmission

1.06 DELIVERY AND STORAGE

A. Store PVC pipe material so that there is no exposure to sunlight.

1.07 JOB CONDITIONS; PERMITS AND EASEMENT REQUIREMENTS

A. Where the work is in the public right-of-way or railroad company right-of-way, the Owner will secure the appropriate permits or easements. The Contractor shall observe regulations and instructions of the right-of-way Owner as to the methods of performing the work and take precautions for the safety of the property and the public. Negotiations and coordination with the right-of-way Owner shall be carried on by the Contractor, not less than 5 days prior to the time of his intentions to begin work on the right-of-way.

B. Comply with the requirements of the permit and/or easement. Work within the Texas Department of Transportation (TXDOT) right of way shall comply with TXDOT requirements. If required by the Right-of-Way Owner, obtain Protective Liability Insurance in the amount required by the particular company or other insurance as is specified in the permit at no cost to the Owner. Acquire a permit, agreement, or work order from the right-of-way Owner as is required.

C. Construction along roads, railroads and public areas shall be performed in such manner that does not interfere with the operations of the roads, driveways, sidewalks, pedestrian traffic and railroads.

D. Barricades, warning signs, and flagmen, when necessary and specified, shall be provided by the Contractor.

E. No blasting shall be allowed.

F. Existing pipelines and underground conduits are to be protected. The Contractor shall verify location and elevation of any pipe lines, telephone cable and fiber optics before proceeding with the construction and shall plan his construction so as to avoid damage to the existing pipe lines or telephone cables. Verification of location (vertical and horizontal) of existing utilities shall be the complete responsibility of the Contractor.

PART 2 P R O D U C T S

2.01 GENERAL

A. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the crossing, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be re-used, a guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, trained and competent personnel to operate the system.

B. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

2.02 DRILLING SYSTEM

A. Drilling Rig: The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pullback operations. The rig shall be grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.

B. Drill Head: The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.

C. Mud Motors (if required): Mud motors shall be of adequate power to turn the required drilling tools.

D. Drill Pipe: Shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.

2.03 GUIDANCE SYSTEM

A. A Magnetic Guidance System (MGS) or proven gyroscopic system shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at all depths up to 100 feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate to plus or minus 2 percent of the vertical depth of the bore hole at sensing position at depths up to 100 feet and accurate within 1.5 meters horizontally.

B. The Guidance System shall be of a proven type and shall be operated by personnel trained and experienced with this system. The Operator shall be aware of any magnetic anomalies on the surface of the drill path and shall consider such influences in the operation of the guidance system if using a magnetic system.

2.04 DRILLING FLUID MUD SYSTEM

A. Mixing System: A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid. The drilling fluid reservoir tank shall be of sufficient size for making the bore. Mixing system shall continually agitate the drilling fluid during drilling operations.

B. Drilling Fluids: Drilling fluid shall be composed of clean water and appropriate additives. Water shall be from an authorized source with a pH of 8.5 to 10. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. The water and additives shall be mixed thoroughly and be absent of any clumps or clods. No potentially hazardous material may be used in drilling fluid.

C. Delivery System: The mud pumping system shall have a minimum capacity to maintain correct boring alignment and be capable of delivering the drilling fluid at a constant pressure. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and conveyed to the drilling fluid recycling system. A berm, minimum of 12 inches high, shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system to prevent spills into the surrounding environment. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage and recycling facilities.

D. Drilling Fluid Recycling System: The drilling fluid recycling system shall separate sand, dirt and other solids from the drilling fluid to render the drilling fluid reusable. Spoils separated from the drilling fluid will be stockpiled for later use or disposal.

2.05 OTHER EQUIPMENT

A. Pipe Rammers: Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of Engineer.

B. Restrictions: Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the utility placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the project.

2.06 PIPING MATERIALS

A. Water Line Materials:

1 PVC Water Line Piping 4 through 12 inches shall be Fusible C 900 CLASS 235 (DR-18) by Underground Solutions or approved equal. PVC Water Line Piping 14 through 36 inches shall be Fusible C 905 CLASS 235 (DR-18) by Underground Solutions or approved equal.

2 HDPE Water Line Piping 4 through 30 inches shall be AWWA C906 with ductile iron sizing system (DIOD), PE3408 Materials, DR11 Pressure Class 160.

B. Pipe Markings: Pipe shall be legibly marked in permanent ink with the manufacturer and trade name, nominal size and DR rating/pressure class, hydrostatic proof test pressure, NSF 61 if applicable, and manufacturer date code. Pipe and couplings shall also bear the mark of the certifying agency which have tested and approved the product for use in fire protection applications.

C. Tracer Wire: All piping shall be installed with a continuous, insulated TW, THW, THWN or HMWPE insulated copper, 10 gauge or thicker wire for pipeline location purposes by means of an electronic line tracer. The wire shall be installed along the entire length of pipe. The insulation color shall match the color of the pipe being installed. Sections of wire shall be spliced together using approved splice caps and water proof seals. Twisting the wires together is not acceptable.

D. PVC Couplings: Pipes shall be jointed using non-metallic couplings which have been designed as an integral system. High strength thermoplastic splines shall be inserted into mating precision machined grooves in the pipe and coupling to provide full 360-degree restraint with evenly distributed loading. No external pipe to pipe restraining devices which clamp onto or otherwise damage the pipe surface will be allowed. Pipe couplings shall have a leading beveled edge to reduce resistance during pulling operations. Couplings shall be designed for use at the rated pressure of the pipe which they are used and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage requirements of ASTM D3139.

PART 3 E X E C U T I O N

3.01 GENERAL

A. The Engineer and Owner's Representative must be notified 48 hours in advance of starting work. The Directional Bore shall not begin until the Owner's Representative is present at the job site and agrees that proper preparations for the operation have been made.

B. The approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. It shall be the responsibility of Owner's Representative to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.

3.02 PERSONNEL REQUIREMENTS

A. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety. The operator of the drilling rig must have at least 3 years directional drilling experience. A responsible representative who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control of the operation at all times. In all cases the supervisor must be continually present at the job site during the actual Directional Bore operation. The Contractor shall have a

sufficient number of competent workers on the job at all times to insure the Directional Bore is made in a timely and satisfactory manner.

3.03 DRILLING PROCEDURE

A. Site Preparation: Prior to any alterations to work-site, contractor shall photograph or video tape entire work area, including entry and exit points, one copy of which shall be given to Owner's Representative and one copy to remain with contractor for a period of 1 year following the completion of the project. Work sites shall be within right-of-way and shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. Contractor shall confine all activities to designated work areas.

B. Drill Path Survey: Entire drill path shall be accurately surveyed by the Contractor with entry and exit stakes placed in the appropriate locations within the areas determined in the field with the Owner's Representative Locate existing utilities in advance of boring operations. The Contractor shall be responsible for repairing damage to existing utilities at no additional cost to the Owner. Repair of existing utilities shall proceed until complete and the existing utility is back in service. If contractor is using a magnetic guidance system, drill path will be surveyed by the Contractor for any surface magnetic variations or anomalies.

C. Environmental Protection: Contractor shall place silt fence between all drilling operations and any drainage, wetland, waterway or other area designated for such protection by contract documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Contractor shall adhere to all applicable environmental regulations. Fuel may not be stored in bulk containers within 200 feet of any water-body or wetland.

D. Safety: Contractor shall adhere to all applicable, state, federal and local safety regulations and all operations shall be conducted in a safe manner.

E. Pilot Hole:

1 Pilot hole shall be drilled on bore path with no deviations greater than 4 percent horizontally or vertically (water lines) over a length of 100 feet. In the event that pilot hole does deviate from bore path more than 4 percent, Contractor shall notify Owner's Representative who may require contractor to pull-back and re-drill from the location along bore path before the deviation. In the event that a drilling fluid fracture, inadvertent returns or returns loss occurs during pilot hole drilling operations, contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and then wait another 30 minutes.

2 If mud fracture or returns loss continues, contractor will cease operations and notify Owner's Representative. Owner's Representative and contractor will discuss additional options and work will then proceed accordingly.

F. Reaming: Upon successful completion of pilot hole, contractor will ream bore hole to a minimum of 25 percent greater than outside diameter of pipe using the appropriate tools. Contractor will not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.

G. Pull-Back:

1 After successfully reaming bore hole to the required diameter, contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel and reamer to compact bore hole walls. Pull loads shall not exceed the limits shown in the following tables. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole.

HDPE Maximum Pull Loads (lb.) - ASTM F1804									
Nonimal	**OD**	**DR**							
		7	9	11	13.5	15.5	17	21	26
12	13.2	73,157	59,007	49,376	40,977	36,058	33,077	27,095	22,095
16	17.4	127,118	102,531	85,795	71,202	62,655	57,474	47,081	38,392

PVC Fusible PVC - Underground Solutions Maximum Pull Loads			
AWWA C900			
Size (in.)	**DR**	**Minimum Radius (ft.)**	**Maximum Pull In Force (lb.)**
12	18 (235 psi)	275	83,000

PVC Fusible PVC - Underground Solutions Maximum Pull Loads			
AWWA C905			
Size (in.)	**DR**	**Minimum Radius (ft.)**	**Maximum Pull In Force (lb.)**
16	18 (235 psi)	363	139,700

Certa-Lok PVC Pipe – Maximum Pull Load must meet Manufacturer's Requirements. Contractor will submit Allowable Maximum Pull Loads as a Submittal.

2 During pull-back operations contractor will not apply more than the maximum safe pipe pull pressure at any time. In the event that pipe becomes stuck, contractor will cease pulling operations to allow any potential hydro-lock to subside and will recommence pulling operations. If pipe remains stuck, contractor will notify Owner's Representative to discuss options and then work will proceed accordingly.

3.04 HDPE AND FUSIBLE PVC PIPE JOINING

A. The pipe shall be assembled and joined at the site using the thermal butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.

B. The butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. When cool, all weld beads shall then be removed from both the inside and outside surface such that the joint surfaces shall be smooth. The fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Owner's Representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the Owner. Any section of the pipe with a gash, blister, abrasion, nick, scar or other deleterious fault greater in depth than 10 percent of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Owner's Representative shall be discarded and not used.

C. Terminal sections pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp. The butt gap between pipe ends shall not exceed 1/2 inch.

3.05 PIPE TESTING

A. Testing shall be as specified in Section 02676 – Hydrostatic Testing of Pipelines.

B. Hydrostatic Testing for pressure piping systems shall be performed in accordance with ASTM F2164. Testing pressure shall not exceed 1.5 times the system design pressure and total testing time including the time required to pressurize, stabilize, hold test pressure, and depressurize should not exceed 8 hours. If 5 psi is lost during testing pipeline must be re-pressurized.

C. HDPE pipe deflection shall not exceed deflection percentages identified in ASTM F1962 or manufacturer's maximum allowable deflection, whichever is lower. Allowable pipe deflection varies based on DR rating. The following maximum deflection percentages can be used for the following OR ratings: DR21-7.5 percent, DR17 -6.0 percent, DR15.5-6.0 percent, DR13 .5 - 6.0 percent, DR11 - 5.0 percent, DR9 - 4.0 percent, DR7 .3 - 3.0

percent. Deflection measurements can be taken by mandrel or by measurement of inside diameter before and after backfill operations.

D. Do not enclose or cover any Work until inspected.

END OF SECTION

SECTION 02500

MILLING PAVEMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Milling of existing asphalt or concrete pavement surface as required for installation of pavement overlay.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

PART 2 P R O D U C T S

2.01 EQUIPMENT

A. The teeth of the machine shall be capable of milling concrete or asphalt as appropriate. The equipment for removing the pavement surface shall be a power operated planning machine with a minimum six-foot cutting width. For detail work and for cutting widths less than six feet, equipment with less than six-foot cutting widths will be allowed. The equipment shall be self-propelled with sufficient power, traction and stability to maintain accurate depth of cut and slope. The equipment shall be capable of cutting four inches of asphaltic concrete pavement, one inch of portland cement concrete pavement, or a combination of two inches of asphaltic concrete pavement and one half inch of portland cement concrete pavement in one continuous operation.

B. The equipment shall be equipped with an approved automatic dual longitudinal grade control system and a transverse control system unless otherwise directed by the Engineer. The longitudinal controls shall be capable of operating from any longitudinal grade reference, including stringline, ski, mobile stringline, or matching shoe. The transverse controls shall have an automatic system for controlling cross slope at a given rate.

C. The grade reference used by the Contractor may be of any type approved by the Engineer. Control points shall be established for the finished profile. These points shall be set at intervals not to exceed 50 feet. The Contractor shall set the grade reference from the control points. The grade reference shall have sufficient support so that the maximum deflection shall not exceed 1/16-inch between supports.

D. The machine shall have a manual system providing for uniformly varying the depth of cut while the machine is in motion, thereby making it possible to cut flush to all inlets, manholes, or other obstructions within the paved area. The speed of the machine shall be variable in order to leave the desired grid pattern.

E. The machine shall be equipped with integral loading and reclaiming devices to immediately remove material being cut from the surface of the roadway and discharge the cuttings into a truck, all in one operation. The machine shall be equipped with devices to control dust created by the cutting action.

F. Various machines may be permitted to make trial runs to demonstrate the capabilities of that machine. Any machine that is incapable of meeting the requirements of this Section, in the option of the Engineer, will not be permitted.

G. A street sweeper equipped with a water tank spray assembly to control dust, a pick-up broom, a gutter broom, and a dirt hopper shall be provided by the Contractor. The street sweeper shall be capable of removing cuttings and debris from the planed pavement. Other sweeping equipment may be provided in lieu of the street sweeper when approved by the Engineer in writing.

H. The Contractor shall provide any other equipment and personnel necessary for proper operation of the planing machine, to minimize dust and to remove cuttings.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. The Contractor shall not mill roadway more than 7 calendar days prior to pavement overlay construction.

3.02 MILLING

A. The existing pavement to within one foot of the face of curb shall be removed for a depth of one inch or otherwise designated or shown on the drawings for milling of existing pavement.

B. The pavement surface shall be removed for the length, depth and width and to the typical section shown on the drawings. The planed surfaced shall provide a satisfactory riding surface free from gouges, continuous longitudinal grooves, ridges, oil film and other imperfections of workmanship and shall have a uniform textured appearance.

C. When removing an asphaltic concrete pavement from an underlying portland cement concrete pavement, all of the asphaltic concrete pavement shall be removed, leaving a uniform surface of portland cement concrete, unless otherwise directed by the Engineer.

D. Any vertical or near vertical longitudinal face exceeding 1-1/4 inches in height in the pavement surface open to traffic at the end of a work period shall be sloped a minimum of 1:1. Transverse faces that are present at the end of a work period shall be tapered in a manner acceptable to the Engineer.

E. Loose portland cement concrete material from the operation shall be disposed of at sites obtained by the Contractor or otherwise approved by the Engineer. All materials

removed under this contract become the property of the Contractor. Contractor shall legally dispose of such removed materials.

F. Pavement that is not removed by the planing machine adjacent to steep curbs, inlets, manholes or other obstructions shall be removed by other methods acceptable to the Engineer.

G. The pavement and curb surfaces shall be swept with a street sweeper or other sweeping equipment to remove all debris leaving a clean and presentable condition.

3.03 PROTECTION

A. Damage to water valves, water meters, manholes, curbs or other improvements shall be repaired or replaced at no additional cost to the Owner.

3.04 SURFACE TEXTURE AND TESTS

A. In areas where traffic will be permitted, the texture product shall be a grid pattern or any other pattern with discontinuous longitudinal striations that will provide, in the opinion of the Engineer, a satisfactory temporary riding surface.

B. The surface of the pavement, after planing, shall be ready for HMAC overlay and shall be true to the established line, grade and cross section. The pavement surface, when tested with a 10-foot straightedge placed parallel to the centerline of the roadway or tested by other equivalent or acceptable means, shall not have any deviation greater than 1/8-inch in 10 feet. The deviations shall be measured from the top of the texture. Any point in the surface not meeting this requirement shall be corrected as directed by the Engineer at the Contractor's expense.

END OF SECTION

SECTION 02505

ASPHALT OVERLAY

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Application of all tack and prime coats.

B. A surface course of asphaltic material.

C. A level up course of asphaltic material.

D. All transitioning to driveways and existing pavements.

E. Adjustment of all existing surface utilities to the finished surface.

F. Saw cut at intersection taper.

1.02 UNIT PRICES

A. Payment for surface course will be paid by the square yard of overlay placed on the level up course.

B. The amount of overlay, in square yards, will be to the limits designated on the drawings. Additional transitioning of driveways and intersections will be considered incidental to this item.

C. Payment for level up course will be paid for by the ton of HMAC placed on the existing concrete road.

D. No Separate payment will be made for adjusting manhole covers and valve boxes to the finished grade of the overlay unless called out in the bid documents with a unit price. Include in the unit price for asphalt overlay.

1.03 QUALITY ASSURANCE

A. The quality assurance requirements of all Specification sections referenced within this section shall be followed.

1.03 SUBMITTALS

A. Conform to Section 01300 - Submittals.

PART 2 MATERIALS

2.01 SURFACE ASPHALT

A. Materials as designated in Section 02510, "Asphaltic Concrete Pavement".

PART 3 E X E C U T I O N

3.01PREPERATION – CONCRETE ROADS

A. On existing concrete roads with previous overlays, remove the existing overlay material in accordance with Section 02500.

B. When removing the asphalt material, adequate measures shall be taken to protect curbs, inlets, manholes, water valves, driveways and any other appurtenance to the roadway.

C. The existing concrete surface prepared for overlay must be free of dirt, water and vegetation. Dirt and debris shall be broomed from the surface. Cracks shall be cleaned and sealed in accordance with Section 02542.

3.02 TACK COAT

A. Tack coat shall be applied as described in Section 02512.

B. Care should be taken to insure that the tack coat completely fills any unfilled cracks in the existing pavement.

3.03 SURFACE ASPHALT

A. Surface asphalt shall be installed as described in Section 02510, "Asphaltic Concrete Pavement".

B. The surface asphalt shall be a minimum thickness, as designated on the drawings, and shall be placed at the proper cross section.

C. The surface asphalt shall be placed with attention given to the directions of flow of drainage indicated on the drawings. The Contractor shall place the surface asphalt to meet these directions.

D. Driveways and intersections shall be transitioned (feathered), where shown on the drawings, to prevent an abrupt change from the overlay material to the existing surface. This shall be accomplished by hand spreading and raking. Where abrupt changes are shown on the drawings, the change will be accomplished by successive layers and wood forms, as required.

E. The overlay material shall be placed so that a smooth transition is provided to existing inlet throats. Positive drainage must be maintained.

3.04 ADJUSTING EXISTING UTILITIES

A. All manholes, water valves, or any other existing utility, within the project area receiving overlay, shall be adjusted to be flush with the finish surface. Adjustment shall be completed prior to placement of the surface course.

3.05 FIELD QUALITY CONTROL

A. All quality control requirements specified in other sections of the Specifications shall apply.

END OF SECTION

SECTION 02510

ASPHALTIC CONCRETE PAVEMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Surface courses of compacted mixture of coarse and fine aggregates and asphaltic material.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

B. Refer to paragraph 3.08 for unit price adjustments.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit certificates that asphaltic materials and aggregates meet requirements of Article 2.01, Materials, of this Specification Section.

C. Submit proposed design mix and test data for each type and strength of surface course in Work.

D. Submit manufacturer's description and characteristics of mixing plant for approval.

E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Coarse Aggregate: Gravel or crushed stone, or combination thereof, that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic or other injurious matter occurring either free or as coating on aggregate. Aggregate shall conform to ASTM C33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C131.

B. Fine Aggregate: Sand or stone screenings or combination of both passing No. 10 sieve. Aggregate shall conform to ASTM C33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested

by Tex-106-E. Sand equivalent shall have a minimum value of 45 when tested by Tex-203-F.

C. Composite Aggregate: Conform to the grading limits of TxDOT Item 340 for the paving type indicated on the drawings.

D. Asphaltic Material: Moisture-free homogeneous material which will not foam when heated to 347 degrees F, meeting following requirements:

VISCOSITY GRADE

Test	AC-10		AC-20	
	Min.	Max.	Min.	Max.
Viscosity, 140E strokes	1000	±200	2000	±400
Viscosity, 275E strokes	1.9	-	2.5	-
Penetration, 77E, 100 g, 5 sec.	85	-	55	-
Flash Point, C.O.C., F.	450	-	450	-
Solubility in trichloroethkene	99.0	-	99.0	-
Tests on residues from thin film oven tests:				
Viscosity, 140E strokes	-	3000	-	6000
Ductility, 77E, 5 cms per min., cms	70	-	50	-
Spot tests	Negative for all grades			

1. Material shall not be cracked
2. The Engineer will designate grade of asphalt to use after design tests have been made. Use only one grade of asphalt after grade is determined by test design for project.

2.02 EQUIPMENT

A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuously mixtures meeting specifications. Plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:

1. Cold aggregate bins and proportioning device.

2. Dryer.

3. Screens.

4. Aggregate weight box and batching scales.

5. Mixer.

6. Asphalt storage and heating devices.

7. Asphalt measuring devices.

8. Truck scales.

B. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix.

2.03 MIXES

A. Employ and pay certified testing laboratory to prepare design mixes. Test in accordance with Tex-126-E or Tex-204-F and Tex-208-F.

B. Density and Stability Requirements:

Percent Density		Percent	HVEEM Stability Percent
Min.	Max.	Optimum	Not Less Than
95	99	97	35

C. Proportions for Asphaltic Material: As specified in TxDOT Item 340 for the paving type shown on the Drawings.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted base course is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Prime Coat: If indicated on the Drawings, apply a prime coat conforming to requirements of Section 02511. Do not apply a tack coat until primed base has cured to satisfaction of the Engineer.

B. Tack Coat: Conform to requirements of Section 02512. Where the mixture will adhere to the surface on which it is to be placed without use of a tack coat, tack coat may be eliminated if approved by the Engineer.

C. Do not use cutback asphalt during the period of April 16 to September 15.

3.03 PLACEMENT

A. Do not place asphaltic mixture when air temperature is below 50 degrees F and falling. Mixture may be placed when air temperature taken in shade and away from artificial heat is above 40 degrees F and rising.

B. Haul prepared and heated asphaltic concrete mixture to the project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.

C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type. Use track-mounted finish machine to place base course directly on earth subgrade.

D. Surface Course Material: Surface course 2 inches or less in thickness may be spread in one lift. Spread all lifts in such manner that, when compacted, finished course will be smooth, of uniform density, and will be to section, line and grade as shown. Coincide construction joints on surface courses with lane lines, or as directed by the Engineer.

E. Place courses as nearly continuously as possible. Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.

F. When new asphalt is laid against existing or old asphalt, existing or old asphalt shall be saw cut full depth to provide straight smooth joint.

G. In restricted areas where use of paver is impractical, spread and finish asphalt by mechanical compactor. Use wood or steel forms, rigidly supported to assure correct grade and cross section. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove any lumps that do not break down readily. Place asphalt courses in same sequence as if placed by machine.

3.04 COMPACTION

A. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hair cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water.

B. Compress surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing from 8 to 10 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by

at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and all rolling marks are eliminated. Complete all rolling before mixture temperature drops below 175 degrees F.

C. Use tandem roller for final rolling. Double coverage with approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.

D. Along walls, curbs, headers and similar structures, and in all locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.

E. Compact binder course and surface course to density not less than 93 percent of the maximum possible density of voidless mixture composed of same materials in like proportions.

3.05 TOLERANCES

A. Furnish templates for checking surface in finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.

B. Completed surface, when tested with 10-foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct any surface not meeting this requirement.

3.06 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Minimum of one core will be taken at random locations per 1,000 feet per lane of roadway or 500 square yards of asphalt concrete pavement to determine in-place depth and density.

C. In-place density will be determined in accordance with Tex-207-F and Tex-227-F from cores or sections of asphaltic base located near each core. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by the Engineer.

D. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

E. Fill cores and density test sections with new compacted asphaltic concrete pavement.

3.07 NONCONFORMING PAVEMENT

A. Recompact pavement sections not meeting specified densities or replace them with new asphaltic concrete material. Replace with new material sections of surface course

pavement not meeting surface test requirements or having unacceptable surface texture. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute.

B. Remove and replace areas of asphaltic concrete pavement found deficient in thickness by more than 10 percent. Use new asphaltic concrete pavement of thickness shown on Drawings.

C. Nonconforming pavement sections shall be replaced at no cost to Owner.

3.08 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to lower limit of 90 percent and upper limit of 105 percent of unit price bid.

3. Average depth below 90 percent may be rejected by the Engineer.

3.09 PROTECTION

A. Do not open pavement to traffic until 12 hours after completion of rolling, or as shown on Drawings.

B. Maintain asphaltic concrete pavement in good condition until completion of Work.

C. Repair defects immediately by replacing asphaltic concrete pavement to full depth.

END OF SECTION

SECTION 02511

PRIME COAT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Prime coat for asphaltic concrete paving

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit product data for proposed prime coat.

C. Submit report of recent calibration of distributor.

PART 2 P R O D U C T S

2.01 CUTBACK ASPHALT

A. Provide moisture-free homogeneous material which will not foam when heated to 347° F and which meets following requirements:

1. Asphalt material for prime coat shall be MC-30 or MC-70 and shall meet following requirements:

Type-Grade	MC-30		MC-70	
Properties	Min.	Max.	Min.	Max.
Water, percent	---	0.2	---	0.2
Flash Point, T.O.C., °F	100	---	100	---
Kinematic Viscosity at 140°F, cst	30	60	70	140

2. Distillate shall be as follows, expressed as percent by volume of total distillate to 680° F:

	MC-30		MC-70	
	Min.	Max.	Min.	Max.
to 437°F	---	25	---	20
to 500°F	40	70	20	60
to 600°F	75	93	65	90
Residue from 680°F Distillation, Volume, percent	50	---	55	---

3. Tests on Distillation Residue:

	MC-30		MC-70	
	Min.	Max.	Min.	Max.
Penetration at 77°F, 100g, 5 sec.	120	250	120	250
Ductility at 77°F, 5 cm/min. cms	100*	---	100*	---
Solubility in trichloroethylene, %	99	---	99	---
Spot Test	All Negative			

* If penetration of residue is more than 200 and ductility at 77°F is less than 100 cm, material will be acceptable if its ductility at 60°F is more than 100.

2.02 EMULSIFIED PETROLEUM RESIN

A. EPR-1 Prime: Slow curing emulsion of petroleum resin and asphalt cement conforming to the following requirements:

PROPERTIES	MIN	MAX
Fural Viscosity at 77°F, sec	14	40
Residue by Evaporation, % by weight	60	-
Sieve Test, %	-	0.1
Particle Charge Test	Positive	
Tests on the Distillation Residue:		
Flash Point, COC (F)	400	-
Kinematic Viscosity @ 140°F (cSt)	190	350

B. For use, EPR-1 may be diluted with water up to a maximum of three parts water to one part EPR-1 in order to achieve the desired concentration of residual resin/asphalt to facilitate application.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify base is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Thoroughly clean base course surface of loose material by brooming prior to application of prime coat.

B. Prepare sufficient base in advance of paving for efficient operations.

3.03 APPLICATION, GENERAL

A. Apply prime coat with approved type of self-propelled pressure distributor. Distribute prime coat evenly and smoothly under pressure necessary for proper distribution.

B. Keep all storage tanks, piping, retorts, booster tanks and distributors used in handling asphaltic materials clean and in good operating conditions. Conduct operations so that asphaltic material does not become contaminated.

C. If yield of asphaltic material appears to be in error, recalibrate distributor prior to continuing Work.

D. Maintain the surface until Work is accepted by Owner.

3.04 APPLICATION, CUTBACK ASPHALT

A. Do not use cutback asphalt during the period of April 16 to September 15.

B. Do not place prime coat when air temperature is below 60 degrees F and falling. Materials may be placed when air temperature taken in shade and away from artificial heat is above 50 degrees F and rising.

C. Distribute at rate of 0.25 to 0.35 gallons per square yard.

D. Provide all necessary facilities for determining temperature of asphaltic material in all heating equipment and in distributor, for determining rate of application, and for obtaining uniformity at junction of two distributor loads. Provide and maintain in good working order, recording thermometer at storage heating unit at all times.

E. Temperature of application shall be based on temperature-viscosity relationship that will permit application of asphalt with viscosity of 100 to 125 centistokes. Maintain asphalt within 15° F of temperature required to meet viscosity. Selected temperature shall be within following range.

Prime Coat Type	Minimum (° F)	Maximum (° F)
MC-30	70	150
MC-70	125	175

F. Do not allow temperature of MC-30 to exceed 175° F at any time.

G. Do not allow temperature of MC-70 to exceed 200° F at any time.

3.05 APPLICATION, EMULSIFIED PETROLEUM RESIN

A. Do not place prime coat when air temperature is below 36° F and falling.

B. Distribute at rate of 0.15 to 0.25 gallons per square yard.

3.06 PROTECTION

A. No traffic or placing of subsequent courses shall be permitted over freshly applied prime coat until authorized by the Engineer.

END OF SECTION

SECTION 02512

TACK COAT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Tack coat for asphaltic concrete paving.

1.02 UNIT PRICES

A. No separate payment will be made for tack coat under this Section. Include payment in unit price for asphaltic concrete pavement.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit product data for proposed tack coat.

C. Submit report of recent calibration of distributor.

PART 2 P R O D U C T S

2.01 CUTBACK ASPHALT

A. Provide moisture-free homogeneous material which will not foam when heated to 347 degrees F and which meets following requirements:

1. Asphalt material for tack coat: RC-250 and meet following:

Properties	Min.	Max.
Water, percent	---	0.2
Flash Point, T.O.C., deg. F	80	---
Kinematic Viscosity at 140EF, cst	250	400

2. Distillate: Expressed as percent by volume of total distillate to 680° F:

	Min.	Max.
to 437EF	40	75
to 500EF	65	90
to 600EF	85	--
Residue from 680EF Distillation, Volume, percent	70	--

3. Tests on Distillation Residue:

	Min.	Max.
Penetration at 77EF, 100g, 5 sec.	100	150
Ductility at 77EF, 5 cm/min. cms	100	---
Solubility in trichloroethylene	99	---
Spot Test	All Negative	

2.02 EMULSION

A. Provide homogeneous material which shall show no separation of asphalt after mixing and shall meet the viscosity requirements at any time within 30 days after delivery.

1. Emulsion material for tack coat: SS-1 and meet following:

	Min.	Max.
Furol Viscosity as 77 F, sec.	30	100
Residue by Distillation, %	60	---
Oil Portion of Distillate, %	---	2
Sieve Test, %	---	0.1
Miscibility (Standard Test)	Passing	Passing
Cement Mixing, %	---	2.0
Storage Stability, 1 Day, %	---	1
Test on Residue:		
Penetration at 77 F, 100 g, 5 sec	120	160
Solubility in Trichloroethylene, %	97.5	---
Ductility at 77 F, cm/min, cms	100	---

2. For emulsions used for tack coats during the period of April 16 to September 15, volatile organic compound solvents (VOC) shall not exceed 12% by weight when tested in accordance with ASTM D244.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted base is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Thoroughly clean base course or concrete surface of loose material by brooming prior to application of tack coat.

3.03 APPLICATION

A. Apply tack coat uniformly by use of approved distributor at rate not to exceed 0.05 gallons per square yard of surface.

B. Paint all contact surfaces of curbs and structures, and all joints with thin uniform coat of tack coat.

C. Cutback Asphalt:

1. Do not use cutback asphalt during the period of April 16 to September 15.

2. Do not place tack coat when air temperature is below 50 degrees F and falling. Materials may be placed when air temperature taken in shade and away from artificial heat is above 40 degrees F and rising.

3. Temperature of tack coat shall be between 125 degrees F and 180 degrees F when applied.

4. Do not heat tack coat above 200 degrees F at any time.

3.04 PROTECTION

A. No traffic or placing of subsequent courses shall be permitted over freshly applied tack coat until authorized by the Engineer.

END OF SECTION

SECTION 02521

CONCRETE PAVING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Portland Cement Concrete Paving.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

B. Refer to Paragraph 3.15 for unit price adjustments.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual compressive strength obtained from design mixes at required test ages.

C. Submit manufacturer's description and characteristics for mixing equipment, and for traveling form paver, if proposed for use, for approval.

D. Submit manufacturer's certificates giving properties of reinforcing steel. Provide specimens for testing when required by the Engineer.

1.04 HANDLING AND STORAGE

A. Do not mix different classes of aggregate without written permission of the Engineer.

B. Class of aggregate being used may be changed before or during Work with written permission of the Engineer. New class shall comply with specifications.

C. Segregated aggregate will be rejected. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.

D. Aggregates mixed with dirt, weeds or foreign matter will be rejected.

E. Do not dump or store aggregate in roadbed.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Portland Cement:

1. Sample and test cement to verify compliance with Standards of ASTM C150, Type I or Type III.

2. Bulk cement which meets referenced standards may be used if the method of handling is approved by the Engineer. When using bulk cement, provide satisfactory weighing devices.

B. Water: Conform to requirements for water in ASTM C94.

C. Coarse Aggregate: Crushed stone or gravel, or combination thereof, which is clean, hard, durable, conforms to requirements of ASTM C33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C131).

1. Maximum percentage by weight of deleterious substances shall not exceed following values:

Item	Percent by Weight of Total Sample Maximum
Clay lumps and friable particles	3.0
Material finer then 75-µm (No. 200) sieve:	
Concrete subject to abrasion	3.0*
All Other concrete	5.0*
Coal and lignite:	
Where surface appearance pf concrete is of importance	0.5
All other concrete	1.0

* In case of manufactured sand, if material is finer than 75-µm (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

2. Coarse aggregate (size 1-1/2 inch to No. 4 sieve) shall conform to requirements of ASTM C33. Gradation shall be within following limits when graded in accordance with ASTM C136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 1-3/4” sieve	0
Retained on 1-1/2” sieve	0 to 5
Retained on 3/4" sieve	30 to 65
Retained on 3/8” sieve	70 to 90
Retained on No. 4 sieve	95 to 100
Loss by Decantation Test	
*Method Tex-406-A	1.0 maximum

* In case of aggregates made primarily from crushing of stone, if material finer than 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of Tex-406-A, percent may be increased to 1.5.

D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Fine aggregate for concrete shall conform to requirements of ASTM C33. Gradation shall be within following limits when graded in accordance with ASTM C136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 3/8" sieve	0
Retained on No. 4 sieve	0 to 5
Retained on No. 8 sieve	0 to 20
Retained on No. 16 sieve	15 to 50
Retained on No. 30 sieve	35 to 75
Retained on No. 50 sieve	65 to 90
Retained on No. 100 sieve	90 to 100
Retained on No. 200 sieve	97 to 100

1. When subjected to color test for organic impurities (ASTM C40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.

E. Air Entraining Agent: Furnish an air entraining agent conforming to requirements of ASTM C260.

F. Water Reducer: Water reducing admixture conforming to requirements of ASTM C494 may be used if required to improve the workability of concrete. Amount and type of such admixture shall be subject to approval by the Engineer.

G. Reinforcing Steel:

1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil or other injurious materials.

2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.

H. Fibrous Reinforcing: Conform to requirements of Section 03240.

2.02 EQUIPMENT

A. Equipment: Conform to requirements of ASTM C94.

2.03 MIXING

A. Employ and pay certified testing laboratory to prepare mix designs. Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C31 and tested in accordance with ASTM C39. Contractor shall determine and measure

batch quantity of each ingredient, including all water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.

B. Mix design to produce concrete which will have compressive strength of 3000 psi at 7 days and 3500 psi at 28 days. When high-early-strength cement is used, it shall reach at least 3250 psi at 72 hours and 3500 psi at 28 days. Slump of concrete shall be at least 1 inch, but no more than 5 inches, when tested in accordance with ASTM C143.

1. Concrete pavement shall contain at least 5-1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water cement ratio maximum 0.57). Cement content shall be determined in accordance with ASTM C138. No fly ash will be allowed.

2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.

3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4-1/2 percent plus or minus 1-1/2 percent. Air content shall be determined by testing in accordance with ASTM C231.

4. Use retardant when temperature exceeds 90 degrees F. Proportion shall be as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted base is ready to support imposed loads and meets compaction requirements.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.

B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

3.03 EQUIPMENT

A. Alternate equipment and methods, other than those required by this article, may be used provided the Contractor demonstrates that equal, or better, results will be obtained.

Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.

B. Subgrade Planer and Template:

1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form at all times, and have such strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.

2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have such strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1-foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.

C. Machine Finisher: Provide a power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires if it operates on concrete pavement.

D. Hand Finishing:

1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.

2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.

E. Belt Finishing: While concrete is still workable, give surface final belting to produce a uniform surface of gritty texture. Perform belting with short rapid transverse strokes having sweeping longitudinal motion.

F. Vibrators: Furnish mechanically operated synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.

G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment.

Requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship shall be met. If traveling form paver does not provide concrete paving that meets the compaction, finish and tolerances requirements of this specification, its use shall be immediately discontinued when so ordered by the Engineer and conventional methods shall be used.

1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Float shall be long enough to extend across pavement to side forms or edge of slab.

2. Insure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.

3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace any pavement in which tie bars assume final position other than that shown on Drawings, unless corrective alternates are authorized in writing by the Engineer.

3.04 FORMS

A. Side Forms: Use metal forms of approved shape and section. Preferred depth of form shall be equal to required edge thickness of pavement. Forms with depths greater or less than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness is not greater than 1 inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to bottom of form, or by grouting under form. Bottom flange of form shall be same size as thickness of pavement. Aluminum forms are not allowed. All forms shall be approved by the Engineer. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. In no case shall base width be less than 8 inches for form 8 inches or more in height. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide reasonable straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used.

B. Form Setting:

1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and

alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by the Engineer.

2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. These adjacent slabs shall not be used for forms until concrete has aged at least 7 days.

3.05 REINFORCING STEEL AND JOINT ASSEMBLIES

A. Accurately place reinforcing steel and joint assemblies and position them securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Place all reinforcing steel and secure to chairs.

B. Place pavement joint assemblies at required locations and elevations, and rigidly secure all parts in required positions. Install dowel bars accurately in joint assemblies as shown, each parallel to pavement surface and to center line of pavement. Rigidly secure in required position to prevent displacement during placing and finishing of concrete. Accurately cut header boards, joint filler and other material used for forming joints to receive each dowel bar. Drill dowels into existing pavement, secure with epoxy, and provide paving headers, as required, to provide rigid pavement sections.

3.06 FIBROUS REINFORCING

A. Do not use fibrous reinforcing to replace structural, load bearing or moment reinforcing steel.

B. Mix and place in accordance with requirements of Section 03240.

3.07 PLACEMENT

A. Place concrete only when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Concrete shall not be placed when temperature is below 40 degrees F and falling. When temperatures warrant protection against freezing, protect the pavement for the specified curing period. Submit for approval proposed measures to protect the concrete from anticipated freezing weather for the 72 hr. after placement. Repair or replace all concrete damaged by freezing.

When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.

B. Place concrete within 90 minutes of mixing if concrete temperature is 85 degrees or less. Remove and dispose of concrete not placed within this period.

C. Concrete slump during placement shall be 1 to 5 inches, except when using traveling-form paver slump shall be maximum of 2 inches.

D. Deposit concrete rapidly and continuously on subgrade or subbase in successive batches. Distribute concrete to required depth and for entire width of placement in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At end of day or in case of unavoidable interruption of more than 30 minutes, place transverse construction joint at point of stopping work. Remove and replace sections less than 10 feet long.

E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

3.08 COMPACTION

A. Consolidate the concrete using mechanical vibrators as specified herein. Extend a vibratory unit across the pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.

B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

3.09 FINISHING

A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.

1. Use transverse finishing machine to make at least two trips over each area. Make last trip continuous run of not less than 40 feet. After transverse screeding, use hand-operated longitudinal float to test and level surface to required grade.

2. Hand finish with mechanical strike and tamping template as wide as pavement to be finished. Shape template to pavement section. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make at least two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and

maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.

C. While concrete is still workable, give surface final belting to produce a uniform surface of gritty texture and striations of 1/16" to 1/8"deep.

3.10 JOINTS AND JOINT SEALING

A. Conform to requirements of Section 02523.

3.11 CONCRETE CURING

A. Conform to requirements of Section 02525.

3.12 TOLERANCES

A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10-foot straightedge parallel to center of roadway to bridge any depressions and touch all high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10-foot straightedge shall not exceed 1/8 inch.

3.13 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made for each 150 cubic yards or less of pavement that is placed in one day. Two specimens will be tested at 7 days or at number of hours as directed by the Project Manager for high early strength concrete. Test the remaining two specimens at 28 days. Specimens will be made, cured and tested in accordance with ASTM C-39. Minimum compressive strength shall be 3000 pounds per square inch at 7 days and 3500 pounds per square inch at 28 days.

C. Yield test will be made in accordance with ASTM C138 for cement content per cubic yard of concrete. If such cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.

D. Minimum of one 4-inch core will be taken at random locations per 1,000 feet per lane or 500 square yards of pavement to measure in-place depth. Each core may be tested for 28-day compressive strength according to methods of ASTM C42. The 28-day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch.

E. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

F. Fill cores and density test sections with new concrete paving or non-shrink grout.

3.14 NONCONFORMING PAVEMENT

A. Remove and replace areas of pavement found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with concrete of thickness shown on Drawings unless accepted by the Engineer.

B. Remove and replace pavement with unsatisfactory finish as determined by the Owner and Engineer. An unsatisfactory finish includes, but is not limited to, rain event that occurs during or after a concrete pour resulting in a poor finish, poor tooling, finishing or workmanship.

C. Nonconforming pavement sections shall be replaced at no cost to Owner.

3.15 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to a lower limit of 90 percent of unit price bid.

3. No adjustment will be made for excess thickness.

3.16 PAVEMENT MARKINGS

A. Restore pavement markings to match those existing in accordance with standard specifications and details and the Engineer's requirements.

3.17 PROTECTION

A. Barricade pavement section from use until concrete has attained minimum design strength.

B. On those sections of pavement to be opened to traffic, seal joints, clean pavement and place earth against pavement edges before permitting use by traffic. Such opening of pavement to traffic shall not relieve Contractor from his responsibility for Work.

C. Maintain concrete paving in good condition until completion of Work.

D. Repair defects by replacing concrete to full depth.

END OF SECTION

SECTION 02523

CONCRETE JOINTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A Joints for concrete paving; concrete sidewalks; and curbs, and curb and gutter.

B Saw-cutting existing concrete or asphalt pavements for new joints.

1.02 UNIT PRICES

A No separate payment will be made for concrete joints under this Section. Include payment in unit price for Concrete Paving.

B No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.

C No separate payment will be made for joints or saw-cutting for Curb, Curb and Gutter; Concrete Sidewalks; Wheelchair Ramps; and Concrete Driveways. Include payment in unit price for Curb and Gutter; Concrete Sidewalks; Handicap Ramps and Concrete Driveways.

D Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A Submit product data and samples in accordance with requirements of Section 01300 - Submittals.

B Submit product data for joint sealing compound and proposed sealing equipment for approval.

C Submit samples of dowel cup, metal supports, and deformed metal strip for approval.

PART 2 P R O D U C T S

2.01 MATERIALS

A Board Expansion Joint Material: Filler board of selected stock. Use wood of density and type as follows:

1 Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.

2 Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

3 Use wood only when part of a load transmission device assembly.

B Joint Sealing Compound:

1 Joint Sealing Compound shall be self-leveling Low Modulas Silicone sealant single component meeting the requirements of TxDOT Specification 433.2, Class 5.

C Load Transmission Devices:

1 Smooth, steel dowel bars conforming to ASTM A615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.

2 Deformed steel tie bars conforming to ASTM A615, Grade 60.

D Metal Supports for Reinforcing Steel and Joint Assembly: Employ metal supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by the Engineer.

PART 3 E X E C U T I O N

3.01 PLACEMENT

A When new work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.

B If the limit of removal of existing concrete or asphaltic pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.

3.02 CONSTRUCTION JOINTS

A Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 5 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.03 EXPANSION JOINTS

A Place 3/4-inch expansion joints at locations shown on drawings. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings. Seal with joint sealing compound.

3.04 CONTRACTION JOINTS

A Place formed groove contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Maximum spacing of contraction/construction joints is 20 feet, or as shown on plans. Polyethylene foam backer rods shall be installed in contraction joints. Seal groove with joint sealing compound.

3.05 LONGITUDINAL WEAKENED PLANE JOINTS

A Place formed groove longitudinal weakened plane joints at spaces indicated on Drawings. Seal groove with joint sealing compound.

3.06 SAWED JOINTS

A Contractor may use sawed joints as an alternate to formed groove contraction and weakened plane joints. Circular cutter shall be capable of cutting straight line groove 1/4" – 3/8" inch wide. Depth shall be one fourth of pavement thickness plus 1/2". Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, it shall be continued until completed. Make saw cut with one pass. Complete sawing between 4 to 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.

B Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Provide at least one standby saw in good working order. Maintain an ample supply of saw blades at work site at all times during sawing operations. Sawing equipment shall be on job at all times during concrete placement.

3.07 JOINTS FOR CURB, CURB AND GUTTER

A Place 3/4-inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement; at end of radius returns at street intersections and driveways; and at curb inlets. Maximum spacing shall be 60-foot centers.

3.08 JOINTS FOR CONCRETE SIDEWALKS

A Provide 3/4-inch expansion joints conforming to ASTM A1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 20 feet. Provide expansion joint material conforming to ASTM D994 for small radius curves and around fire hydrants and utility poles. Extend the expansion joint material full depth of the slab. Reinforcing bars shall extend 10 inches beyond the expansion joint and then shall be wrapped with building paper, or approved sleeves, so that the 10 inches shall not be bonded to the concrete.

3.09 JOINTS FOR CONCRETE DRIVEWAYS

A Provide 3/4-inch expansion joints conforming to ASTM D1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab. Where dowels are used, wrap or sleeve one end.

3.10 JOINT SEALING

A Seal joints only when surface and joints are dry, ambient temperature is within manufacturers recommendations, and weather is not foggy or rainy.

B Joint sealing equipment shall be in first-class working condition, and be approved by the Engineer. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.

C Clean joints of loose scale, dirt, dust and curing compound. Term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.

D Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch below level of adjacent surface or at elevation as directed.

3.11 PROTECTION

A Maintain joints in good condition until completion of Work.

B Replace damaged joints material with new material as required by this Section.

END OF SECTION

SECTION 02525

CONCRETE PAVEMENT CURING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Curing of Portland Cement Concrete Paving.

1.02 UNIT PRICES

A. No separate payment will be made for concrete curing under this Section. Include payment in unit price for Concrete Paving; Concrete Sidewalks; Wheelchair Ramps; Curb; and Curb and Gutter.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds

PART 2 P R O D U C T S

2.01 COVER MATERIALS FOR CURING

A. Curing materials shall conform to one of following:

1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C171.

2. Waterproofed Paper: Paper conforming to requirements of ASTM C171.

3. Cotton Mats: Single layer of cotton filler completely enclosed in cover of cotton cloth. Mats shall contain not less than 3/4 of a pound of uniformly distributed cotton filler per square yard of mat. Cotton cloth used for covering materials shall weigh not less than 6 ounces per square yard. Mats shall be stitched so that mat will contact surface of pavement at all points when saturated with water.

2.02 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Liquid membrane-forming compounds shall conform to ASTM C309. Membrane shall restrict loss of water to not more than 0.55 kg/m^2 of surface in 72 hours.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Concrete pavement shall be cured by protecting it against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphaltic concrete.

B. Where curing requires use of water, curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

3.02 POLYETHYLENE FILM CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in the form of a fine spray. Cover surface with polyethylene film so film will remain in direct contact with surface during specified curing period.

B. Cover entire surface and both edges of pavement slab. Joints in film sheets shall overlap minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or by replacing.

3.03 WATERPROOFED PAPER CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with waterproofed paper so paper will remain in direct contact with surface during specified curing period.

B. Prepare waterproofed paper to form blankets of sufficient width to cover entire surface and both edges of pavement slab, and not be more than 60 feet in length. Joints in blankets caused by joining paper sheets shall lap not less than 5 inches and shall be securely sealed with asphalt cement having melting point of approximately 180°F. Place blankets to secure an overlap of at least 12 inches. Tears or holes appearing in paper during curing period shall be immediately repaired by cementing patches over defects.

3.04 COTTON MAT CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, completely cover surface with cotton mats, thoroughly saturated before application, in such manner that they will contact surface of pavement equally at all points.

B. Mats shall remain on pavement for specified curing period. Keep mats saturated so that, when lightly compressed, water will drip freely from them. Keep banked earth or cotton mat covering edges saturated.

3.05 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Immediately after finishing surface, and after concrete has taken its initial set, apply liquid membrane-forming compound in accordance with manufacturer's instructions.

END OF SECTION

SECTION 02530

CONCRETE SIDEWALKS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Reinforced concrete sidewalks.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.

C. Submit manufacturer's certificates giving properties of reinforcing steel. Provide specimens for testing when required by the Owner Representative.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Section 02521 - Concrete Paving.

B. Reinforcing Steel: Conform to material requirements for reinforcing steel of Section 02521 - Concrete Paving.

C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02523 - Concrete Joints.

D. Joint Sealing Compound: Conform to material requirements of Section 02523 - Concrete Joints.

E. Sand Bed: Conform to material requirements for bank run sand of Section 02229 - Utility Backfill Materials.

PART 3 E X E C U T I O N

3.01 REPLACEMENT

A. Replace sidewalks which are removed or damaged during construction with sidewalk of thickness and width equivalent to one removed or damaged.

B. Provide replaced and new sidewalks with wheelchair ramps if sidewalk intersects curb at street or driveway intersection.

3.02 PREPARATION

A. Identify and protect utilities which are to remain.

B. Protect living trees, other plant growth, and features designated to remain.

C. Conduct clearing and grubbing operations in accordance with Section 02100 - Right-of-Way Preparation.

D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to the line, grade and cross section. Compact subgrade, to a minimum of 95 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D698.

3.03 PLACEMENT

A. Forms: Straight, unwarped wood or metal forms with nominal 4-inch depth. Securely stake forms to line and grade, and maintain in true position during concrete placement.

B. Reinforcement: Install No. 3 reinforcing steel bars spaced in accordance with Drawing detail. Lay longitudinal bars in walk continuously, through expansion joints in accordance with Section 02523 - Concrete Joints. Support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.

C. Expansion Joints: Install expansion joints in accordance with Section 02523 - Concrete Joints.

D. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.

E. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.

F. Unless otherwise indicated on Drawings, mark off joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.

G. Finish edges with tool having 1/4-inch radius.

H. After concrete has set sufficiently, refill space along sides of sidewalk to top of walk with suitable material. Tamp unit firm and solid. Dispose of excess material in accordance with Section 01564 - Waste Material Disposal.

3.04 CURING

A. Conform to requirements of Section 02525 - Concrete Pavement Curing.

3.05 PROTECTION

A. Maintain sidewalks in good condition until completion of Work.

B. Replace damaged sidewalks in accordance with Paragraph 3.01 in this Section.

3.06 ACCESSIBILITY STANDARDS

A. All sidewalk and wheelchair ramp shall meet criteria of the Texas Accessibility Standards and the Federal Design Guidelines, i.e. slopes, texture and coloring. If applicable, the Texas Department of Licensing and Regulation (TDLR) shall inspect the site and rule on compliance. Any item found out of compliance shall be remedied at the expense of the Contractor.

END OF SECTION

SECTION 02531

CONCRETE DRIVEWAYS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Portland cement concrete driveways.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Section 02521 - Concrete Paving.

B. Reinforcing Steel: Conform to material requirements of Section 02521 - Concrete Paving.

C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02523 - Concrete Joints.

D. Joint Sealing Compound: Conform to material requirements of Section 02523 - Concrete Joints.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Prepare subgrade in accordance with applicable portions of Sections 02221 through 02227 and 02241.

3.02 PLACEMENT

A. Place and finish concrete in accordance with applicable portions of Section 02521 - Concrete Paving.

3.03 JOINTS

A. Install joints in concrete driveway in accordance with Section 02523 - Concrete Joints.

3.04 CONCRETE CURING

A. Cure concrete driveway in accordance with Section 02525 - Concrete Pavement Curing.

3.05 PROTECTION

A. Conform to applicable requirements of Section 02521 - Concrete Paving.

END OF SECTION

SECTION 02532

CURB, CURB & GUTTER, AND HEADERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb.

B. Paving headers poured monolithically with concrete base or pavement.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for Unit Price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit details of proposed formwork for approval.

C. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.

D. Submit manufacturer's certifications giving properties of reinforcing steel. Provide specimens for testing when required by the Owner Representative.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Section 02521 - Concrete Paving.

B. Reinforcing Steel: Conform to material requirements for reinforcing steel of Section 02521 - Concrete Paving.

C. Grout: Nonmetallic, nonshrink grout containing no chloride producing agents conforming to the following requirements.

Compressive strength, psi	
at 7 days	3,500
at 28 days	8,000
Initial set time, minutes	45
Final set time, hours	1.5

D. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02523 - Concrete Joints.

E. Joint Sealing Compound: Conform to material requirements of Section 02523 - Concrete Joints.

F. Mortar: Mortar finish composed of one part Portland cement and 1-1/2 parts of fine aggregate. Use only when approved by the Engineer.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Prepare subgrade or base in accordance with applicable portions of Sections 02221 and 02225.

3.02 PLACEMENT

A. Guideline: Set to follow top line of curb. Attach indicator to provide constant comparison between top of curb and guideline. Insure flow lines for monolithic curb and gutters conform to slopes indicated on Drawings.

B. Forms: Brace sufficiently to maintain position during pour. Use metal templates cut to section shown on Drawings.

C. Reinforcement: Secure in proper position so that steel will remain in place throughout placement.

D. Joints: Place in accordance with Section 02523 - Concrete Joints. Place dummy groove joints at 6-foot centers at right angles to curb lines. Cut dummy grooves 1/4 inch deep using an approved edging tool.

E. Place concrete in forms to required depth. Consolidate thoroughly. Do not permit rock pockets in form. Entirely cover top surfaces with mortar.

3.03 MANUAL FINISHING

A. After concrete is in place, remove front curb forms. Form exposed portions of curb, and of curb and gutter, using mule which conforms to curb shape, as shown on Drawings.

B. Thin coat of mortar may be worked into exposed face of curb using mule and two-handled wooden darby at least 3 feet long.

C. Before applying final finish move 10-foot straightedge across gutter and up curb to back form of curb. Repeat until curb and gutter are true to grade and section. Lap straightedge every 5 feet.

D. Steel trowel finish surfaces to smooth, even finish. Make face of finished curb true and straight.

E. Edge outer edge of gutter with 1/4-inch edger. Finish edges with tool having 1/4-inch radius.

F. Finish visible surfaces and edges of finished curb and gutter free from blemishes, form marks and tool marks. Finished curb or curb and gutter shall have uniform color, shape and appearance.

3.04 MECHANICAL FINISHING

A. Mechanical curb forming and finishing machines may be used instead of, or in conjunction with, previously described methods, if approved by the Owner Representative. Use of mechanical methods shall provide specified curb design and finish.

3.05 CURING

A. Immediately after finishing operations, cure exposed surfaces of curbs and gutters in accordance with Section 02525 - Concrete Pavement Curing.

3.06 TOLERANCES

A. Top surfaces of curb and gutter shall have uniform width and shall be free from humps, sags or other irregularities. Surfaces of curb top, curb face and gutter shall not vary more than 1/8 inch from edge of a 10-foot long straightedge laid along them, except at grade changes.

3.07 PROTECTION

A. Maintain curbs and gutters in good condition until completion of Work.

B. Replace damaged curbs and gutters to comply with this Section.

END OF SECTION

SECTION 02540

POINT REPAIR OF EXISTING CONCRETE PAVEMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Full-depth repair of existing section of Portland cement concrete pavement, removing the old concrete and replacing it with concrete as herein specified, in conformance with the typical sections shown on the Drawings.

1.02 UNIT PRICES

A. Refer to Section 01025 – Measurement and payment for unit price procedures.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete shall conform to the requirements of Section 02751, “Sitework Concrete”.

B. Reinforcing steel shall conform to the requirements of Section 02751, “Sitework Concrete”.

C. Subgrade material shall conform to the material requirements of Section 02252.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. The Contractor shall survey the area determined by the Engineer as described in Section 01050, Field Surveying. The Engineer will review the survey data and provide final limits and elevations for the proposed repairs.

B. The areas to be repaired shall be outlined by the contractor and approved by the Engineer, prior to saw cutting, if required.

C. The areas will be determined after the removal of the asphaltic concrete. The removal of the asphalt will be in accordance with Section 02500

3.02 PREPARATION

A. Make required saw cuts as approved by the Engineer around the perimeter of the repair area. Remove the distressed area, taking care not to spall or fracture the adjacent concrete. Install the dowels or prepare the undercut and complete the patch as shown on the Drawings.

3.03 GENERAL

A. Dispose of removed concrete at sites which are obtained by the Contractor.

B. Replacement of transverse joints will be required where the failed area necessitates the removal of an existing joint.

C. When a point repair includes portions of more than one lane of traffic, only one lane shall be repaired at a time. The adjacent lane shall not be repaired until such time as traffic can travel on the first lane repaired. Provisions shall be made to include steel in first pour for tie to second pour.

D. On concrete streets, where existing asphalt overlay is being removed prior to pavement repair, the Contractor shall be aware that additional or less point repairs may be required, once the condition of the presently covered concrete street is known. After removal of the asphalt overlay, the Contractor shall outline the limits of point repair, on the existing concrete pavement, with spray paint, so that the Owner may reevaluate the limits of the point repair. The Contractor shall allow sufficient time for the Owner to determine required point repair adjustments, prior to proceeding with the point repairs. The point repair quantity may be adjusted.

E. After removal of the concrete in the point repair area, the Engineer will determine the type of point repair required. The Engineer will determine if the subgrade requires removal and replacement or if the existing subgrade can be reused.

F. The condition of the existing concrete streets within this project may be very deteriorated and cracked. During the point repair process, the Contractor shall remove pieces of unstable concrete which exist beyond and adjacent to the limits of point repair indicated on the drawings. Unsuitable concrete shall be that which is loose from the existing concrete pavement or that which “rocks” when surface pressure is applied. The purpose for removing these pieces will be to provide a firm solid pavement adjacent to the new point repair. Measurement and payment will include the unstable areas as approved by the Engineer.

G. The Contractor shall be aware that due to the deteriorated state of the existing concrete pavement, vehicular or construction traffic adjacent to point repair excavation may aggravate and worsen the cracked pavement condition. This can cause concrete considered stable at the time of excavation to become unstable. The Contractor shall be responsible for removing and replacing such unstable concrete with new paving material at no additional cost to the Owner.

3.04 PLACEMENT

A. The requirements of Section 02751, "Sitework Concrete", shall govern the placing of the concrete. Immediately prior to placing the concrete, the subbase and each face of existing concrete shall be wetted. Approved, hand manipulated, mechanical vibrators shall be used to insure proper consolidation of the concrete. The concrete shall be screeded off to the

elevation of the adjacent concrete pavement and checked with a straightedge to insure that the riding surface will be satisfactory. The concrete shall be finished with a broom finish, as directed by the Engineer.

3.05 OPENING TO TRAFFIC

A. The repaired area may be opened to traffic when the pavement has attained a flexural strength of 500 pounds per square inch. All test specimens, representing tests for opening to traffic, shall be cured using the same methods and under the same conditions as the concrete represented.

3.06 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Any modifications in the construction methods requested by the Contractor must be submitted to the Engineer, in writing, for his approval.

END OF SECTION

SECTION 02542

SEALING PORTLAND CEMENT CONCRETE PAVEMENT CRACKS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Sealing of cracks in portland cement concrete pavement greater than 1/4-inch with a rubber asphalt crack sealing compound.

1.02 UNIT PRICES

A. Cleaning and resealing of cracks in concrete pavement greater than 1/4-inch will be paid for by the linear foot of sealed crack.

B. Refer to Section 01025 – Measurement and payment for unit price procedures.

1.03 SUBMITTALS

A. Manufacturer's data on sealant products

B. Description and specifications for cleaning, heating and application equipment proposed for use.

PART 2 MATERIALS

2.01 MATERIALS

A. Rubber asphalt crack sealing compound:

The material shall be a blend of rubber and asphalt and shall be suitable for sealing cracks 1/4-inch or larger.

It shall be capable of being melted and applied by suitable oil-jacketed kettle equipped with pressure pump, hose and nozzle at a temperature of 400° F or less. It shall contain no water or highly-volatile matter and shall not track by traffic as soon as cooled to road temperature.

B. MATERIAL REQUIREMENTS

1. Rubber shall be one of the following types:
   a. Type I - Ground-Tire Rubber
   b. Type II - Mixture of ground-tire rubber and high natural reclaimed scrap rubber.
      1) The natural rubber content, determined by ASTM C 297, shall be a minimum of 25 percent

c. The ground rubber recovered in the determination of rubber content shall comply with the following gradation requirements when tested by test method TEX-200-F, Part I.

US Std Sieve Size	Percent Retained Type I	Percent Retained Type II
No. 8	0	0
No. 10	0-5	-
No. 30	90-100	50-70
No. 50	95-100	70-95
No. 100	-	95-100

d. The ground rubber shall be free from fabric, wire, cord or other contaminating materials.

2. Rubber content of the crack sealing compound
   a. Percent by weight: 22 minimum
      26 maximum
3. Flash point, modified C.O.C. - Minimum of 400°F
   a. The equipment and procedure shall be as specified in ASTM D92 with the following modification.
      1) Prior to passing the test flame over the cup, agitate the sealing compound with a 3/8 to ½-inch wide square-end metal spatula in a manner so as to bring the material on the bottom of the cup to the surface. This shall be done, starting at one side of the thermometer, moving around to the other, then returning to the starting point, using 8 to 10 rapid circular strokes. The agitation shall be accomplished in 3 to 4 seconds. The test flame shall be passed over the cup immediately after the stirring is completed.
      2) The procedure shall be repeated at each successive 10° F interval until the flash point is reached.
4. Consistency

	Minimum	Maximum
Penetration at 77° F, 150 g, 5 sec	30	50
Penetration at 32°F, 200 g, 60 sec	12	-

a. The penetration shall be determined by ASTM D5 except that the cone specified in ASTM D217 shall be substituted for the penetration needle.

5. Packaging

   a. The material shall be packaged in boxes which contain two (2) 30-35 pound blocks that are individually packaged in a liner made of polyethylene or packaged in self-releasing cardboard containers which contain two (2) 30-35 pound blocks and which will stack properly.
   b. The boxes or containers shall be placed on pallets.
   c. The total weight of pallet and containers shall be approximately 2100 pounds.

C. EQUIPMENT

1. An oil jacketed kettle equipped with a pressure pump, hose, and nozzle capable of applying the crack sealing compound at the temperature of 400° or less. The equipment shall be approved by the Engineer.
2. Other equipment, tools and machinery necessary for proper prosecution of the work shall be on the project and approved by the Engineer prior to beginning crack sealing operations.

PART 3 E X E C U T I O N

3.01 PREPERATION

A. Cracks shall be cleaned of infiltrated material and blown dry with compressed air.

3.02 APPLICATION

A. After cleaning, the rubber asphalt material shall be heated and applied to seal the cracks in a manner satisfactory to the Engineer.

B. No sealing shall be done unless the pavement temperature is above 40°F

END OF SECTION

Section 02554

SLIPLINING GROUT (HDPE SLIPLINED PIPE)

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Furnishing and placing of grout in the annular space between slipliner pipes and host pipe.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices: Measurement for Sliplining grout will not be paid for separately and must be included in the unit price bid for sliplined pipe. This shall include installing the grout in the annulus between the host pipe and the sliplined pipe.

1.03 REFERENCES

A. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)

B. ASTM C 138 - Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

C. ASTM C 144 - Standard Specification for Masonry Mortar

D. ASTM C 150 - Standard Specification for Portland Cement

E. ASTM C 403 - Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

F. ASTM C 495 - Test Method for Compressive Strength of Lightweight Insulating Concrete

G. ASTM C 618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete

H. CRD C 621 - Specification for Non-shrink Grout

1.04 SUBMITTALS

A. At least 30 days prior to grouting, submit information on equipment, grout mixes and procedures in accordance with Section 01330 – Submittal Procedures. Shop drawings and product data shall include but not be limited to the following:

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1. Detailed descriptions of equipment and operational procedures to accomplish the annular grouting operation, including mixing and pumping schedule, grouting pressures, rates of pumping, and methods for monitoring the effectiveness of the grouting.

2. Detailed descriptions and drawings indicating proposed locations, of surface mixing equipment, subsurface injection points, flowlines, waste grout recovery, grout pressure limiting equipment, bulkheads, and venting system. Show details of bulkhead design.

3. Grout mix design and trial mix tests, with set time, compressive strength and density test results.

4. Qualifications and experience of grout mix applicator.

B. During pressure grouting operations, maintain and submit daily logs of grouting operations including pressure, grout volume pumped and such other data as may be required by the City Engineer.

1.05 PERFORMANCE REQUIREMENTS

A. Design grout mix to be pumped through a 2-inch-diameter hose for a distance of 1000 feet, with a maximum allowable pressure at point of placement of 5 psi. The cast density shall be 55 pcf plus or minus 5 pcf. Minimum penetration resistance after 24 hours shall be 100 psi in accordance with ASTM C 403. The minimum compressive strength at 28 days shall be 300 psi in accordance with ASTM C 495. Grout mix shall have less than 1 percent shrinkage by volume.

B. The application system shall have sufficient gages, monitoring devices and tests to determine the efficiency and effectiveness of the grouting work and to provide a means of accurately determining the amount of grout injected. Contractor shall be prepared to modify the operation should grouting not perform as proposed. Such modifications and changes shall be done in a timely manner to avoid unnecessary delay in completion of the Project.

C. No deleterious amounts of toxic or other poisonous substances shall be included in the grout mix nor otherwise injected underground.

D. Mix Designs: One or more mixes shall be developed to completely fill the annular space based, but not restricted to, the following requirements:

1. Size of annular void.

2. Void (size) of the surround soil.

.

3. Sufficient strength and durability to prevent movement of the liner pipe.

4. Provide adequate retardation.

5. Provide less than 1 percent shrinkage by volume.

E. Density/Viscosity: The contractor shall design a grout mix with a density to prevent floating of the liner pipe. The apparent viscosity shall not exceed 20 seconds in accordance with ASTM C939, unless otherwise approved by the Engineer.

F. Foaming agents used in the production of cellular grouts shall be acceptable upon approval of the Engineer.

PART 2 P R O D U C T S

2.01 MANUFACTURERS/APPLICATORS

A. Refer to City of Houston approved Products List for acceptable product manufactured.

B. The applicator of the grout mix shall be certified by the grout mix manufacturer and approved by the City Engineer. The certified applicator shall be regularly engaged in the placement of grout, including completion of pipeline grouting installations having at least 1000 cubic yards in the past 3 years.

2.02 MATERIALS

A. Cement: Comply with ASTM C 150. Pozzolans and other cementitious materials are permitted.

B. Fly Ash: Comply with ASTM C 618; either Type C or Type F shall be used.

C. Sand, if provided, shall conform to ASTM C 144, except as modified below:

U.S. Standard Sieve Size	Percent Passing by Weight
No. 16	100
No. 30	60 - 85
No. 50	10 - 35
No. 100	5 - 25
No. 200	0 - 10

D. Water: Use potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the sliplining grout.

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E. Admixtures: Admixtures shall be selected by the sliplining grout manufacturer to meet performance requirements, improve pumpability, control set time and reduce segregation. No aggregate shall be used in the grout mix.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Notify Engineer at least 24 hours in advance of grouting operations.

B. Select and operate grouting equipment and carry out procedures with sufficient safety and care to avoid damage to existing underground utilities and structures.

3.02 EQUIPMENT

A. Mixers and Pumps: System shall mix the grout to a homogeneous consistency. Deliver grout to the injection point at a steady pressure with a nonpulsating centrifugal or triplex pump at the mix tank. Provide ways to increase or decrease the water-cement ratio and accurately measure grout component quantities, pumping pressures, and volumes pumped.

B. Pressure Gauges:

1. Pressure gauges shall be equipped with diaphragm seals, have a working range between 1.5 to 2.0 times the design grout pressure, and have an accuracy within 0.5 percent of full range.

2. Provide one pressure gauge at the point of injection and one pressure gauge at the grout pump.

3. Grouting shall not proceed without appropriate gauges in place and in working order.

4. Grout pressure gauge and recorder shall be installed immediately adjacent to each injection port. During grouting operations, the recorder shall continuously record the actual grouting pressure versus time on paper with ink. The gauge shall conform to an accuracy of plus or minus 0.5 psi. The range of the gauge should not be more than 100 percent greater than the design grout pressure. Pressure gauges shall be instrument oil filled and attached to a saddle-type diaphragm seal (gauge saver) to prevent clogging with grout. All gauges shall be certified and calibrated in accordance with ANSI B40, Grade 2A. The grout pressure recordings shall be identified as a minimum, with date, batch, and time of day grouting was performed and shall be submitted to the Engineer at the end of the work day that grouting was performed.

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3.03 GROUTING

A. Place grout in the annular space between the sliplining pipe and the host sewer. Completely fill the annular space without deflecting or floating the pipe. Test grout equipment and procedures in accordance with approved submittals. Perform testing on the first pipeline segment to be grouted; testing must be performed under observation by the Project Manager. If the grout does not totally fill the annular space, adjust the procedure or the mix, and rerun the test on the first pipeline segment.

B. Procedure:

1. Place grout for a given pipeline segment between bulkheads. Place bulkheads at the ends of each pipeline segment to seal the annular space from sewer flow. Do not remove bulkheads until after grout has set.

2. Equip slipliner pipes with weirs to fill the pipes with water to prevent flotation during grouting operations.

3. Remove or control standing or running water in annular spaces to maintain the correct water ratio of the grout mixture. Grout the annular space by injecting grout from one end of the pipeline segment, allowing it to flow toward the other end. Vent the annular space to assure uniform filling of the void space.

4. Limit pressure on the annular space to prevent damage to the liner; do not exceed 5 psi. Regardless of the pressure, Contractor shall be solely responsible for any damage or distortion to slipliner pipe due to grouting. At the bulkhead opposite to the point of grouting, provide and monitor an open-ended high point tap or equivalent vent.

5. Pump grout until grout within 0.3 pounds per gallon of specified grout injection density discharges from the end opposite the injection point. This procedure is intended to ensure that the grout is not diluted by extraneous water in the annulus.

6. The drilling of additional injection holes from the surface to facilitate grouting may be allowed if approved by the City Engineer.

7. Upon completion of sliplining or SPR ™ PVC installation but prior to grouting, bulkheading of the ends and appropriate venting shall be required. This is to seal the annular space from sewer flow to permit the grout to set and withstand the loads imposed by the grout and groundwater. The Contractor shall test the integrity of the installed liner pipe and constructed bulkheads for any leaks by performing the following:

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a. Dewater and inject dye water into the annular space (this will not be permitted if the crown or any portion of the host pipe is severely deteriorated to the point where water may escape through the host pipe).

b. Pressurize the annular space to the maximum permissible grouting pressure per manufacturer's recommendation with approval of the Engineer.

8. The Contractor shall submit a detailed plan to the Engineer that shows how the liner pipe will be held on the invert for a period of time long enough to allow the grout to set when buoyant uplift is a factor.

3.04 FINAL CLEANUP

A. No hardened grout is permitted in the slipliner pipe invert after completion of grouting operations.

B. Any grout bushings or ports must be closed, sealed, and coated over to prevent corrosion or abrasion damage to liner pipe.

3.05 DEWATERING SYSTEM OPERATION

A. Operate dewatering systems until the grouting of slipliner pipe is complete.

3.06 TESTING

A. Density: During placement of grout, measure density in accordance with ASTM C 138 at least twice per hour. Adjust the mix as required to obtain the specified cast density.

B. Sampling:

1. Take 4 test specimens for each 100 cubic yards of grout, or for each 4 hours of placing.
2. Test in accordance with ASTM C 495 except:

a. Specimens shall be 3-inch by 6-inch cylinders covered after casting to prevent damage and loss of moisture. Moist-cure specimens for at least the first 7 days; perform at least one compressive strength test of each set of samples at 28 days.

b. Do not oven-dry specimens to be tested. Specimens may be tested at any age to monitor compressive strength. The material may require special handling and testing techniques.

c. The Contractor shall be required to perform a test on each type of grout and grout system proposed to be used. The test section to be grouted and the size of the annular space considered for each type of grout system shall be determined by the Contractor.

d. The Contractor shall engage the services of an approved, nationally accredited, independent testing laboratory to certify that the proposed materials and methods comply with these requirements.

END OF SECTION

SECTION 02571

PAVEMENT REPAIR FOR UTILITIES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Repairing and resurfacing streets, highways, driveways, sidewalks, curbs and gutters, and other pavements that have been cut, broken, or damaged during construction.

1. Parking areas, service drives, driveways, and sidewalks: Replace with material equal to or better than existing or as indicated on Drawings.

2. Street pavements and curbs, curbs and gutters: Match general pavement type and provide subgrade, base, and surface materials as indicated on the Drawings and as specified in this Section.

B. Repair State highway crossings in accordance with the highway department permit and within 1 week after utility work is installed.

C. Conform to Section 02076 - Removing Existing Pavement and Structures, for removal of existing pavements.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for other unit price procedures.

1.03 NONCONFORMING PAVEMENT

A. Remove and replace areas of non-conforming Portland cement concrete or asphaltic concrete pavement found deficient in thickness by more than 10 percent, or that fail specified tests, unless accepted by Engineer.

1.04 UNIT PRICE ADJUSTMENT

A. For non-conforming pavement, accepted by the Engineer, unit price adjustments shall be made for actual in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to lower limit of 90 percent of unit price. No adjustments in price will be made for excess thickness.

1.05 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit test results or other data confirming that materials meet the specified requirements for:
   1. Fill, backfill and subgrade materials
   2. Base course materials
   3. Asphalt materials and mix designs
   4. Concrete materials and mix design
   5. Joint material

PART 2 P R O D U C T S

2.01 SUBGRADE

A. Provide fill and backfill materials beyond the limits of the utility trench as indicated on the Drawings and conforming to the following classifications. The classifications follow Unified Soil Classification Symbols as defined in ASTM D2487. Use soils with dual designation according to ASTM D2487 according to the least restrictive class.

   1. Class I: Well graded sands and gravels, gravel-sand mixtures, crushed well graded rock, little or no fines (GW, SW)
      a. Plasticity Index - Nonplastic.
      b. Gradation - D_{60}/D_{10} - greater than 4 percent passing No. 200 Sieve - less than or equal to 5 percent.

   2. Class II: Poorly graded gravels and sands, silty sands and gravels, little to moderate fines (GM, GP, SP, SM).
      a. Plasticity Index: Nonplastic to 4 percent.
      b. Gradation: percent passing No. 200 Sieve - less than 5 percent (GP, SP).
      c. Gradation: percent passing No. 200 Sieve - between 12 percent and 50 percent (GM, SM).

   3. Class III: Clayey gravels and sands, poorly graded mixtures of sand, gravel, and clay (GC, SC).
      a. Plasticity Index: greater than 7.
      b. Gradation: percent passing No. 200 Sieve between 12 percent and 50 percent.

   4. Backfill Material: Conform to requirements of Section 02229 – Utility Backfill Material.

   5. Lime Stabilized Subgrade: Lime for subgrade stabilization shall conform to the following:
      a. Type A - Hydrated lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide and magnesium hydroxide.
      b. Type B - Commercial lime slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not

contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.

c. Lime shall conform to following requirements:

Chemical Composition	Type A	Type B
Active lime content, % by weight		
$Ca(OH)_2 + CaO$	90.0 min(1)	87.0 min(2)
Unhydrated lime content, % by weight CaO	5.0 max	- - -
Free water content, % by weight H_2O	5.0 max	- - -
Sizing		
Wet Sieve, as % by weight residue retained:		
No. 6	0.2 max	0.2 max(2)
No. 30	4.0 max	4.0 max(2)
Dry sieve, as % by weight residue retained:		
1-inch	---	---
¾-inch	---	---

Notes:
(1) Maximum 5.0 percent by weight CaO shall be allowed in determining total active lime content.
(2) Maximum solids content of slurry

d. Lime slurry may be delivered to the job site as commercial lime, or may be prepared at the job site by using hydrated lime or quicklime. The slurry shall be free of liquids other than water and shall be of a consistency that can be handled and uniformly applied without difficulty.

6. Concrete Backfill: Conform to Class B (2000 psi) concrete as specified in Section 03305 - Concrete for Utility Construction or Section 03310 - Structural Concrete, as applicable.

2.02 BASE COURSE MATERIALS

A. Crushed Stone Flexible Base Course Materials

1. Crushed Stone: Material retained on the No. 40 Sieve meeting the following requirements:

a. Durable particles of crusher-run broken limestone, sandstone, or granite obtained from an approved source.

b. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C131.

2. Soil Binder: Material passing the No. 40 Sieve meeting the following requirements when tested in accordance with ASTM D4318.
   a. Maximum Liquid Limit: 40
   b. Maximum Plasticity Index: 12
   c. Maximum Lineal Shrinkage: 7 (when calculated from volumetric shrinkage at liquid limit).

B. Mixed Materials shall have a minimum compressive strength of 35 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure using triaxial testing procedures. Mixed materials shall be graded as follows:

Sieve	Percent Retained
1 ¾-inch	0 to 10
No. 4	45 to 75
No. 40	60 to 85

2.03 ASPHALTIC CONCRETE

A. Coarse Aggregate: Gravel, crushed stone or a combination of the two, that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic or other injurious matter occurring either free or as coating on aggregate. Aggregate shall conform to ASTM C33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C131.

B. Fine Aggregate: Sand or stone screenings or combination of both passing No. 10 sieve. Use aggregate conforming to ASTM C33, except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Confirm a Plasticity Index of not more than 6 for fine aggregate passing the No. 40 sieve when tested by Tex-106-E. The sand equivalent shall have a minimum value of 45 when tested by Tex-203-F.

C. Composite Aggregate: Conform to following limits when graded in accordance with ASTM C136.

Gradation of Composite Aggregate

Sieve Size	Percent Passing
1/2-inch	100
3/8-inch	85 to 100
#4	50 to 70
#10	32 to 42
#40	11 to 26
#80	4 to 14
#200	1 to 8

D. Asphaltic Material: Moisture-free homogeneous material which will not foam when heated to 347 degrees F. Material shall not be cracked. City Engineer will approve grade of asphalt to use after design tests have been made. Use only one grade of asphalt after grade is determined by test design for project and shall meet the following requirements:

	AC-10		AC-20	
Test	Min	Max	Min	Max
Viscosity, (140°F) poises	800	1,200	1,600±	
Viscosity, (275°F) cs	150	---	210	---
Penetration, (77°F), 100 g, 5 sec.	70	---	40	---
Flash Point, COC, (°F)	425	---	450	---
Solubility in trichloroethylene, %	99.0	---	99.0	---
Tests on residues from thin film oven tests	Min	Max	Min	Max
Viscosity, (140°F) stokes	---	4,000	---	8,000
Ductility, (77°F), 5 cms per min	50	---	20	---
Spot tests	Negative for all grades			

E. Prime Coat

1. Cutback Asphalt Prime Coat. Moisture-free homogeneous material (MC-30 or MC-70) which will not foam when heated to 347 degrees F and which meets the following requirements:

	MC-30		MC-70	
Type – Grade Properties	Min	Max	Min	Max
Water, percent	---	0.2	---	0.2
Flash Point, TOC, °F	100	---	100	---
Kinematic Viscosity at 140°F, cst	30	60	70	140
	MC-30		MC-70	
	Min	Max	Min	Max
Distillate expressed as percent by volume of total distillate to 680°F				
to 437°F	---	25	---	20
to 500°F	40	70	20	60
to 600°F	75	93	65	90
Residue from 680°F Distillation, volume, %	50	---	55	---
Tests on Distillation Residue:				
Penetration at 77°F, 100 g, 5 sec.	120	250	120	250

Ductility at 77°F, 5 cm/min. cms	100*	---	100*	---
Solubility in Trichloroethylene, %	99	---	99	---
Spot Test		All Negative		

* If penetration of residue is more than 200 and ductility at 77 degrees F is less than 100 cm, material will be acceptable if its ductility at 60 degrees F is more than 100.

2. Emulsified Petroleum Resin Prime Coat (EPR-1 Prime): Slow curing emulsion of petroleum resin and asphalt cement conforming to the following requirements. For use, EPR-1 may be diluted with water up to a maximum of three parts water to one part EPR-1 in order to achieve the desired concentration of residual resin/asphalt and facilitate application.

Properties	Min.	Max.
Furol Viscosity at 77°F, sec	14	40
Residue by Evaporation,		
% by weight	60	---
Sieve Test, %	---	0.1
Particle Charge Test		Positive
Tests on the Distillation Residue:		
Flash Point, COC (°F)	400	---
Kinematic Viscosity		
@ 140°F (cst)	190	350

F. Tack Coat

1. Cutback Asphalt Tack Coat

Moisture-free homogeneous asphalt material (RC-250) which will not foam when heated to 347°F and which meets the following requirements:

Properties	Min.	Max.
Water, percent	---	0.2
Flash Point, TOC, (°F)	80	---
Kinematic Viscosity at 140°F, cst	250	400
Distillate: Expressed as percent by volume of total distillate to 680°F:		
to 437°F	40	75
to 500°F	65	90
to 600°F	85	---
Residue from 680°F Distillation, Volume, percent	70	---
Tests on Distillation Residue:		

Penetration at 77°F, 100 g, 5 sec.	100	150
Ductility at 77°F, 5 cm/min. cms	100	---
Solubility in Trichoroethylene	99	---
Spot Test	All Negative	

2. Emulsified Tack Coat

Homogeneous material which shows no separation of asphalt after mixing and shall meet the viscosity requirements at any time within 30 days after delivery. Emulsion material (SS-1) for tack coat shall meet the following:

Properties	Min.	Max.
Furol Viscosity at 77°F, sec.	30	100
Residue by Distillation, %	60	---
Oil Portion of Distillate, %	---	2
Sieve Test, %	---	0.1
Miscibility (Standard Test)	Passing	Passing
Cement Mixing, %	---	0.2
Storage Stability, 1 Day, %	---	1
Test on Residue:		
Penetration at 77°F, 100 g, 5 sec	120	160
Solubility in Trichloroethylene, %	97.5	---
Ductility at 77°F, 5 cm/min, cms	100	---

G. Asphalt Concrete Pavement Mixes. Employ and pay certified testing laboratory to prepare design mixes. Test or certify test on the proposed mixes have been performed on similar materials in accordance with Tex-126-E or Tex-204-F and Tex-208-F.

Density and Stability Requirements: Percent Density		HVEEM Stability Percent	
Min.	Max.	Optimum	Not Less Than
94.5	97.5	96	35

1. Proportions for Asphaltic Material: Provide 4 to 8 percent of mixture by weight. Aggregate by weight shall not contain more than 1.0 percent by weight of fine dust, clay-like particles or silt present when tested in accordance with Tex-217-F, Part II.

2.04 PORTLAND CEMENT CONCRETE PAVING MATERIALS

A. Concrete shall conform to requirements for Class A concrete as specified in Section 03305 - Concrete for Utility Construction or Section 03310 - Structural Concrete, as applicable.

B. Reinforcing shall conform to requirements for bars and welded wire fabric as specified in Section 03305 - Concrete for Utility Construction or Section 03210 - Reinforcing Steel, as applicable.

2.05 JOINT MATERIALS

A. Board Expansion Joint Material: Filler board of selected stock. Use wood of density and type as follows:

1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.

2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

B. Preformed Expansion Joint Material: Bituminous fiber and bituminous mastic composition material conforming to ASTM D994 and ASTM D1751.

C. Joint Sealing Compound: Hot-poured rubber-asphalt compound conforming to ASTM D3405.

D. Load Transmission Devices:

1. Smooth, steel dowel bars conforming to ASTM A615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.

2. Deformed steel tie bars conforming to ASTM A615, Grade 60.

E. Metal Supports for Reinforcing Steel and Joint Assembly: Employ metal supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete.

2.06 SIDEWALK AND DRIVEWAY MATERIALS

A. Sand bed shall be bank run sand, classified as SW, SP, or SM by the Unified Soil Classification System of ASTM D2487, with the following:

1. Less than 0.5 percent clay lumps (ASTM C142).

2. Less than 5.0 percent lightweight pieces (ASTM C123).

3. Organic impurities, color no darker than standard color (ASTM C40).

4. Plasticity index of 4 or less per ASTM D4318.

B. Portland cement concrete shall conform to requirements for Portland cement concrete paving in this Section.

C. Asphaltic concrete shall conform to requirements for asphaltic concrete paving in this Section.

D. Gravel paving shall conform to the requirements of Class II backfill in this section but with a gradation to match the gravel surface being replaced.

PART 3 E X E C U T I O N

3.01 EQUIPMENT

A. Alternate equipment and methods, other than those required by this section, may be used provided the Contractor demonstrates that equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting pavement in good working order.

3.02 SUBGRADE

A. Preparation

1. Verify backfill of new utilities is complete, in accordance with Section 02227 - Excavation and Backfill for Utilities.

2. Correct subgrade deviations of plus or minus 1/2 inch in cross section or in 16-foot length by loosening, adding, or removing material, reshaping, and recompacting by sprinkling and rolling.

3. Prepare sufficient subgrade in advance of base course operations.

B. Unstabilized Subgrade. Replace and compact unstabilized subgrade in accordance with the requirements for compaction, tolerance, testing and protection of lime stabilized subgrade.

C. Lime Stabilized Subgrade

1. Scarify or excavate to bottom elevations to receive stabilized subgrade as indicated on the drawings. Remove material or windrow to expose secondary grade. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting. Obtain uniform stability.

2. Lime Slurry Application

a. Mix hydrated lime with water to form a slurry of the solids content specified. Commercial lime slurry shall have dry solids content as specified.

b. Apply slurry with a distributor truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content.

Limit spreading to an area where preliminary mixing operations can be completed on the same working day.

c. Apply so that dry subgrade will contain a minimum lime content of 5 percent by weight of dry subgrade unless otherwise instructed by Testing Laboratory.

3. Preliminary Mixing

a. Do not mix and place material when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.

b. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.

c. Mix and pulverize until all material passes a 1-3/4 inch sieve; a minimum of 85 percent, excluding nonslacking fractions, passes a 3/4 inch sieve; and a minimum of 60 percent excluding nonslacking fractions pass a No. 4 sieve.

d. Shape mixed subgrade to final lines and grades.

e. Seal subgrade as a precaution against heavy rainfall by rolling lightly with light pneumatic rollers.

f. Cure soil-lime material for 1 to 4 days. Keep subgrade moist during cure.

4. Compaction

a. Aerate or sprinkle to attain optimum moisture content. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.

b. Start compaction immediately after final mixing, unless approved by Engineer.

c. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches.

d. Compact with approved heavy pneumatic or vibrating rollers, or a combination of tamping rollers and light pneumatic rollers. Begin compaction at the bottom and continue until entire depth is uniformly compacted.

e. Do not allow stabilized materials to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.

f. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:

(1). Areas to receive pavement without subsequent base course: Minimum density of 98 percent of maximum dry density.

(2). Areas to receive subsequent base course: Minimum density of 95 percent of maximum dry density.

g. Seal with approved light pneumatic tired rollers: Prevent surface hairline cracking. Rework and recompact at areas where hairline cracking develops.

5. Curing

a. Moist cure for a minimum of 3 days before placing base or surface course. Time may be adjusted as approved by Engineer. Subgrade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

b. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

c. Place base, surface, or seal course within 14 days after final mixing and compaction unless prior approval is obtained from Engineer.

D. Backfill Material. Where indicated on the Drawings, provide cement stabilized subgrade in accordance with Section 02229 – Utility Backfill Materials.

E. Tolerances

1. Completed surface shall be smooth and conform to typical section and established lines and grades.

2. Top of compacted surface: plus or minus 1/4 inch in cross section, or in 16-foot length.

F. Field Quality Control

1. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

2. A minimum of one core will be made at random locations per 1000 linear feet per lane of roadway or 500 square yards of subgrade to determine in-place depth. For areas less than 500 square yards, the Engineer may waive the in-place depth test provided the Contractor can demonstrate by measurement the thickness of the subgrade stabilized.

3. Contractor may obtain and pay for additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact addition material at no cost to the Owner.

4. Compaction testing will be performing in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017 at random locations near depth determination tests. Rework and recompact areas that do not conform to compaction requirements at no cost to the City.

5. Fill test sections with new compacted lime stabilized subgrade.

G. Protection

1. Maintain subgrade to lines and grades and in good condition until placement of base or surface course.

2. Repair defects immediately by replacing material to full depth.

3.03 BASE COURSE

A. Placement

1. Spread and shape base in lifts to compacted thickness not to exceed 6 inches. Complete spreading, shaping, and compacting on same day material is deposited.

2. Place base so that projecting reinforcing steel from curbs or pavement remain at approximate center of base or pavement as indicated on the Drawings.

3. Start compaction operations as soon as possible after placement. Use sheep foot, steel, or pneumatic rollers or other equipment, as approved.

4. Maintain moisture between optimum and 3 percent above optimum moisture.

5. Compact to 95 percent of Modified Proctor density in accordance with ASTM D1557, unless otherwise indicated on the Drawings.

6. Finish to grade and compact lift before placing any successive lift.

7. Maintain shape by grading throughout operation.

8. Provide total thickness indicated on Drawings.

B. Tolerances

1. Completed base surface shall be smooth and conform to typical section and established lines and grades.

2. Top surface of embankment: Plus or minus 1/4 inch in cross section, or in 16-foot length.

C. Field Quality Control

1. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

2. A minimum of one core will be taken at random locations per 1000 linear feet per lane of roadway or 500 square yards of base or at least once per location of base placement to determine in-place depth. For areas of less than 500 square yards, the Engineer may waive the depth core test, provided the contractor can demonstrate by measurement the thickness of the base.

3. Contractor may obtain and pay for additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no additional cost to the Owner.

4. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 at a random location near each depth determination. Rework and recompact areas that do not conform to compaction requirements.

5. Fill cores and density test sections with new compacted crushed stone flexible base.

D. Protection

1. Sprinkle to prevent excessive loss of moisture.

2. Restrict construction traffic on finished base to equipment required to complete the work.

3.04 ASPHALTIC CONCRETE PAVEMENT

A. Preparation

1. Thoroughly clean base course surface of loose material by brooming prior to application of tack coat.

2. Prepare sufficient base in advance of paving for efficient operations.

B. General Prime Coat Application

1. Apply prime coat with approved type of self-propelled pressure distributor or other approved equipment. Distribute prime coat evenly and smoothly under pressure necessary for proper distribution.

2. Keep all storage tanks, piping, retorts, booster tanks and distributors used in handling asphaltic materials clean and in good operating conditions. Conduct operations so that asphaltic material does not become contaminated.

3. If yield of asphaltic material appears to be in error, recalibrate distributor prior to continuing Work.

4. Maintain the surface until Work is accepted by Owner.

5. No traffic or placing of subsequent courses shall be permitted over freshly applied prime coat until authorized by Engineer.

C. Cutback Asphalt Prime Coat Application

1. Do not use cutback asphalt during the period of April 16 to September 15.

2. Do not place prime coat when air temperature is below 60 degrees F and falling. Materials may be placed when air temperature taken in shade and away from artificial heat is above 50 degrees F and rising.

3. Distribute at rate of 0.25 to 0.35 gallons per square yard.

4. Provide facilities for determining temperature of asphaltic material in heating equipment and in distributor, for determining rate of application, and for obtaining uniformity at junction of two distributor loads. Provide and maintain in good working order, recording thermometer at storage heating unit.

5. Temperature of application shall be based on temperature-viscosity relationship that will permit application of asphalt with viscosity of 100 to 125 centistokes. Maintain asphalt within 15 degrees F of temperature required to meet viscosity. Selected temperature shall be within following range.

Prime Coat Type	Minimum (F)	Maximum (F)
MC-30	70	150
MC-70	125	175

6. Do not allow temperature of MC-30 to exceed 175 degrees F at any time.

7. Do not allow temperature of MC-70 to exceed 200 degrees F at any time.

D. Emulsified Prime Coat Application

1. Do not place prime coat when air temperature is below 36 degrees F and falling.

2. Distribute at rate of 0.15 to 0.25 gallons per square yard.

E. Tack Coat Application

1. Apply tack coat uniformly by use of approved distributor at rate not to exceed 0.05 gallons per square yard of surface. Where the asphaltic concrete mixture will adhere to the surface on which it is placed without the use of a tack coat, the tack coat may be eliminated if approved by the Engineer.

2. Paint contact surfaces of curbs and structures and joints with thin uniform coat of tack coat.

3. Application:

   a. Do not use cutback asphalt during the period of April 16 to September 15.

   b. Do not place tack coat when air temperature is below 50 degrees F and falling. Materials may be placed when air temperature taken in shade and away from artificial heat is above 40 degrees F and rising.

   c. Temperature of tack coat shall be between 125 degrees F and 180 degrees F when applied.

   d. Do not heat tack coat above 200 degrees F at any time.

4. Tack Coat Protection. No traffic or placing of subsequent courses shall be permitted over freshly applied tack coat until authorized by Engineer.

F. Placement of Asphaltic Concrete

1. Do not place asphaltic mixture when air temperature is below 50 degrees F and falling. Mixture may be placed when air temperature taken in shade and away from artificial heat is above 40 degrees F and rising.

2. Haul prepared and heated asphaltic concrete mixture in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.

3. For large areas, spread material into place with approved mechanical spreading and finishing machine of screening or tamping type. Use track-mounted finish machine to place base course directly on subgrade or base as shown on the Drawings.

4. In restricted areas where use of paver is impractical, spread and finish asphalt by mechanical compactor. Use wood or steel forms, rigidly supported to assure correct grade and cross section. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove any lumps that do not break down readily. Place asphalt courses in same sequence as if placed by machine.

5. Surface Course Material: Surface course 2 inches or less in thickness may be spread in one lift. Spread lifts in such manner that, when compacted, finished course will be smooth, of uniform density, and will be to section, line and grade as shown.

6. Place courses as nearly continuously as possible. Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.

7. When new asphalt is laid against existing or old asphalt, existing or old asphalt shall be saw cut full depth to provide straight smooth joint.

G. Compaction of Asphaltic Concrete

1. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hair cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water.

2. Compress surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing from 8 to 10 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and rolling marks are eliminated. Complete rolling before mixture temperature drops below 175 degrees F.

3. Use tandem roller for final rolling. Double coverage with approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.

4. Along walls, curbs, headers and similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.

5. Compact binder course and surface course to density not less than 93 percent of the maximum possible density of voidless mixture composed of same materials in like proportions.

H. Tolerances

1. Furnish templates for checking surface in finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.

2. Completed surface, when tested with 10-foot straightedge laid parallel to centerline of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct any surface not meeting this requirement.

I. Field Quality Control

1. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

2. Minimum of one core will be taken at random locations per 1000 feet per lane of roadway or 500 square yards of pavement or at least once per location of pavement placement to determine in-place depth and density. For areas less than 500 square yards the Engineer may waive the in-place depth test provided the Contractor can demonstrate by measurement the thickness of the pavement placed.

3. In-place density will be determined in accordance with Tex-207-F and Tex-227-F from cores or sections of asphaltic base located near each depth determination. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by Engineer.

4. Contractor may obtain and pay for three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

5. Fill cores and density test sections with new compacted asphaltic pavement.

J. Protection

1. Do not open pavement to traffic until 12 hours after completion of rolling, or as shown on Drawings.

2. Maintain asphaltic concrete pavement in good condition until completion of Work.

3. Repair defects immediately by replacing asphaltic concrete pavement to full depth.

3.05 PORTLAND CEMENT CONCRETE PAVING

A. Preparation

1. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.

2. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

B. Concrete Paving Equipment

1. Subgrade Planer and Template:

a. For large areas, use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form at all times, and have such strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.

b. For restricted areas, where planer is impractical, prepare the subgrade by mechanical tampers and other equipment as approved by the Engineer.

c. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have such strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1-foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.

2. Machine Finisher: For large areas, provide a power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires if it operates on concrete pavement.

3. Hand Finishing: For restricted areas, provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section. Also, provide two bridges to ride on forms and span pavement

for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.

4. Burlap Drag for Finishing Slab: Furnish four plies of 10-ounce burlap material fastened to bridge to form continuous strip of burlap full width of pavement. The 3-foot width of burlap material shall be in contact with pavement surface. Keep burlap drags clean and free of encrusted mortar.

5. Vibrators: For large areas, furnish mechanically operated synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation. For restricted areas, hand operated vibrators may be utilized.

6. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship shall be met. If traveling form paver does not provide concrete paving that meets the compaction, finish and tolerance requirements of this specification, its use shall be immediately discontinued when so ordered by Engineer and conventional methods shall be used.

   a. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Float shall be long enough to extend across pavement to side forms or edge of slab.

   b. Insure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.

   c. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace any pavement in which tie bars assume final position other than that shown on Drawings, unless corrective alternates are authorized in writing by Engineer.

C. Forms

1. Side Forms: Use metal forms of approved shape and section. Preferred depth of form shall be equal to required edge thickness of pavement. Forms with depths greater or less than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness is not greater than 1 inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to

bottom of form, or by grouting under form. Bottom flange of form shall be same size as thickness of pavement. Aluminum forms are not allowed. Forms shall be approved by Engineer. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. In no case shall base width be less than 8 inches for form 8 inches or more in height. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide reasonable straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used.

2. Form Setting: Rest forms directly on subgrade. Do not shim with rocks or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. For large areas, set forms and check grade for at least 300 feet ahead of placement or as approved by Engineer. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. These adjacent slabs shall not be used for forms until concrete has aged at least 7 days.

D. Reinforcing Steel and Joint Assemblies

1. Accurately place reinforcing steel and joint assemblies and position them securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Place reinforcing steel and secure to chairs.

2. Place pavement joint assemblies at required locations and elevations, and rigidly secure parts in required positions. Install dowel bars accurately in joint assemblies as shown, each parallel to pavement surface and to centerline of pavement. Rigidly secure in required position to prevent displacement during placing and finishing of concrete. Accurately cut header boards, joint filler and other material used for forming joints to receive each dowel bar. Where indicated on the drawings, drill dowels into existing pavement, secure with epoxy, and provide paving headers, as required, to provide rigid pavement sections.

E. Placement

1. Place concrete only when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Concrete shall not be placed when temperature is below 40 degrees F and falling.

2. Place concrete within 60 minutes of mixing. Remove and dispose of concrete not placed within this period.

3. Concrete slump during placement shall be 1 to 4 inches, except when using traveling-form paver slump shall be maximum of 2 inches.

4. Deposit concrete rapidly and continuously on subgrade or base in successive batches. Distribute concrete to required depth and for entire width of placement in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At end of day or in case of unavoidable interruption of more than 30 minutes, place transverse construction joint at point of stopping work. Remove and replace sections less than 10 feet long.

5. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

F. Compaction

1. Consolidate the concrete using mechanical vibrators. Extend a vibratory unit across the pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.

2. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

G. Finishing

1. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.

   a. Use transverse finishing machine to make at least two trips over each area. Make last trip continuous run of not less than 40 feet. After transverse screening, use hand-operated longitudinal float to test and level surface to required grade.

b. Hand finish with mechanical strike and tamping template as wide as pavement to be finished. Shape template to pavement section. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make at least two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

2. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.

3. After completion of straightedge operation, make first pass of burlap drag as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.

H. Joints and Joint Sealing

1. Placement

a. When new work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.

b. If the limit of removal of existing concrete or asphaltic pavement does not fall on existing joint, saw cut existing pavement minimum of 1-1/2 inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.

2. Construction Joints. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3. Expansion Joints. Place 3/4-inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 60 feet apart. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings. Seal with joint sealing compound.

4. Contraction Joints. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

5. Longitudinal Weakened Plane Joints. Place longitudinal weakened plane joints at spaces indicated on Drawings. Seal groove with joint sealing compound.

6. Sawed Joints

   a. Contractor may use sawed joints as an alternate to contraction and weakened plane joints. Circular cutter shall be capable of cutting straight line groove minimum of 1/2 inch wide. Depth shall be one quarter of pavement thickness plus 1/2 inch. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, it shall be continued until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.

   b. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Provide at least one standby saw in good working order. Maintain an ample supply of saw blades at work site at all times during sawing operations. Sawing equipment shall be on job at all times during concrete placement.

7. Joints for Curb, Curb and Gutter. Place 3/4-inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement; at end of radius returns at street intersections and driveways; and at curb inlets. Maximum spacing shall be 120-foot centers.

8. Joints for Concrete Sidewalks. Provide 3/4-inch expansion joints conforming to ASTM D1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 36 feet. Provide expansion joint material conforming to ASTM D994 for small radius curves and around fire hydrants and utility poles. Extend the expansion joint material full depth of the slab.

9. Joints for Concrete Driveways. Provide 3/4-inch expansion joints conforming to ASTM D1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

10. Joint Sealing

    a. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F, and weather is not foggy or rainy.

b. Joint sealing equipment shall be in first-class working condition, and be approved by Engineer.

c. Clean joints of loose scale, dirt, dust and curing compound. Remove loose material from concrete surfaces adjacent to joints. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro- or abrasive-cleaning machines, as required to produce satisfactory results.

d. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch below level of adjacent surface or at elevation as directed.

11. Protection

a. Maintain joints in good condition until completion of Work.

b. Replace damaged joints material with new material.

I. Concrete Curing. Conform to requirements of Section 03305 - Concrete for Utility Construction or Section 03310 - Structural Concrete.

J. Tolerances. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10-foot straightedge parallel to center of roadway to bridge any depressions and touch high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10-foot straightedge shall not exceed 1/8 inch. Grind spots in excess of requirements of this paragraph to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

K. Field Quality Control

1. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

2. Flexural Strength Test Specimens: Four test specimens for flexural strength test will be made for each 150 cubic yards or less of pavement that is placed in one day. Two specimens will be tested at 7 days. For failed 7-day tests, remaining two specimens will be tested at 28 days. Specimens will be made, cured and tested in accordance with ASTM C78 (using simple beam with third point loading). Minimum flexural strength (modulus of rupture) shall be 500 pounds per square inch at 7 days and 600 pounds per square inch at 28 days.

3. Yield test will be made in accordance with ASTM C138 for cement content per cubic yard of concrete. If such cement content is found to be less than that

specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.

4. Minimum of one 4-inch core to measure in-place depth will be taken at random locations per 1000 feet per lane or 500 square yards of pavement or at least once per location of pavement placement. Each core may be tested for 28-day compressive strength according to methods of ASTM C42. The 28-day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch. Compressive strength shall not be utilized to satisfy the flexural strength requirements.

5. For areas less than 500 square yards, the Engineer may waive the in-place depth test provided the Contractor can demonstrate by measurement the thickness of the pavement placed. Compressive strength cylinders may be made as indicated in Section 03305 - Concrete for Utility Construction or Section 03310 - Structural Concrete if the core for in place depth determination is not required.

6. Contractor may obtain and pay for three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

7. Fill cores and density test sections with new concrete paving or non-shrink grout.

L. Protection

1. Barricade pavement section from use until concrete has attained minimum design strength.

2. To provide access at driveways, city street intersections, esplanades, and other locations approved by Engineer; Contractor may use high-early-strength cement or place an additional 2 inches of concrete pavement on untreated subgrade in lieu of specified concrete pavement depth on stabilized base or lime treated subgrade. Additional depths of concrete placement shall be paid for under original specified concrete depth.

3. On those sections of pavement to be opened to traffic, seal joints, clean pavement and place earth against pavement edges before permitting use by traffic. Such opening of pavement to traffic shall not relieve Contractor from responsibility for the Work.

4. Maintain concrete paving in good condition until completion of Work.

5. Repair defects by replacing concrete to full depth.

3.06 PAVEMENT MARKINGS

A. Restore pavement markings to match those existing or as indicated on the Drawings and details.

3.07 SIDEWALKS AND DRIVEWAYS

A. Replacement

1. Replace sidewalks and driveways which are removed or damaged during construction with paving of the same type and with thickness and width equivalent to one removed or damaged. Asphaltic concrete and Portland cement concrete shall meet the requirements of this Section.

2. Provide replaced and new sidewalks with wheelchair ramps if sidewalk intersects curb at street or driveway intersection.

B. Preparation and Placement

1. Identify and protect utilities which are to remain.

2. Protect living trees, other plant growth, and features designated to remain.

3. Excavate subgrade 6 inches beyond outside lines of sidewalk or driveway. Shape to the line, grade, and cross section. For soils with plasticity index above 40 percent, stabilize soil with lime. Compact subgrade to minimum of 90 percent maximum dry density as determined by ASTM D698.

4. For concrete surface, immediately after subgrade is prepared, cover with 2-inch-thick compacted sand bed. Place concrete as indicated below.

5. For asphaltic concrete surface, place and compact directly on prepared subgrade.

6. For gravel surface, place and compact gravel directly on prepared subgrade.

C. Concrete Placement

1. Forms: Straight, unwarped wood or metal forms with nominal 4-inch depth. Securely stake forms to line and grade, and maintain in true position during concrete placement.

2. Reinforcement: Unless shown otherwise on the drawings, install No. 3 reinforcing steel bars on 18-inch centers longitudinally and transversely. Lay longitudinal bars in walk continuously, except through expansion joints. Support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.

3. Expansion Joints: Install expansion joints in accordance with Section.

4. Colored concrete: Where indicated on the drawings, apply coloring agent in accordance with manufacturers' instructions.

5. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.

6. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.

7. Unless otherwise indicated on Drawings, mark off joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.

8. Finish edges with tool having 1/4-inch radius.

9. After concrete has set sufficiently, refill space along sides of sidewalk to top of walk with suitable material. Tamp fill firm and solid.

D. Protection

1. Maintain sidewalks and driveway in good condition until completion of Work.

2. Replace sidewalks and driveway subsequently damaged by Contractor's operations.

END OF SECTION

SECTION 02581

BLAST CLEANING OF PAVEMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Removal of existing pavement markings.

B. Preparation of pavement surfaces for new pavement markings.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this Section. Include payment in unit price for related work.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit description and characteristics of proposed blasting medium and equipment for approval.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Blasting Media: Quality commercial product capable of producing specified surface cleanliness without deposition of deleterious materials on cleaned pavement surface. Do not use high silica content sand that may result in high levels of free crystalline silica dust particles as a blasting agent.

2.02 EQUIPMENT

A. Equipment shall be power driven and of sufficient capacity to clean the pavement surface to specified cleanliness. Equipment shall utilize moisture and oil traps of sufficient capacity to remove contaminants from the air and prevent deposition of moisture, oil or other contaminants on the pavement surface.

PART 3 E X E C U T I O N

3.01 REMOVAL OF EXISTING MARKINGS

A. Remove pavement markings where necessary to prevent driver confusion, or where indicated on drawings. Included are areas where it will be necessary for drivers to cross existing markings which they would not normally cross. Remove or obliterate markings to the satisfaction of the Engineer. Do not damage pavement surface.

3.02 CLEANING FOR PLACEMENT OF MARKERS

A. Remove old pavement markings, loose material, and other contaminants deleterious to the adhesion of new pavement markings to be placed. On portland cement concrete pavement, minimize overblasting to prevent damage to pavement surface. Small particles of tightly adhering existing pavement markings may remain if complete removal will result in pavement surface damage.

B. Follow manufacturer's written instructions for proper cleaning of pavement surfaces to receive pavement marking.

END OF SECTION

SECTION 02582

THERMOPLASTIC PAVEMENT MARKINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Thermoplastic pavement markings.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Each container shall be clearly marked to indicate the color, weight, type of material, manufacturer’s name and the lot/batch number.

PART 2 P R O D U C T S

A. Pavement markings are thermoplastic type marking materials that require heating to elevated temperatures for application.

B. Materials shall conform to TxDOT Specification Item 666.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Prepare pavement surfaces and install markings in accordance with manufacturer's recommendations and TxDOT specifications.

B. Accurately locate and install approved markings to conform to classes, colors, lengths, widths, and configurations indicated on Drawings.

3.02 PREPARATION

A. Clean and repair surfaces to receive markings. Blast clean surfaces indicated on Drawings or where directed by the Engineer in accordance with requirements of Section 02581. Do not clean portland cement concrete pavements by grinding.

3.04 SURFACE INSTALLATION

A. Test pavement surface for moisture content prior to application of markings. Place an approximate 2 square foot sheet of clear plastic or tar paper on road surface and hold in place for 20 minutes. Immediately inspect the sheet for build up of condensed moisture. If sufficient moisture has condensed to cause water to drip from sheet, do not apply markings. Repeat test as necessary until adequate moisture has evaporated from pavement to allow placement.

B. Observe manufacturer's recommended pavement and ambient air temperature requirements for application. If manufacturer has no temperature recommendations, do not install markings if pavement temperature is below 60 degrees F or above 120 degrees F.

C. Prime pavement surface and apply markings as recommended by manufacturer.

3.05 FIELD QUALITY CONTROL

A. Pavement markings shall present a neat, uniform appearance.

B. Repair or replace improperly installed markers at Contractors expense.

3.06 CLEANING

A. Keep project site free of unnecessary traffic hazards at all times.

B. Clean area upon completion of work and remove rubbish from work site.

3.07 WARRANTY

A. Contractor shall warrant material and labor for a period of twelve months from date of installation of markings. Immediately upon notification, replace portions of pavement marking lines or legends that have lifted, shifted or spread, lost daytime color, or nighttime retro-reflectivity.

END OF SECTION

SECTION 02583

RAISED REFLECTIVE PAVEMENT MARKERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Raised reflective pavement markers.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's product data concerning following materials for approval:

1. Class I and II markers.
2. Primers, solvents, and adhesives.
3. Installation instructions.

C. Submit certificate by manufacturer that each class of marker and each type of adhesive conforms to the requirements of this specification.

D. Submit details of manufacturers replacement policy for each class of marker.

1.04 DELIVERY AND STORAGE

A. Deliver markers is cartons of 100 units, epoxy adhesive in one gallon pails. Ship like materials in like-sized containers to facilitate storage.

B. Store material in cool dry conditions until application.

PART 2 P R O D U C T S

2.01 MARKERS

A. Raised Reflective Pavement Markers: Shallow frustum of pyramid shaped markers with tempered glass prismatic reflective elements. Bodies shall be plastic shells with resin/sand fillings, or single-piece injection-molded bodies of impact resistant polymers. Plastic shells shall be Methyl Methacrylate conforming to Federal Specification L-P-380C, Type I, Class 3 and shall have a minimum wall thickness of 0.65 inches.

B. Marker configuration shall be as follows:

	Normal Dimensions	Reflecting Face Slope	Reflecting Face Surface Area
Type I	4”x4”x0.75” high	30˚	3.25 sq. in.
	3”x5”x0.70” high	30˚	4.00 sq. in.
Type II	2”x4”x0.40” high	30˚	1.87 sq. in.
Type III	3”x5”x0.70” high	30˚	4.00 sq. in.

C. Optical performance shall be as follows:

1. Type I and II:

	White	Yellow	Red
Specific Intensity, SI, min			
Entrance Angle = 0˚	15.0	9.0	3.5
Entrance Angle = 20˚	6.0	3.6	1.2

2. Type III:

	White	Yellow	Red
Specific Intensity, SI, min			
Entrance Angle = 0˚	15.0	9.0	3.5
Entrance Angle = 20˚	6.0	3.6	1.2

3. Testing Procedure: Locate a randomly selected test marker with center of reflecting face 5 feet from uniformly bright light source with effective diameter of 0.2 inches. Use a photocell width of 0.05 inches for Type I markers and a photocell with annular ring of 0.37 inches by 0.46 inches for type II markers; shield to eliminate stray light. Distance from light source to photocell center of 0.21 inches. Modify source receiver dimensions and distance between source and receiver proportionally to test distance change for test distances other than 5 feet. Lots containing more than 4% reflecting face failures shall be rejected according to ASTM E808 and ASTM E809.

D. Physical requirements shall be in accordance with the following test procedures:

1. Type I and Type III Markers: Select 3 random markers per lot. Center marker over open end of a vertically positioned 1-inch long hollow metal cylinder with a 3-inch inside diameter and a 0.25-inch wall thickness. Apply load slowly to top of marker through a 1-inch diameter by 1-inch high metal plug centered on the marker. Breakage or appreciable deformation of a test sample at a load less than 2000 pounds shall be cause for lot rejection.

2. Type II Markers: Select 20 random markers per lot. Condition markers in a convection oven at 130°F for one hour. At elevated temperature, impact reflective face by dropping a 90-gram dart, fitted with a 0.25-inch radius spherical head, 6 inches perpendicularly onto center of reflective surface. Cracks

in impact surface area shall be generally concentric in appearance. Small radial cracks less than 0.25 inches in length will be allowed. Lot will be acceptable if 18 test samples meet testing requirements; failure of 4 test samples will cause lot rejection. Retest an additional 20 markers if 3 samples fail; failure of one lens of resample group will cause lot rejection.

E. Impact Resistance: Test in accordance with ASTM D2444 Type A.

2.02 EPOXY ADHESIVE

A. Obtain two-component epoxy adhesive from reflective pavement marker manufacturer conforming to manufacturer's requirements for marker installation.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Prepare pavement surfaces and install markers in accordance with marker and adhesive manufacturer's recommendations.

B. Accurately locate and install approved markers to conform to classes and colors indicated on Drawings.

3.02 PREPARATION

A. Clean and repair surfaces to receive markings. Remove loose material, dust, contaminants such as oil and curing membrane, and polished aggregates.

B. Blast clean surfaces indicated on Drawings or where directed by the Engineer in accordance with requirements of Section 02581. Do not clean portland cement concrete pavements by grinding. Mechanical wire brushing may be used to remove curing membranes.

3.03 INSTALLATION

A. Test pavement surface for moisture content prior to application of markings. Place an approximate 2 square foot sheet of clear plastic or tar paper on road surface and hold in place for 20 minutes. Immediately inspect the sheet for build up of condensed moisture. If sufficient moisture has condensed to cause water to drip from sheet, do not apply markings. Repeat test as necessary until adequate moisture has evaporated from pavement to allow placement.

B. Observe manufacturer's recommended pavement and ambient air temperature requirements for application. If manufacturer has no temperature recommendations, do not install markings if pavement temperature is below 60°F or above 120°F.

C. Prime pavement surface and apply markings as recommended by manufacturer.

3.04 CLEANING

A. Keep project site free of unnecessary traffic hazards at all times.

B. Clean area upon completion of work and remove rubbish from work site.

3.05 WARRANTY

A. Contractor shall warrant material and labor for a period of twelve months from date of installation of markings.

END OF SECTION

SECTION 02590

TEMPORARY AND REMOVABLE REFLECTORIZED PAVEMENT MARKINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Temporary retroreflective preformed pavement markings.

B. Wet retroreflective markers.

1.02 UNIT PRICES

A. No separate measurement or payment will be made for the installation or removal of temporary pavement markings. Include cost for all such marking in the cost for traffic control

B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 TEMPORARY PAVEMENT MARKING DEFINITIONS

A. Class I - Temporary preformed pavement markings suitable for longitudinal and word and symbol markings where removability will be required.

B. Class II - Temporary non-removable preformed pavement markings suitable for overlay lane lines, edge lines, and channelizing lines where pavement will be resurfaced.

C. Class III - Class I markers with wet reflective markers added every 8 feet.

D. Class IV - Class II markers with wet reflective markers added every 8 feet.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's product data for each proposed class of marking material and installation instructions for approval. Include certificate by manufacturer that each class of marking conforms to the requirements of this specification.

C. Submit details of manufacturer’s replacement policy for each class of marker.

1.05 DELIVERY AND STORAGE

A. Deliver preformed plastic marking material in rolls or strips.

B. Store material in cool dry conditions until application.

PART 2 P R O D U C T S

2.01 PREFORMED MARKINGS

A. Retroreflective preformed markings: White or yellow retroreflective tape on conformable backing with pigments conforming to standard highway colors. Glass beads shall be incorporated in film and a reflective layer of beads shall be bonded to the top surface of the film. Bead adhesion shall be such that beads cannot be easily removed by scratching with a thumbnail.

B. Preformed marking shall be precoated with pressure sensitive adhesive and shall have a demonstrated ability to adhere to roadways under climatic and traffic conditions normally encountered in a construction work zone when properly applied.

C. Class I markings shall be removable from portland cement and asphaltic concrete pavements intact, or in large pieces, at temperatures above 40 degrees F without use of heat, solvents, grinding, or blast cleaning. Marking film shall be removable after exposure to following minimum traffic exposure when tested on transverse test decks with rolling traffic:

1.	Time in Place (days)	632
2.	ADT per lane (23% trucks, 3.5 axles/unit)	9,000
3.	Minimum Axle Hits	13,000,000

D. Quality performance characteristics:

	CLASS I		CLASS II		TEST MEHOD
	White	Yellow	White	Yellow	
Init. Retroreflective (mcd $ft^{-2}fc^{-1}$), min.					
**@86.0˚, 0.2˚	1770	1310	1360	820	ASTM D4061
**@86.5˚, 1.0˚	750	450	500	350	
Daytime Reflectance Factor "Y" %, min.	65	36	65	36	ASTM E97
Init. Skid Resistance, Avg. BPN	50		35		ASTM E303
Refractive Index of Beads, min.	1.9		1.9		LIQUID IMMERSION
Thickness, without adhesive, mils, min.	40		9		Caliper Gauge

* (Entrance Angle, Observation Angle).

2.02 RAISED WET REFLECTIVE MARKERS

A. Raised Markers: Expanded rubber extrusions capable of being elastically compressed and deflected when impacted by rotating vehicle tires. Marker body shall have the following properties when tested in accordance with ASTM D1056:

1. Compression deflection - < 16 psi @ 25^0 deflection.

2. Oven aged compression deflection - % change, +18.

3. Compress set low - 10%.

4. Water absorption - < 9%.

5. Density (lbs/ft) - -24.

B. Markers shall be precoated with pressure sensitive adhesive capable of holding markers to top of preformed marking film.

C. Markers shall have enclosed retroreflective lens sheeting elements attached to marker bodies with pressure sensitive adhesive.

1. Retroreflective lenses elements shall have the following initial minimum reflectance when measured in accordance with ASTM E809:

Color:	White	Yellow	White	Yellow	White	Yellow	White	Yellow
Observation angle	0.2°		0.5°		1.0°		1.5°	
Coeff. Of Luminous Intensity , R (cd fc^{-1})	1.00	0.60	0.40	0.24	0.19	0.11	0.14	0.08

Notes:
1. Tests at an entrance angle (Beta 2 horizontal entrance component described In ASTM E808) of -4° measured from an axis perpendicular to top edge of Marker when viewed from above.
2. Angle formed by reflective surface and base of marker shall be between 75° and 90° prior to measurement.

2. Marker reflective elements shall be visible at night, to motorists with low beam headlights, under the following conditions:

a. Dry conditions - 1500 feet

b. Rainfall at a rate of 1" per hour - 1000 feet

c. Rainfall at a rate of 8" per hour - 250 feet

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Apply markings to clean dry surfaces in accordance with manufacturer's recommendations at locations indicated on Drawings, or as directed by the Engineer.

B. Place markings on each paving lift that is to be opened to traffic prior to the end of each day's work.

C. Maintain markings, and replace as needed, until they are covered with subsequent paving courses or replaced by permanent markings on final lifts.

3.02 REMOVAL

A. Remove and obliterate markings on existing and final lifts used for redirecting traffic during construction. If blast cleaning is required, comply with requirements of Section 02581.

END OF SECTION

SECTION 02600

CAST-IN-PLACE CONCRETE MANHOLES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cast-in-place sanitary and storm sewer manholes.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittals.

B. Submit proposed design mix and test data for each type and strength of concrete.

C. Submit manufacturer's data and details of following items for approval:

1. Frames, grates, rings, and covers.
2. Materials to be used in fabricating drop connections.
3. Materials to be used for pipe connections at manhole walls.
4. Materials to be used for stubs and stub plugs.
5. Plugs to be used for sanitary sewer hydrostatic testing.

PART 2 P R O D U C T S

2.01 CONCRETE

A. Conform to requirements of Section 03305 - Concrete for Utility Construction.

B. Manholes - Class A concrete with minimum compressive strength of 4,000 psi unless otherwise indicated on Drawings or approved by the Engineer for use on extra depth units.

2.02 REINFORCING STEEL

A. Conform to requirements of Section 03305 - Concrete for Utility Construction.

2.03 MORTAR

A. Conform to requirements of ASTM C 270, Type S using portland cement.

2.04 MISCELLANEOUS METALS

A. Provide cast-iron frames, grates, rings, and covers conforming to requirements of Section 02603 - Frames, Grates, Rings and Covers.

2.05 DROP CONNECTIONS AND STUBS

A. Drop connections and stubs shall conform to the same pipe material requirements used in the main pipe, unless otherwise indicated on the Drawings.

2.06 PIPE CONNECTIONS

A. Use resilient connectors conforming to requirements of ASTM C 923. Metallic mechanical devices as defined in ASTM C 923 shall be made of the following materials:

1. External clamps: Type 304 stainless steel

2. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gage minimum.

3. Internal, expandable clamps on corrosion-resistant manholes:

a. Type 316 stainless steel, 11 gage minimum, or

b. Type 304 stainless steel, 11 gage minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C 213.

B. Where rigid joints between pipe and a cast-in-place manhole base are specified or shown on the Drawings, use polyethylene-isoprene waterstop meeting the physical property requirements of ASTM C 923, Press-Seal WS Series, or equal.

C. Storm sewer pipe connections:

1. Connections acceptable for sanitary sewers.

2. Line pipe grouted in place with mortar.

2.07 SEALANT MATERIALS

A. Sealing materials between precast concrete adjustment ring and manhole cover frame shall be Adeka Ultraseal P201, or approved equal.

2.08 CORROSION RESISTANT MANHOLE MATERIALS

A. Manholes shall be corrosion resistant only if stated on the drawings. For cast-in-place manholes provide corrosion resistant barrier coating on all interior surfaces. The materials shall be applied by an approved certified applicator. Acceptable material is:

1. Raven 405 as manufactured by Raven Lining Systems, Inc., Tulsa, Oklahoma. The corrosion resistant barrier shall be spray applied as per the manufacturer's recommendation and shall have an average minimum finished thickness of 125 mils.

2. Or approved equal.

B. The Contractor shall have manufacturer's representative present on site at all times during the installation of corrosion resistant barrier.

C. The Contractor shall make provisions in his unit price bid for each structure to maintain dry conditions for the corrosion resistant liner application and subsequent curing as per manufacturer's recommendations.

2.09 BACKFILL MATERIALS

A. Backfill materials shall conform to the requirements of Section 02227 - Excavation and Backfill for Utilities.

2.10 NON-SHRINK GROUT

A. For non-shrink grout, use prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. It shall meet the requirements of ASTM C 1107 and shall have a minimum 28-day compressive strength of 7,000 psi.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify lines and grades are correct.

B. Determine if the subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. If it cannot be compacted to that density, the subgrade shall be moisture conditioned until that density can be reached or shall be treated as an unstable subgrade.

C. Do not build sanitary sewer manholes in ditches, swales, or drainage paths unless approved by the Engineer.

3.02 MANHOLES

A. Construct manholes to dimensions shown on Drawings. Commence construction as soon as possible after pipes are laid. On monolithic sewers, construct manholes at same time sewer is being constructed.

B. Unstable Subgrade Treatment: When unstable subgrade is encountered the subgrade will be examined by the Engineer to determine if the subgrade has heaved upwards after being excavated. If heaving has not occurred, the subgrade shall be over-excavated to allow for a 24-inch thick layer of crushed stone wrapped in filter fabric as the foundation material under the manhole base. If there is evidence of heaving, a pile-supported concrete foundation, as detailed on the Drawings, shall be provided under the manhole base, when indicated by the Engineer.

C. Cast manhole foundations and walls monolithically. A cold joint with approved water stop will be allowed when the manhole flow line depth exceeds 12 feet. No other joints will be allowed unless shown on Drawings or approved by the Engineer.

D. Place, finish and cure concrete for manholes following the procedures given in Section 03305 - Concrete for Utility Construction, for concrete containing microsilica admixtures.

3.03 PIPE CONNECTIONS AT MANHOLE

A. Install approved resilient connectors at each pipe entering and exiting sanitary sewer manholes in accordance with manufacturer's instructions.

B. Ensure that no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter the space between the pipe and the edge of the wall opening at and around the resilient connector on either the interior or exterior of the manhole. If necessary, fill the space with a compressible material to guarantee the full flexibility provided by the resilient connector.

C. Where a new manhole is to be constructed on an existing sewer, install a waterstop gasket around the existing pipe at the center of the cast-in-place wall. Join ends of split waterstop material at the pipe springline using an adhesive recommended and supplied by the waterstop manufacturer.

D. Do not construct joints on sanitary sewer pipe within wall sections of manholes. Use approved connection material.

E. Construct pipe stubs with resilient connectors for future connections at locations and with material indicated on Drawings. Install approved stub plugs at interior of manhole.

F. Test connection for watertight seal before backfilling.

3.04 INVERTS FOR SANITARY SEWERS

A. Construct invert channels to provide a smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inch per foot maximum.

2. Depth of bench to invert:

a. Pipes smaller than 15-inches: one-half largest pipe diameter

b. Pipes 15 to 24-inches: three-fourths the largest pipe diameter

c. Pipes larger than 24-inches: equal to the largest pipe diameter

3. Invert slope through manhole: 0.10-foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

B. Form invert channels with class A concrete if not integral with manhole base. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.05 DROP CONNECTIONS FOR SANITARY SEWERS

A. Construct drop connections with same materials used in main pipe unless otherwise indicated on Drawings or approved by the Engineer. Install a drop connection when a sewer line enters a manhole higher than 24-inches above the invert of the manhole.

B. Encase drop assembly with class A concrete to form a solid mass. Extend concrete outside of bells a minimum of 4 inches. Cast base of encasement monolithically with manhole base and ensure concrete bonds to exterior manhole wall.

C. Terminate encasement of blind drops a minimum of 5 inches below top of bell and not less than 12 inches above top of next lower bell. Install approved plug at bell.

3.06 MANHOLE FRAME AND ADJUSTMENT RINGS

A. Combine precast concrete adjustment rings so that the elevation of the installed casting cover is 3/8 inch below the pavement surface. Seal between adjustment ring and the manhole top with non-shrink grout; do not use mortar between adjustment rings. Apply a latex-based bonding agent to concrete surfaces to be joined with non-shrink grout. Set the cast iron frame on the adjustment ring in a bed of approved sealant. The sealant bed shall consist of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 3/4-inch wide.

B. For manholes in unpaved areas, top of frame shall be set a minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase

the manhole frame in mortar or non-shrink grout placed flush with the face of the manhole ring and the top edge of the frame. Provide a rounded corner around the perimeter.

3.07 BACKFILL

A. Place and compact backfill materials in the area of excavation surrounding manholes in accordance with requirements of Section 02227 - Excavation and Backfill for Utilities. Use embedment zone backfill material, as specified for the adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to the manhole. Provide trench zone backfill, as specified for the adjacent utilities, above the embedment zone backfill.

B. Where rigid joints are used for connecting existing sewers to the manhole, backfill under the existing sewer up to the springline of the pipe with Class B concrete or flowable fill.

C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide a minimum of 4 inches of topsoil conforming to requirements of Section 02920 - Topsoil. Seed in accordance with Section 02932 - Hydromulch Seeding. If shown on Drawings, sod disturbed areas in accordance with Section 02935 - Sodding.

3.08 FIELD QUALITY CONTROL

A. Conduct leakage testing of manholes in accordance with requirements of Section 02732 - Acceptance Testing for Sanitary Sewers.

3.09 PROTECTION

A. Protect manholes from damage until subsequent work has been accepted. Repair or replace damaged elements of manholes at no additional cost to the Owner.

END OF SECTION

SECTION 02601

PRECAST CONCRETE MANHOLES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Precast concrete sanitary sewer and storm sewer manholes.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's data and details of following items for approval:

1. Shop drawings of manhole sections and base units and construction details, including reinforcement, jointing methods, materials and dimensions.
2. Certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in paragraph 2.01 E of this specification.
3. Frames, grates, rings, and covers.
4. Materials to be used in fabricating drop connections.
5. Materials to be used for pipe connections at manhole walls.
6. Materials to be used for stubs and stub plugs, if required.
7. Materials and procedures for corrosion-resistant liner and coatings, if required.
8. Plugs to be used for sanitary sewer hydrostatic testing.
9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches.

C. Submitted shop drawings shall be sealed by a licensed Professional Engineer registered in the State of Texas.

PART 2 P R O D U C T S

2.01 PRECAST CONCRETE MANHOLES

A. Use manhole sections and base sections conforming to ASTM C 478. Use base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of the manufacturer of the manhole sections

meeting material requirements of ASTM C 478. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

B. Construct barrels for precast manholes from 48-inch diameter standard reinforced concrete manhole sections unless otherwise indicated on Drawings. Use various lengths of manhole sections in combination to provide the correct height with the fewest joints. Wall sections shall be designed for depth as shown and loading conditions as described in paragraph 2.01E, but shall not be less than 5 inches thick. Base section shall have a minimum thickness of 12 inches under the invert.

C. Provide cone tops to receive cast iron frames and covers, unless indicated otherwise. Use tops designed to support an AASHTO M306 loading.

D. Where the Drawings indicate that manholes larger than 48-inch diameter are required, precast base sections of the required diameter shall be provided with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric. The transition shall be located to provide a minimum of 7-foot head clearance from the top of bench to underside of transition.

E. Design Loading Criteria: The manhole walls, transition slabs, cone tops, and manhole base slab shall be designed by the manufacturer to the requirements of ASTM C 478 for the depth as shown on Drawings and the following design criteria:

1. AASHTO M306 loading applied to the manhole cover and transmitted down to the transition and base slabs.
2. Unit soil weight of 120 pcf located above all portions of the manhole, including base slab projections.
3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf, with soil pressure acting on empty manhole.
4. Internal liquid pressure based on a unit weight of 63 pcf, with manhole filled with liquid from invert to cover, with no balancing external soil pressure.
5. Dead load of manhole sections fully supported by the transition and base slabs.
6. Design additional reinforcing steel to transfer stresses at openings.
7. The minimum clear distance between any two wall penetrations shall be 12 inches or half the diameter of the smaller penetration, whichever is greater.

F. Form joints between sections with o-ring gaskets conforming with ASTM C 443.

G. Do not incorporate manhole steps in manhole sections.

H. Do not use brick masonry in construction of sanitary sewer manholes.

2.02 CONCRETE

A. Conform to requirements of Section 03305 - Concrete for Utility Construction.

B. Channel Inverts: Concrete for inverts not integrally formed with manhole base shall be either 5 sack premix (bag) concrete or Class A concrete, with a minimum compressive strength of 4,000 psi.

C. Cement Stabilized Sand Foundation: Provide cement stabilized sand foundation under base section in lieu of foundation slab, where allowed, conforming to requirements of Section 02252 - Cement Stabilized Sand.

D. Concrete Foundation: Use Class A concrete with minimum compressive strength of 4,000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

2.03 REINFORCING STEEL

A. Reinforcing steel shall conform to requirements of Section 03305 - Concrete for Utility Construction.

2.04 MORTAR

A. Conform to requirements of ASTM C 270, Type S using Portland Cement.

2.05 MISCELLANEOUS METALS

A. Provide cast-iron frames, rings, and covers conforming to requirements of Section 02603 - Frames, Grates, Rings and Covers.

2.06 DROP CONNECTIONS AND STUBS

A. Drop connections and stubs shall conform to the same pipe material requirements used in the main pipe, unless otherwise indicated on the Drawings.

2.07 PIPE CONNECTIONS

A. Sanitary Sewer:

1. Use resilient connectors conforming to requirements of ASTM C 923. Metallic mechanical devices as defined in ASTM C 923 shall be made of the following materials:
   a. External clamps: Type 316 stainless steel
   b. Internal, expandable clamps on standard manholes: Type 316 stainless steel, 11 gauge minimum.
   c. Internal, expandable clamps on corrosion-resistant manholes: Type 316 stainless steel, 11 gauge minimum.

2. Where rigid joints between pipe and a cast-in-place manhole base are specified or shown on the Drawings, use polyethylene-isoprene waterstop meeting the physical property requirements of ASTM C 923, Press-Seal WS Series, or equal.

B. Storm Sewer: Use non-shrink grout for storm sewer pipe connections. Grout around pipe on both inside and outside of manhole for watertight connection.

2.08 SEALANT MATERIALS

A. Sealing materials between precast concrete adjustment ring and manhole cover frame shall be Adeka Ultraseal P201, or approved equal.

2.09 CORROSION RESISTANT MANHOLE MATERIALS

A. Manholes shall be corrosion resistant only if stated on the drawings. For cast-in-place manholes provide corrosion resistant barrier coating on all interior surfaces. The materials shall be applied by an approved certified applicator. Acceptable material is:

1. Raven 405 as manufactured by Raven Lining Systems, Inc., Tulsa, Oklahoma. The corrosion resistant barrier shall be spray applied as per the manufacturer's recommendation and shall have an average minimum finished thickness of 125 mils.
2. or approved equal.

B. The Contractor shall have manufacturer's representative present on site at all times during the installation of corrosion resistant barrier.

C. The Contractor shall make provisions in his unit price bid for each structure to maintain dry conditions for the corrosion resistant liner application and subsequent curing as per manufacturer's recommendations.

2.10 BACKFILL MATERIALS

A. Backfill materials shall conform to the requirements of Section 02227 - Excavation and Backfill for Utilities.

2.11 NON-SHRINK GROUT

A. For non-shrink grout, use prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. It shall meet the requirements of ASTM C 1107 and shall have a minimum 28-day compressive strength of 7,000 psi.

2.12 PROHIBITED MATERIALS

A. Do not use brick masonry for construction of sanitary sewer manholes, including adjustment of manholes to grade. Use only specified materials listed above.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify lines and grades are correct.

B. Determine if the subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. If it cannot be compacted to that density, the subgrade shall be moisture conditioned until that density can be reached or shall be treated as an unstable subgrade.

C. Do not build sanitary sewer manholes in ditches, swales, or drainage paths unless directed by the Engineer.

3.02 PLACEMENT

A. Install precast manholes to conform to locations and dimensions shown on Drawings.

B. Place manholes at points of change of alignment, grade, size, pipe intersections, and end of sewer.

3.03 MANHOLE BASE SECTIONS AND FOUNDATIONS

A. Place precast base on 12-inch-thick (minimum) foundation of cement stabilized sand or a concrete foundation slab. Compact cement-sand in accordance with requirements of Section 02252 - Cement Stabilized Sand.

B. Unstable Subgrade Treatment: When unstable subgrade is encountered, the subgrade will be examined by the Engineer to determine if the subgrade has heaved upwards after being excavated. If heaving has not occurred, the subgrade shall be over-excavated to allow for a 24-inch thick layer of crushed stone wrapped in filter fabric as the foundation material under the manhole base. If there is evidence of heaving, a pile-supported concrete foundation, as detailed on the Drawings, shall be provided under the manhole base, when indicated by the Engineer.

3.04 PRECAST MANHOLE SECTIONS

A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.

B. Install precast adjustment rings above tops of cones or flattop sections as required to adjust the finished elevation and to support manhole frame.

C. Seal all joints and any lifting holes with non-shrink grout.

D. Place at least two precast concrete grade rings with thickness of 12 inches or less, under casting.

3.05 PIPE CONNECTIONS AT MANHOLES

A. Install approved resilient connectors at each pipe entering and exiting sanitary sewer manholes in accordance with manufacturer's instructions.

B. Ensure that no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter the space between the pipe and the edge of the wall opening at and around the resilient connector on either the interior or exterior of the manhole. If necessary, fill the space with a compressible material to guarantee the full flexibility provided by the resilient connector.

C. Where a new manhole is to be constructed on an existing sewer, install a waterstop gasket around the existing pipe at the center of cast-in-place wall. Join ends of split waterstop material at the pipe springline using an adhesive recommended and supplied by waterstop manufacturer.

D. Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetration on both inside and outside of manhole, making connection watertight.

E. Test connection for watertight seal before backfilling.

3.06 INVERTS FOR SANITARY SEWERS

A. Construct invert channels to provide a smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inch per foot maximum.
2. Depth of bench to invert:
   a. Pipes smaller than 15-inches: one-half largest pipe diameter
   b. Pipes 15 to 24-inches: three-fourths the largest pipe diameter
   c. Pipes larger than 24-inches: equal to the largest pipe diameter
3. Invert slope through manhole: 0.10-foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum

possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.07 DROP CONNECTIONS FOR SANITARY SEWERS

A. Install Drop Connection when sewer line enters manhole higher than 24-inches above the invert of the lowest pipe in the manhole.

B. Backfill drop assembly with crushed stone wrapped in filter fabric, cement stabilized sand, or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of 4 inches outside bells.

3.08 STUBS FOR FUTURE CONNECTIONS

A. In manholes, where future connections are indicated on the Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.09 MANHOLE FRAME AND ADJUSTMENT RINGS

A. Combine precast concrete adjustment rings so that the elevation of the installed casting cover is 3/8 inch below the pavement surface. Seal between adjustment ring and the precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply a latex-based bonding agent to precast concrete surfaces to be joined with non-shrink grout. Set the cast iron frame on the adjustment ring in a bed of approved sealant. The sealant bed shall consist of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 3/4-inch wide.

B. For manholes in unpaved areas, top of frame shall be set a minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase the manhole frame in mortar or non-shrink grout placed flush with the face of the manhole ring and the top edge of the frame. Provide a rounded corner around the perimeter.

3.10 BACKFILL

A. Place and compact backfill materials in the area of excavation surrounding manholes in accordance with requirements of Section 02227 - Excavation and Backfill for Utilities. Use embedment zone backfill material, as specified for the adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to the manhole. Provide trench zone backfill, as specified for the adjacent utilities, above the embedment zone backfill.

B. Where rigid joints are used for connecting existing sewers to the manhole, backfill under the existing sewer up to the springline of the pipe with Class B concrete or flowable fill.

C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide a minimum of 4 inches of topsoil conforming to requirements of

Section 02920 - Topsoil. Seed in accordance with Section 02932 - Hydromulch Seeding. If shown on Drawings, sod disturbed areas in accordance with Section 02935 - Sodding.

3.11 FIELD QUALITY CONTROL

A. Conduct leakage testing of manholes in accordance with requirements of Section 02732 - Acceptance Testing for Sanitary Sewers.

3.12 PROTECTION

A. Protect manholes from damage until work has been finally accepted. Repair damage to manholes at no additional cost to Owner.

END OF SECTION

SECTION 02603

FRAMES, GRATES, RINGS, AND COVERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings and extensions.

B. Ring grates.

1.02 UNIT PRICES

A. No payment will be made for frames, grates, rings, covers, and seals under this Section. Include payment in unit price for related item.

1.03 SUBMITTALS

A. Submit product data in accordance with Section 01300 - Submittals.

B. Provide copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.

C. Provide shop drawings for fabrication and erection of casting assemblies. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

PART 2 P R O D U C T S

2.01 CASTINGS

A. Castings for frames, grates, rings and covers shall conform to ASTM A48, Class 35B. Provide locking covers if indicated on Drawings.

B. Castings shall be capable of withstanding the application of a 40,000 pound proof load test as outlined in AASHTO M306 without permanent deformation.

C. Fabricate castings to conform to the shapes, dimensions, and with wording or logos shown on the Drawings.

D. Castings shall be clean, free from blowholes and other surface imperfections. Cast holes in covers shall be clean and symmetrical, free of plugs.

E. Castings shall be made in U.S.A.

2.02 BEARING SURFACES

A. Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for any position in which the casting may be seated in the frame.

2.03 SPECIAL FRAMES AND COVERS

A. Where indicated on the Drawings, provide watertight manhole frames and covers with a minimum of four bolts and a gasket designed to seal cover to frame. Supply watertight manhole covers and frames, Model V-1420 by East Jordan Iron Works, or approval equal.

2.04 FABRICATED RING GRATES

A. Ring grates shall be fabricated from reinforcing steel conforming to ASTM A615.

B. Welds connecting the bars shall conform to AWS D12.1.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install castings according to approved shop drawings, instructions given in related specifications, and applicable directions from the manufacturer's printed materials.

B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in formwork until permanently set.

C. Ring grates shall be fabricated in accordance with drawings and shall be set in mortar in the mouth of the pipe bell.

END OF SECTION

SECTION 02604

VALVE BOXES, METER BOXES, AND METER VAULTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Valve boxes for water service.

B. Meter boxes for water service.

C. Meter vaults for water service.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's product data for following items for approval:

1. Each type of valve box and lid.

2. Each type of meter box and cover.

3. Each type of meter vault frame and cover.

C. Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from Drawings.

PART 2 P R O D U C T S

2.01 VALVE BOXES

A. Provide Type "A", cast-iron, slide-type, valve boxes as manufactured by Sigma Corporation, East Jordan Iron Works, Inc. or approved equal. Design of valve box shall minimize stresses on valve imposed by loads on box lid.

B. Cast a letter "W" into lid, 1/2 inch in height and raised 3/32 inch, for valves serving potable water lines.

C. Coat boxes, bases, and lids by dipping in hot bituminous varnish.

D. Provide 6-inch PVC, Class 150, DR 18, riser pipes unless noted as D.I. pipe on the project details.

E. Concrete for valve box placement:

1. For locations in new concrete pavement, use strength and mix design of new pavement.

2. For other locations use Class A concrete conforming to requirements of Section 03305 - Concrete for Utility Construction.

2.02 METER BOXES

A. Provide polymer rectangle meter boxes, C Series, as manufactured by DFW Plastics, Inc. Lid shall accommodate placement of automatic reading transponder.

1. For single 3/4-inch meters: Model No. DFW37C, 17-inch x 11-inch.

2. For single 1-inch meters or dual 3/4-inch meters: Model No. DFW39C, 16-inch x 14-inch.

3. For 1-1/2-inch to 2-inch meters: Model No. DFW65C, 26-inch x 15-inch.

4. For 3-inch meters: Model No. DFW1730C, 17-inch x 30-inch.

2.03 METER VAULTS

A. Meter vaults may be constructed of precast concrete, cast-in-place concrete, or solid masonry unless a specific type of construction is required by Drawings.

B. Concrete for meter vaults: Class A concrete, conforming to requirements of Section 03305 - Concrete for Utility Construction, with minimum compressive strength of 4,000 psi at 28 days.

C. Reinforcing steel for meter vaults: Conform to requirements of Section 03305 - Concrete for Utility Construction.

D. Grates and Covers: Conform to requirements of Section 02603 - Frames, Grates, Rings, and Covers.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Obtain approval from the Engineer for location of meter vault.

B. Verify lines and grade are correct.

C. Verify compacted subgrade will support loads imposed by vaults.

3.02 VALVE BOXES

A. Provide riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade.

B. Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of valve box, for vertical movement damping. Riser may rest on valve flange, or provide suitable footpiece to support riser pipe.

C. After valve box has been set, aligned, and adjusted so that lid is level with final grade, pour a 18-inch by 18-inch by 6-inch thick concrete block around valve box. Center valve box horizontally within concrete block.

D. Paint covers of new valve boxes in "Fluorescent Orange" when installed. After completion and acceptance by Owner, repaint covers in "Blue". This work is incidental and no separate payment will be made.

3.03 METER BOXES

A. Install meter boxes in accordance with manufacturer's instructions.

B. Adjust top of meter boxes to conform to cover elevations specified in paragraph of this section for Frame and Cover for Meter Vaults.

C. Do not locate under paved areas unless approved by Engineer. Use approved traffic-type box with cast iron lid when meter must be located in paved areas.

3.04 METER VAULTS

A. Construct concrete meter vaults to dimensions and requirements shown on drawings. Do not cast in presence of water. Make bottom as uniform as practicable.

B. Precast Meter Vaults:

1. Install precast vaults in accordance with manufacturer's recommendations. Set level on a minimum 3-inch thick bed of sand conforming to the requirements of Section 02229 - Utility Backfill Materials.

2. Seal lifting holes cement-sand mortar or non-shrink grout.

C. Meter Vault Floor Slab:

1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center, or install mortar trench for keying walls to floor slab.

2. Precast floor slab elements may be used for precast vault construction.

D. Cast-in-Place Meter Vault Walls:

1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.

2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 feet.

3. Set frame for cover while concrete is still green.

3.05 FRAME AND COVER FOR METER VAULTS

A. Set cast iron frame in a mortar bed and adjust elevation of cover as follows:

1. In unpaved areas, set top of meter box or meter vault cover 2 to 3 inches above natural grade.

2. In sidewalk areas, set top of meter box or meter vault cover 1/2 to 1 inch above adjacent concrete.

3.06 BACKFILL

A. Backfill and compact in accordance with Section 02227 - Excavation and Backfill for Utilities.

B. In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope 1 to 5 from top to natural grade.

C. In sidewalk areas slope concrete down from meter boxes to meet adjacent concrete.

END OF SECTION

SECTION 02605

CAST-IN-PLACE INLETS, HEADWALLS, AND WINGWALLS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cast-in-place inlets for storm or sanitary sewers, including cast iron frame and plate or grate.

B. Cast-in-place headwalls and wingwalls for storm sewers.

C. Cast-in-place junction box with lid or grate top.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit shop drawings for approval of design and construction details for cast-in-place units which differ from units shown on Drawings.

C. Submit manufacturers' data and details for frames, grates, rings, and covers.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Class A concrete with minimum compressive strength of 4000 psi conforming to requirements of Section 03305, unless otherwise indicated on Drawings or approved by the Engineer.

B. Reinforcing steel: Conform to requirements of Section 03305.

C. Mortar: Conform to requirements of ASTM C270, Type S using portland cement.

D. Miscellaneous metals: Cast-iron frames, grates, rings, and covers conforming to requirements of Section 02603.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify lines and grades are correct.

B. Verify compacted subgrade will support loads imposed by inlets.

3.02 INSTALLATION

A. Construct units complete in place to the dimensions, lines and grades as shown on Drawings.

B. Excavate in accordance with requirements of Section 02227.

C. Forms will be required for both the outside and inside faces of concrete inlet walls, however, if the nature of the material excavated for the inlet is such that it can be hand trimmed to a smooth vertical face, the outside forms may be omitted with approval of the Engineer.

D. Place reinforcing steel to conform to details shown on the Drawings. Provide a positive means for holding steel cages in place during concrete placement. Welding of reinforcing steel is not permitted unless noted on the Drawings. The maximum variation in reinforcement position is plus or minus 10 percent of wall thickness or plus or minus 1/2 inch whichever is less. Regardless of variation, the minimum cover of concrete over reinforcement as shown on the Drawings shall be maintained.

E. Chamfer exposed edges unless otherwise indicated on Drawings.

3.03 FINISHES

A. Cut off inlet leads neatly at the inside face of inlet wall. Point up with mortar.

B. When the box section of the inlet has been completed, shape the floor of the inlet with mortar to conform to the detailed Drawings.

C. Finish concrete surfaces in accordance with requirements of Section 03305.

3.04 INLET WATERTIGHNESS

A. Test each inlet for leaks. Verify that inlets are free of visible leaks. Repair leaks in an approved manner.

3.05 BACKFILL

A. Backfill the area of excavation surrounding each completed inlet according to the requirements of Section 02227.

END OF SECTION

SECTION 02606

PRECAST CONCRETE INLETS, HEADWALLS, AND WINGWALLS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Precast concrete inlets for storm or sanitary sewers, including cast iron frame and plate or grate.

B. Precast concrete headwalls and wingwalls for storm sewers.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit shop drawings for approval of design and construction details for precast concrete inlets, headwalls and wingwalls. Precast units differing from the standard designs shown on the Drawings will be rejected unless submittals are made and approved. Submittals must clearly show that the proposed substitution is equal or superior in every respect to the standard designs.

C. Submit manufacturers' data and details for frames, grates, rings, and covers.

1.04 STORAGE AND SHIPMENT

A. Store precast units on level blocking. Do not place loads on them until design strength is reached. Shipment of acceptable units may be made when the 28-day strength requirements have been met.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Concrete for precast machine-made units meeting requirements of ASTM C76 regarding reinforced concrete, cement, aggregate, mixture, and concrete test. Minimum 28-day compressive strength shall be 4,000 psi.

B. Reinforcing steel: Place reinforcing steel to conform to details shown on Drawings and as follows:

1. Provide a positive means for holding steel cages in place throughout production of concrete units. The maximum variation in reinforcement position is plus or minus 10 percent of wall thickness or plus or minus 1/2 inch whichever is less. Regardless of variation, the minimum cover of concrete over reinforcement as shown on the Drawings shall be maintained.

2. Welding of reinforcing steel is not permitted unless noted on the Drawings.

C. Mortar: Conform to requirements of ASTM C 270, Type S using portland cement.

D. Miscellaneous metal: Cast-iron frames and plates conforming to requirements of Section 02603.

2.02 SOURCE QUALITY CONTROL

A. Tolerances: Allowable casting tolerances for concrete units are plus or minus 1/4 inch from dimensions shown on the Drawings. Concrete thickness in excess of that required will not constitute cause for rejection provided that such excess thickness does not interfere with proper jointing operations.

B. Precast Unit Identification: Mark date of manufacture and name or trademark of manufacturer clearly on the inside of inlet, headwall or wingwall.

C. Rejection: Precast units may be rejected for non-conformity with these specifications and for any of the following reasons:

1. Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint.

2. Surface defects indicating honeycombed or open texture.

3. Damaged or misshaped ends, where such damage would prevent making a satisfactory joint.

D. Replacement: Immediately remove rejected units from the work site and replace with acceptable units.

E. Repairs: Occasional imperfections resulting from manufacture or accidental damage may be repaired if, in the opinion of the Engineer, repaired units conform with requirements of these specifications.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify lines and grades are correct.

B. Verify compacted subgrade will support loads imposed by inlets.

3.02 INSTALLATION

A. Install units complete in place to the dimensions, lines and grades as shown on the Drawings.

B. Excavate in accordance with requirements of Section 02227.

C. Bed precast concrete units on foundations of firm, stable material accurately shaped to conform to the shape of unit bases.

D. Provide adequate means to lift and place concrete units.

3.03 FINISHES

A. Use a hydraulic cement to seal joints, fill lifting holes, and as otherwise required.

B. When the box section of the inlet has been completed, shape the floor of the inlet with mortar to conform to Drawings details.

C. Accurately adjust cast iron inlet plate frames to line, grade, and slope. Grout frame in place with mortar.

3.04 INLET WATERTIGHTNESS

A. Test each inlet for leaks. Verify that inlets are free of visible leaks. Repair leaks in an approved manner.

3.05 CONNECTIONS

A. Connect inlet leads to the inlets as shown on the Drawings. Seal connections inside and outside with hydraulic cement. Make connections watertight.

3.06 BACKFILL

A. Backfill the area of excavation surrounding each completed inlet, headwall or wingwall according to the requirements of Section 02227.

END OF SECTION

SECTION 02607

ADJUSTING MANHOLES, INLETS, AND VALVE BOXES TO GRADES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Adjusting elevation of manholes, inlets, and valve boxes to new grades.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

PART 2 P R O D U C T S

2.01 CONCRETE MATERIALS

A. For cast in place concrete, refer to Section 03305 - Concrete for Utility Construction.

B. For precast concrete manhole sections and adjustment rings, refer to Section 02601 - Precast Concrete Manholes.

C. For mortar mix, conform to requirements of ASTM C 270, Type S using Portland Cement.

2.02 CAST IRON ADJUSTING RINGS

A. For cast iron adjusting rings, refer to Section 02603 - Frames, Grates, Rings and Covers.

2.03 PIPING MATERIALS

A. For riser pipes and fittings, refer to applicable piping materials specifications in Sections 02610 through 02620.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, and piping and connections for damage or defects that would affect adjustment to grade. Report such damage or defects to the Engineer.

3.02 ESTABLISHING GRADE

A. Coordinate grade related items with existing grade and finished grade or paving, and relate to established bench mark or reference line.

3.03 ADJUSTING MANHOLES AND INLETS

A. Elevation of manhole or inlet can be raised using precast concrete rings or metal adjusting rings. Use of brick for adjustment of sanitary sewer manholes to grade is prohibited. Elevation of manhole or inlet can be lowered by removing existing masonry, adjusting rings or the top section of the barrel below the new elevation and then rebuilding or raising the elevation to the proper height.

B. Grout inside and outside adjusting ring joints.

C. Salvage and reuse cast iron frame and cover or grate.

D. Protect or block off manhole or inlet bottom using wood forms shaped to fit so that no debris or soil falls to the bottom during adjustment.

E. Set the cast iron frame for the manhole cover or grate in a full mortar bed and adjust to the established elevation. In streets, adjust covers to be 3/8 inch below pavement.

F. Verify that manholes and inlets are free of visible leaks as a result of reconstruction. Repair leaks in a manner subject to the Engineer's approval.

3.04 ADJUSTING VALVE BOXES

A. Salvage and reuse valve box and surrounding concrete block.

B. Remove and replace 6-inch ductile iron riser pipe with suitable length for depth of cover required to establish the adjusted elevation to accommodate actual finish grade.

C. Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.

D. After valve box has been set, aligned, and adjusted so that top lid is level with final grade, pour a 18-inch by 18-inch by 6-inch thick concrete pad around valve box. Center valve box horizontally within concrete slab.

3.05 BACKFILL AND GRADING

A. Backfill the area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of Section 02227 - Excavation and Backfill for Utilities.

B. Grade the ground surface to drain away from each manhole and valve box. Place earth fill around manholes to the level of the upper rim of the manhole frame. Place earth fill around the valve box concrete block.

C. In unpaved areas, grade surface at a uniform slope of 1 to 5 from the manhole frame to natural grade. Provide a minimum of 4 inches of topsoil conforming to requirements of Section 02920 - Topsoil and sod in accordance with Section 02935 - Sodding.

END OF SECTION

SECTION 02610

DUCTILE IRON PIPE AND FITTINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Ductile iron pipe and fittings for water mains, wastewater force mains, gravity sanitary sewers, and storm sewers.

1.02 UNIT PRICES

A. No separate payment will be made for ductile iron pipe and fittings under this Section. Include cost in unit price for water mains, force mains, gravity sanitary sewers, and storm sewers.

1.03 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittals.

B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fitting, flange, and special details. Show location for pipe and fittings corresponding to Drawings. Production of pipe and fittings prior to review by the Engineer is at Contractor's risk.

1.04 QUALITY CONTROL

A. Provide manufacturer's certifications that all ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A21.51.

B. Provide certifications that all pipe joints have been tested and meet requirements of ANSI A21.11.

PART 2 P R O D U C T S

2.01 DUCTILE IRON PIPE

A. Ductile iron pipe barrels: ANSI A21.15, ANSI A21.50 or ANSI A21.51; bear mark of Underwriters' Laboratories approval; pressure classes as shown on the Drawings and/or Bid Proposal.

B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.

2.02 JOINTS

A. Joint types: ANSI A21.11 push-on; ANSI A21.11 mechanical joint; or ANSI A21.15 flanged end. Provide mechanical joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, bolts shall conform to requirements of AWWA C111.

B. Where required by Drawings, provide Series 1700 MEGALUG Restraint Harness, by EBAA Iron Sales, Inc., or approved equal for restrained joints for buried service.

C. Threaded or grooved type joints which reduce pipe wall thickness below minimum required are not acceptable.

D. Provide for restrained joints designed to meet test pressures required under Section 02676 - Hydrostatic Testing of Pipelines or Section 02731 - Sanitary Sewer Force Mains, as applicable.

E. Where ductile iron water main is cathodically protected from corrosion, bond rubber gasketed joints as shown on Drawings to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings.

2.03 GASKETS:

A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material; for flanged joints 1/8-inch thick gasket in accordance with ANSI A21.15.

B. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed pipeline, shall have the following gasket materials for the noted contaminants:

Contaminant	Gasket Material Required
Petroleum (diesel, gasoline)	Nitrile Rubber
Other contaminants	As recommended by the pipe manufacturer

2.04 FITTINGS

A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they serve.

B. Push-on Fittings will not be allowed.

C. Flanged Fittings: ANSI A21.10; ANSI B16.1 cast or ductile iron. Flanges: ANSI B16.1, Class 125; pressure rated at 250 psig.

D. Mechanical Joint Fittings: ANSI A21.10 (AWWA C110); pressure rated at 250 psi.

E. Ductile Iron Compact Fittings for Water Mains: ANSI A21.53 (AWWA C153); 4-inch through 12-inch diameter fusion bonded epoxy-lined or cement-mortar lining.

2.05 COATINGS AND LININGS

A. Water Main Interiors: ANSI A21.4, cement lined with seal coat; ANSI A21.16 fusion bonded epoxy coating for interior; comply with NSF 61-G.

B. Sanitary Sewer and Force Main Interiors:

1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.

2. Liner thickness: Nominal 40 mils, minimum 35 mils, for pipe barrel interior; minimum 6 - 10 mils at gasket groove and outside spigot end to 6-inches back from end.

3. Testing: ASTM G62, Method B for voids and holidays; provide written certification.

4. Acceptable Lining Materials:

a. Virgin polyethylene conforming to ASTM D1248, with inert fillers and carbon black to resist ultraviolet degradation during storage heat bonded to interior surface of pipe and fittings; Polyline by American Cast Iron Pipe Company; or equal.

b. Polyurethane: Corro-pipe II by Madison Chemicals.

c. Ceramic Epoxy: Protecto-401 by Enduron Protective Coatings.

C. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B.

D. Exterior:

1. Water Lines:

a. Auger Holes: Conform to requirements of Section 02629 - Polyurethane Coatings on Steel or Ductile Iron Pipe.

b. Above Ground (or Exposed): Provide a 3-coat epoxy/polyurethane coating system as designated below:

Surface Preparation	SSPC SP10 Near White Blast Clean 2.0 to 3.0 mils surface profile

Prime Coat 2.0 to 4.0 mils DFT	ACRO 4422 Inhibitive Epoxy Primer, or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	ACRO 4460 Chemical Resistant Epoxy, or approved equal
Finish Coat 1.5 to 2.0 mils DFT	ACRO 4428 Polyurethane, Or approved equal

c. Total minimum allowable dry film thickness for system: 10 mils.

d. All materials shall be from same manufacturer.

2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.

E. Polyethylene Wrap: For buried water lines and sanitary sewers, including point repairs, provide polyethylene wrap unless otherwise specified or shown. Provide Polyethylene Wrap for all buried ductile iron pipe, including polyurethane coated pipe. Conform to requirements of Section 02630 - Polyethylene Wrap.

F. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and all alloy steel fasteners. Alternatively, provide bolts made of Type 304 Stainless Steel

G. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer as resistant to the contaminants.

2.06 MANUFACTURERS

A. Pre-approved manufacturers of ductile iron are American Cast Iron Pipe Co., McWane Cast Iron Pipe Co., and U. S. Pipe and Foundry Co.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Conform to installation requirements of Sections 02664 - Water Mains, except as modified in this Section.

B. Install in accordance with AWWA C600 and manufacturer's recommendations.

C. Install all ductile iron pipe in polyethylene wrap, unless cathodic protection is provided. Do not use polyethylene wrap with a cathodic protection system.

D. Holiday Testing

1. Polyurethane: Conform to requirements of Section 02629 - Polyurethane Coatings for Steel or Ductile Iron Pipe.

2. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A21.16.

3.02 GRADE

A. Unless otherwise specified on Drawings, install ductile iron pipe for water service to clear utility lines with following minimum cover:

Diameter (Inches)	Depth of Cover (Feet)
16 and 24	5
12 and smaller	3.5

3.03 FIELD REPAIR OF COATINGS

A. Polyurethane: Conform to requirements of Section 02527 - Polyurethane Coatings for Steel or Ductile Iron Pipe.

B. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A21.16.

END OF SECTION

SECTION 02611

STEEL PIPE AND FITTINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. New steel pipe and fittings for water mains, pumping facilities, and casings.

1.02 UNIT PRICES

A. No payment will be made for steel pipe and fittings under this section. Include cost in unit price for water mains, pumping facilities and casings.

1.03 SUBMITTALS

A. Submit shop drawings, in accordance with requirements of Section 01300 - Submittals.

1. For aerial crossings and water plant/facilities, include design of new pipe and fittings indicating alignment and grade, laying dimensions, lining and coating systems, proposed welding procedures, fabrication, fitting, flange, and special details. Show location for pipe and fittings corresponding to Drawings.

2. Production of pipe and fittings prior to review by the Engineer shall be at Contractor's risk.

1.04 QUALITY CONTROL

A. Provide manufacturer's certifications that all pipe and fittings have been hydrostatically tested at factory in accordance with AWWA C200, Section 3.4.

B. Provide manufacturer's affidavits that polyurethane coatings, linings and tape coatings comply with applicable requirements of this section and that coatings were applied and allowed to cure at a temperature 5 degrees above the dew point.

C. Provide manufacturer's affidavits that mortar coatings and linings comply with applicable requirements of this section and that linings were applied and allowed to cure at a temperature above 32 degrees F.

D. Prior to work being started, provide proof of certification of qualification for all welders employed for type of work, procedures and positions involved. Qualifications shall be in accordance with AWWA C206.

PART 2 P R O D U C T S

2.01 STEEL PIPE

A. Provide steel pipe designed and manufactured in conformance with AWWA C200 and AWWA M11 except as modified herein. Steel shall be minimum of ASTM A 36, ASTM A570 Grade 36, ASTM A 53 Grade B, ASTM A135 Grade B, or ASTM A139 Grade B.

B. Minimum Allowable Steel-Wall Thickness: In accordance with following table for HS-20 live loads and depths of bury of up to 16 feet and AWWA C200 new uncoated welded steel.

GENERAL PURPOSE CARBON STEEL PIPE

Pipe Size	O.D.	Min. Wall Thick.
8”	8.625”	0.322”
10”	10.750”	0.365”
12”	12.750”	0.375”
14”	14.000”	0.375”
16”	16.000”	0.375”
20”	20.000”	0.375”
24”	24.000”	0.375”
30”	30.000”	0.375”

CASING PIPE
(ENCASEMENT SLEEVES)

Casing Pipe Size	Min. Wall O.D.	Min. Wall Thick.	Approx. Wt. Per Lin. Ft. Unct’d.
8”	8.625”	0.219”	19.64
10”	10.750”	0.219”	24.60
12”	12.750”	0.219”	29.28
14”	14.000”	0.219”	32.00
16”	16.000”	0.219”	36.86
20”	20.000”	0.250”	52.73
24”	24.000”	0.250”	63.41
30”	30.000”	0.250”	79.43

C. Provide pipe sections in lengths of no less than 20 feet except as required for special fittings or closure sections.

D. Fittings: Factory forged for sizes 4 inches through 24 inches; long radius bends; beveled ends for field butt welding; wall thickness: equal to or greater than pipe to which fittings is to be welded; unless otherwise shown on the drawings.

E. Joints:

1. Standard field joint for steel pipe: AWWA C206.

a. Single-welded, lap joint.

b. Double-welded, butt joint.

2. Provide mechanically coupled or flanged joints where required for valves and fittings, and as shown on Drawings. Flanges: AWWA C207, Class D; same diameter and drilling as Class 125 cast iron flanges ASA B16.1. Maintain electrically isolated flanged joints between steel and cast iron by using epoxy-coated bolts, nuts, washers and insulating type gasket unless otherwise approved by Engineer.

F. Make curves and bends by use of beveled joints unless otherwise indicated on Drawings. Contractor may submit details of other methods of providing curves and bends for consideration by the Engineer. If other methods are deemed satisfactory, install at no additional cost to Owner.

G. Provide shop coated and shop lined steel pipe with minimum of one coat of shop applied primer approved for use in potable water transmission on all exposed steel surfaces. Primer for tape coated steel pipe to be used for field-applied coatings shall have no less than 5 percent solids. Provide primer compatible with coating system and in accordance with coating manufacturer's recommendations.

H. Standard or Special Sections: Within 1/8 inch + of specified or theoretical lengths. Flanges: Square with pipe with bolt holes straddling both horizontal and vertical axis. Provide 1/2-inch gap between pipe ends where pipe is to be coupled with sleeve couplings.

2.02 EXTERNAL COATING SYSTEMS FOR BURIED STEEL PIPE

A. General: Supplied with either tape coatings or cement-mortar coatings as specified herein.

1. Tape Coating: AWWA C214; 80-mil shop-applied, Polyken YG-III, Tek-Rap Yard-Rap, or equal, except as modified herein. Components: primer, one 20-mil layer of inner-layer tape for corrosion protection and two 30-mil layers of outer-layer tape for mechanical protection. Primer: compatible with tape coating, supplied by coating-system manufacturer. Provide pipe with shop coatings cut back from joint ends to facilitate joining and welding of pipe. Taper successive tape layers by 1-inch staggers to facilitate field wrapping of joints. Cutback approximately 4 to 4-1/2 inches to facilitate welding. Inner and outer tape widths:

Diameter	Tape Width
4” – 6”	6”

8” – 12”	9”
14” – 16”	12”
18” – 24”	18”

2. Cement-Mortar Coating: AWWA C205; shop-applied, cement-mortar coating except as modified herein; 1-inch minimum thickness; cut back coating from joint ends no more than 2 inches to facilitate joining and welding of pipe.

2.03 EXTERNAL COATING SYSTEM FOR STEEL PIPE IN TUNNEL, CASING OR AUGER HOLES

A. Provide exterior coating system of pipe in augered holes or casing, without annular grout, as specified in Section 02629, Polyurethane Coatings on Steel or Ductile Iron Pipe. No additional exterior coating is required for mortar coated pipe.

2.04 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND (OR EXPOSED)

A. Provide a 3-coat epoxy/polyurethane coating system as designated below.

Surface Preparation	SSPC SP10 Near White Blast Clean 2.0 to 3.0 mils surface profile
Prime Coat 2.0 to 4.0 mils DFT	ACRO 4422 Inhibitive Epoxy Primer, or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	ACRO 4460 Chemical Resistant Epoxy, or approved equal
Finish Coat 1.5 to 2.0 mils DFT	ACRO 4428 Polyurethane, Or approved equal

B. Total minimum allowable dry film thickness for system: 10 mils.

C. All materials shall be from same manufacturer.

2.05 INTERNAL LINING SYSTEMS FOR STEEL PIPE

A. General: Supply steel pipe with either epoxy lining or shop applied cement mortar lining, capable of conveying water at temperatures not greater than 140EF. All linings shall conform to American National Standards Institute/National Sanitation Foundation (ANSI/NFS) Standard 61 and certified by an organization accredited by ANSI. Unless otherwise noted, coat all exposed (wetted) steel parts of flanges, blind flanges, bolts, access manhole covers, etc., with epoxy lining, as specified herein.

B. Epoxy Lining: AWWA C210-92 - White, or approved equal for shop and field joint applied, except as modified herein.

1. Surface Preparation: SSPC-SP-10(64); Near White Blast Clean; 2.0 to 3.0 mils surface profile.

2. Prime Coat: ACRO 4460 NSF Certified Epoxy - Buff; 4.0 to 6.0 mils DFT or approved equal.

3. Intermediate Coat: ACRO 4460 NSF Certified Epoxy - Buff: 4.0 to 6.0 mils DFT or approved equal.

4. Finish Coat: ACRO 4460 NSF Certified Epoxy - White 4.0 to 6.0 mils DFT or approved equal.

5. Minimum allowable dry film system thickness: 12.0 mils.

6. Maximum allowable dry film system thickness: 18.0 mils.

7. Minimum field adhesion: 700 psi.

8. Dry film thicknesses for approved alternate products in accordance with the product manufacturer's recommendations.

9. The lining system may consist of three or more coats of the same approved alternate epoxy lining without the use of a separate primer.

10. Provide materials from the same manufacturer.

C. Shop Applied Cement Mortar Lining: AWWA C205; shop-applied cement mortar linings, except as specified herein 3/8 inch minimum thickness for pipe diameters 24 inches and smaller. Pipe with cut back lining from joint ends no more than 2 inches to facilitate joining and welding of pipe.

2.06 MORTAR FOR EXTERIOR JOINTS

A. Cement Mortar: One part cement to two parts of fine, sharp clean sand; mix with water to a consistency of thick cream.

B. Portland Cement: ASTM C150, Type II.

C. Sand:

1. Inside joints: AWWA C602; fine graded natural sand.

2. Outside joints: ASTM C33; natural sand with 100 percent passing No. 16 sieve.

D. Water: ASTM D1888, Method A; total dissolved solids less than 1000 mg/l; ASTM D512 chloride ions less than 100 mg/l for slurry and mortar cure; ASTM D1293 pH greater than 6.5.

PART 3 E X E C U T I O N

3.01 PIPING INSTALLATION

A. Conform to applicable provisions of Section 02664 - Water Mains except as modified herein.

3.02 EXTERNAL COATING SYSTEM FOR BURIED STEEL PIPE

A. Tape Coating System:

1. Inspect pipe, prior to shipment, for holidays and damage to coating. Perform electrical holiday test of minimum of 6,000 volts with a 60 cycle current audio detector. If test indicates no holidays and outer wrap(s) is torn, remove damaged layers of outer wrap by carefully cutting with sharp razor-type utility knife. Wash with Xylol area to be patched and at least 4 inches of undamaged tape where hand-applied tape wrap will overlap. AWWA C209 cold-applied tape; compatible with tape-wrapping system applied for each layer of outer-wrap tape that has been removed. If damaged area shows holiday when tested, remove outer layers and expose inner wrap. Prime exposed area and overlaps with light coat of primer. Firmly press into place patch of inner wrap of sufficient size to extend 4 inches from holidays in all directions. Holiday test patch to verify that it is installed satisfactorily. Retrim outer layer of tape to expose first wrap of outer-wrap tape sufficiently to allow minimum lap of 2 inches in all directions. Wash exposed outer wrap tape with Xylol and prime. Apply two layers of AWWA C209 outer wrap with 35 mils minimum thickness.

2. Regardless of results of electrical holiday test, bubbles in tape coating system are not allowed. Cut out bubbles and patch as detailed above.

3. Field repairs and applications of coatings: AWWA C209 around joint cutbacks except as modified herein. Field-welded joints: clean shop-primed ends of weld splatter, damaged primer and rust to achieve required surface preparation prior to field repair of linings and coatings.

   a. Immediately prior to placing joint in trench, remove shop-applied primer by abrasive blasting, solvent or other method as approved by the Engineer. Avoid damage to adjacent existing coatings. Clean surfaces to achieve surface preparation at least equivalent to SSPC SP6 in accordance with AWWA C209. Solvent: environmentally safe and compatible with coating-system primer.

   b. Apply primer immediately prior to application of first layer of tape to achieve maximum bond. Apply tape while primer is still "tacky" with 3-inch minimum overlap over shop-applied coating.

4. Do not expose tape coatings to harmful ultraviolet light for more than 90 days. Discard (remove) and replace outer layer of tape coating when exposure exceeds

90 days. In case of factory applied coatings, remove joint from site for removal and reapplication of outer layer of tape coatings.

B. At Owner's option, coating system and application may be tested and inspected at plant site in accordance with AWWA C214.

C. Cement Mortar Coating: AWWA C205; 1-inch minimum thickness; cut back from joint ends no more than 2 inches to facilitate joining and welding of pipe.

3.03 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND, IN VAULTS, TUNNELS OR CASINGS, AND INTERNAL LINING FOR ALL INSTALLATIONS

A. Cement Mortar Lining: AWWA C205; 1/2-inch minimum thickness; cut back from joint ends to facilitate joining and welding of pipe.

B. Safety: Paints, coatings, and linings specified herein are hazardous materials. Vapors may be toxic or explosive. Protective equipment, approved by appropriate regulatory agency, is mandatory for all personnel involved in painting, coating, and lining operations.

C. Workmanship:

1. Application: By qualified and experienced workers who are knowledgeable in surface preparation and application of high-performance industrial coatings.

2. Paint Application Procedures: SSPC Good Painting Practices, Volume 1.

D. Surface Preparation:

1. Prepare all surfaces for painting with abrasive blasting.

2. Schedule cleaning and painting so that detrimental amounts of dust or other contaminants do not fall on wet, newly painted surfaces. Protect surfaces not intended to be painted from effects of cleaning and painting operations.

3. Prior to blasting, clean surfaces to be coated or lined of grease, oil and dirt by steaming or detergent cleaning in accordance with SSPC SP1.

4. Metal and Weld Preparation: Remove all surface defects such as gouges, pits, welding and torch-cut slag, welding flux and spatter by grinding to 1/4-inch minimum radius.

5. Abrasive Material:

a. Blast only as much steel as can be coated same day of blasting.

b. Use sharp, angular, properly graded abrasive capable of producing depth of profile specified herein. Transport abrasive to jobsite in moisture-

proof bags or airtight bulk containers. Copper slag abrasives are not acceptable.

c. After abrasive blast cleaning, verify surface profile with replica tape such as Tes-Tex Coarse or Extra Coarse Press-O-Film Tape, or approved equal. Furnish tapes to Owner for filing and future reference.

d. Do not blast if metal surface may become wet before priming commences, or when metal surface is less than 5 degrees F above dew point.

6. Remove all dust and abrasive residue from freshly blasted surfaces by brushing or blowing with clean, dry air.

E. Coating and Lining Application:

1. Environmental Conditions: Do not apply coatings or linings when metal temperature is less than 50 degrees F; when ambient temperature is less than 5 degrees F above dew point; when expected weather conditions are such that ambient temperature will drop below 40 degrees F within 6 hours after application of coating; or when relative humidity is above 85 percent. Measure relative humidity and dew point by use of sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. Provide dehumidifiers for all field-applied coatings and linings to maintain proper humidity levels.

2. Application Procedures:

a. Apply coatings and linings in accordance with manufacturer's recommendations and requirements of this section. Provide a finish free of runs, sags, curtains, pinholes, orange peel, fish eyes, excessive overspray or delaminations.

b. Thin materials only with manufacturer's recommended thinners. Thin only amount required to adjust viscosity for temperature variations, proper atomization and flow-out. Mix material components using mechanical mixers.

c. Discard catalyzed materials remaining at end of day.

3. Apply primer immediately after surface has been cleaned. Thoroughly dry pipe before primer is applied. Apply succeeding coats before contamination of under surface occurs.

4. Allow each coat of paint either to dry or cure amount of time recommended by coating or lining manufacturer before successive coats of paint are applied. Apply all successive coats of paint within recoat threshold time as recommended

by coating or lining manufacturer on printed technical data sheets or through written communications.

3.04 INSPECTION

A. Procure services of an independent testing laboratory or inspection service, approved by the Engineer, to perform tests on all portions of coating and lining applications. Laboratory shall supply services of NACE Certified Coatings Inspectors having Level III Certification for all coating and linings inspection work. Include cost of such testing in contract unit price bid for water main. Furnish copies of all test reports to the Engineer for review. If defective coatings or lining are revealed, cost of repair and testing of repair will be paid for by Contractor. The Engineer shall have full and final decision as to suitability of all coatings and linings tested.

B. For all field applied coatings and linings, including joints, notify Owner sufficiently in advance of work so that Owner can perform examination of and acceptance of surface preparation and application of each coat prior to application of next coat. Furnish appropriate test data to Owner verifying compliance with requirements of this section of each coat prior to proceeding with next coat. Recoat or repair runs, overspray, roughness and/or abrasives in coating, or other indications of improper application in accordance with coating or lining manufacturer's and the Engineer's instructions.

C. Repairs, surface preparation and painting will be subject to inspection by Owner. Guidelines published by Steel Structures Painting Council will be used as basis for acceptance or rejection of cleaning, painting or coating application. SSPC VIS1, Pictoral Surface, along with single-probe magnetic pull-off type dry film thickness gages, electrical holiday detectors, and standard wet film thickness gages will be used to determine acceptability of paint applications.

D. Check film thickness with nondestructive magnetic pull-off gage such as Mikrotest Model DFG-100 or electronic thickness gage. National Bureau of Standards certified thickness calibration plates will be used to verify accuracy of thickness gage. Determine maximum and minimum thickness in accordance with SSPC PA2 for frequency and method. Evaluate each length of pipe under SSPC PA2. Consider each field joint area separate and discrete for purpose of DFT measurements. Perform five spot DFT measurements on each field joint area (15 individual readings). Check thickness of each individual coat as well as thickness of overall system with respect to compliance with this Section. Failure to meet either overall system thickness requirements or requirements of component coats shall be cause for rejection and recoat or repair of entire joint or length of pipe.

E. Holiday Test:

1. Begin inspection after coating has sufficiently cured, usually one to five days. (Consult coating manufacturer for specific curing schedule.)

2. Use high-voltage d-c holiday detector such as D.E. Stearns Company Model 14/20 or Tinker & Rasor Model AP/W. Use 1600 volts, plus or minus 100 volts. Use brass brush type electrode.

3. Ground high-voltage d-c holiday detector to metal being inspected. Earth-type ground tape is not acceptable. Mark detected defects with white chalk, repair and reinspect.

4. Adhesion Tests: ASTM D4541; pull-off testing using an Elcometer Model 106 Fixed Alignment Adhesion Tester. Adhesion testing may be directed by the Engineer on any length of pipe or joint which exceeds maximum coating thickness limitations specified in this Section.

3.05 COATINGS AND LININGS INSPECTION

A. Owner reserves right to inspect or acquire service of independent third-party inspector who is fully knowledgeable of, and qualified to inspect, surface preparation and application of high-performance coatings to inspect any and all phases of all coatings and linings work, whether field or shop applied. Contractor responsible for application and performance of coating and lining whether or not Owner provides such inspection.

END OF SECTION

SECTION 02615
REINFORCED CONCRETE PIPE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Reinforced concrete pipe for storm sewers and culverts.

1.02 UNIT PRICES

A. No separate payment will be made for reinforced concrete pipe under this Section. Include payment in unit price for Sections 02720 - Storm Sewers.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit complete product data for pipe, fittings and gaskets for approval. Indicate conformance to appropriate reference standards.

C. Submit certificates by a testing laboratory, hired and paid by the manufacturer, that concrete pipes meet applicable standards when tested in accordance with ASTM C497.

PART 2 P R O D U C T S

2.01 REINFORCED CONCRETE PIPE

A. Circular reinforced concrete pipe shall conform to requirements of ASTM C76, for Class III wall thickness. Joints shall be rubber gasketed conforming to ASTM C443, or preformed flexible joint sealants conforming to ASTM C990 for tongue and groove culvert pipe.

B. Reinforced concrete arch pipe shall conform to the requirements of ASTM C506 for Class A-III. Joints shall conform to ASTM C877.

C. Reinforced concrete elliptical pipe, either vertical or horizontal, shall conform to the requirements of ASTM C507 for Class VE-III for vertical or Class HE-III for horizontal. Joints shall be rubber gaskets conforming to ASTM C877.

D. Reinforced concrete D-load pipe shall conform to the requirements of ASTM C655.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Conform to requirements of Sections 02720 - Storm Sewers.

B. Install reinforced concrete pipe in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 02617

PRECAST REINFORCED CONCRETE BOX SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Precast reinforced concrete box sewers.

1.02 UNIT PRICES

A. No separate payment will be made for precast reinforced concrete box sewer under this Section. Include payment in unit price for Section 02720 - Storm Sewers.

B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ASTM C 1433 - Standard Specifications for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers.

1.04 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittals.

B. Submit shop drawings and data on box sections, fittings, and appurtenances for approval. Indicate conformance to reference standards.

PART 2 P R O D U C T S

2.01 PRECAST REINFORCED CONCRETE BOX SEWERS

A. All box sewer sections shall conform to ASTM C 1433, as indicated on the Drawings.

B. All pipe and boxes shall be machine-made or cast by a process, which will provide for uniform placement of concrete in the forms and compaction by mechanical devices which will assure a dense, structurally sound concrete.

C. Joint Wrap
1. Box joints shall be wrapped with 4-ounce geotextile with 36-inch width wrapped around the pipe perimeter with 18-inch overlap at end.
2. Geotextile should be applied per manufacturer's instructions.
3. Approved manufacturers include Mirafi 140NC or equal.

2.02 CONCRETE

A. Conform to requirements of Section 03305 - Concrete for Utility Construction.

B. Concrete shall be mixed in a central batch plant or other batching facility from which the quality and uniformity of the concrete can be assured. Transit-mixed concrete is not acceptable.

2.03 SOURCE QUALITY CONTROL

A. Representative of Engineer will inspect manufacturer's plant and casting operations as deemed necessary.

B. The Contractor shall provide bi-weekly reports certified by the box manufacturer's representative that the installation is being performed by the Contractor per the manufacturer's recommendations and guidelines.

PART 3 E X E C U T I O N

3.01 BEDDING

A. Box sections shall be bedded on a foundation of firm and stable material accurately shaped to conform to their bases. When required by the Drawings, special bedding material shall be provided. When single-cell box sections are placed in parallel for multi-cell installation they shall be placed in conformance with the details shown on the Drawings.

3.02 PLACEMENT

A. All box sections shall be carefully lowered to the bottom of the trench and shall be laid accurately in line and grade, with the spigot end downstream entering the bell or groove end to full depth and in such manner as not to drag foreign material into the annular space.

3.03 JOINTING

A. Box sections shall be joined together and matched so that they will form a continuous smooth and uniform invert. The joint opening at any point where two box sections are fitted together shall not exceed one (1) inch. This opening is not considered an average.

B. Joint repair shall be performed on sections of the joint that exceed 1-inch. If more than half the joint exceeds 1-inch, then this whole joint shall be repaired. Repair shall be performed as described in Section 03820 - Joint Repair and Joint Repair Detail.

3.04 BACKFILLING

A. After the box has been properly jointed and bedded, backfilling shall commence.

B. Backfilling shall be in accordance with Section 02227 - Excavation and Backfill for Utilities.

END OF SECTION

SECTION 02620

PVC PIPE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Polyvinyl chloride pressure pipe for water distribution in nominal diameters 4 inches through 16 inches.

B. Polyvinyl chloride pressure pipe for water transmission in nominal diameters.

C. Polyvinyl chloride sewer pipe for gravity sanitary sewers in nominal diameters 4 inches through 48 inches.

D. Polyvinyl chloride pressure pipe for gravity sanitary sewers and force mains in nominal diameters 4 inches through 36 inches.

1.02 UNIT PRICES

A. No separate payment will be made for PVC pipe under this section. Include cost in unit price for related item.

1.03 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittals.

B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

1.04 QUALITY CONTROL

A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900 or AWWA C 905 for pressure pipe applications, or the appropriate ASTM standard specified for gravity sewer pipe.

B. Submit manufacturer's certification that PVC pressure pipe has been hydrostatically tested at the factory in accordance with AWWA C 900 or AWWA C 905 and this Section.

C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from any other source is not acceptable. Furnish copies of test reports to the Engineer for review. Cost of testing shall be borne by Contractor or Supplier.

PART 2 P R O D U C T S

2.01 MATERIAL

A. Use PVC compounds in the manufacture of pipe that contain no ingredient in an amount that has been demonstrated to migrate into water in quantities considered to be toxic.

B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for a rating of 4000 psi for water at 73.4 degrees F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.

C. PVC Pipe for Water Mains:
   1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.

   2. Bear National Sanitation Foundation Seal of Approval (NSF pw-G).

D. Gaskets:
   1. Gaskets shall meet the requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
   2. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed sewer, shall have the following gasket materials for the noted contaminants.

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other contaminants	As recommended by the pipe manufacturer

E. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.

2.02 WATER PIPE

A. Pipe 2-inch: Class 200, SDR 21; nominal 20-ft lengths; for connection to existing 2-inch water mains.

B. Pipe 4-inch through 12-inch: AWWA C 900, Class 235, DR 18; nominal 20-foot lengths; cast iron equivalent outside diameters.

C. Pipe 14-inch through 24-inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast iron equivalent outside diameter.

D. Joints: ASTM D 3139; push-on type joints in integral bell or separate sleeve couplings. Do not use socket type or solvent weld type joints.

E. Make curves and bends by deflecting the joints. Do not exceed maximum deflection recommended by the pipe manufacturer. Submit details of other methods of providing curves and bends for review by the Engineer.

F. Hydrostatic Test: AWWA C 900, AWWA C 905, ANSI A21.10 (AWWA C110); at point of manufacture; submit manufacturer's written certification.

2.03 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

A. Bends and Fittings: ANSI A21.10 or ANSI 21.53, ductile iron; ANSI A21.11 single rubber MJ joints; minimum 150 psi pressure rating.
   1. The restraint shall be MEGALUG Series 2000PV as manufactured by EBAA Iron Sales, Inc., or approved equal.

B. Coatings and Linings: Conform to requirements of Section 02610 - Ductile-Iron Pipe and Fittings.

C. Restraints for large diameter PVC pipe (AWWA C905) at the bell shall be consist of the following:
   1. The restraint shall be manufactured of ductile iron conforming to ASTM A536.
   2. A backup ring shall be utilized behind the PVC bell.
   3. A restraint ring, incorporating a plurality or individually actuating gripping surfaces, shall used to connect the bell ring and gripping ring.
   4. The restraint shall be MEGALUG Series 2800 as manufactured by EBAA Iron Sales, Inc., or approved equal.

2.04 GRAVITY SANITARY SEWER PIPE

A. Polyvinyl Chloride (PVC) Plastic Sewer Pipe:
   1. Approved manufacturers include: J-M Manufacturing, CertainTeed, Can-Tex, Carlon Company, Diamond Plastics Corp., North American Pipe Corp. (NAPCO).
   2. Pipe sizes 15 inches in diameter and smaller shall conform to ASTM D-3034, SDR 26.
   3. Pipe sizes 18 inches in diameter and larger shall conform to ASTM F-679, F-794, SDR 26.
   4. Service connection pipe and fittings: 6 inch diameter, ASTM D-3034, SDR 26.
   5. Fittings: ASTM D-3034, Type PSM (PVC), SDR 26. All connections including bends, wyes, tees, stacks and stubs shall be full bodied.

6. Pipe jointing: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring factory-assembled and securely locked in place to prevent displacement, ASTM D 3212.
7. Standard 13 ft. or 20 ft. plus or minus 1 in. lengths.
8. Pipe shall pass test ASTM D 2444 without shattering or splitting.
9. Pipe shall pass test ASTM D 2412, minimum pipe stiffness: 46 psi at 5% deflection.
10. Joint, assembled in accordance with manufacturer's recommendation shall pass tightness test ASTM D 3212.
11. The deflection of pipe after installation and backfill shall not exceed 5% of the average inside diameter.

B. POLYVINYL CHLORIDE (PVC) PLASTIC SEWER PIPE REQUIRED FOR SEPARATION FROM WATER LINES (REFER TO 3.1 AND PLANS)

1. Pipe and Joints:
   a. Clean, virgin, Type I, Grade I polyvinyl chloride complying with ASTM D 1784.
   b. 6 in. and smaller pipe: AWWA C 900, DR-14, rated for 200 psi, UL listed.
   c. 8 in. to 12": AWWA C 900, DR-18, rated for 150 psi, UL listed or ASTM D 2241 PVC Pipe (SDR-PR), SDR 26 rated for 160 psi.
   d. Greater than 12" pipe: AWWA C 905 DR-25 rated for 165 psi, UL listed
   e. Integral bell with elastomeric or rubber solid cross section compression ring gasketed joints complying with ASTM D 3139.
   f. Bears National Sanitation Foundation (NSF) testing laboratory seal.
   g. Cast iron o.d., ASTM D 1785 for AWWA C-900.
2. Tests:
   a. Each standard, random, or short length of pipe and each coupling sleeve, when manufactured from same material as pipe, shall be tested in accordance with USDC CS-272.
   b. Use Class 150 except pipe 6 in. or less shall be Class 200.
3. Connections of PVC to Cast Iron Pipe, Fittings, and Valves:
   a. Cast iron fittings: Make connections of polyvinyl chloride pipe to cast iron fittings or gate valves in compliance with jointing methods recommended by pipe manufacturer.
   b. Fittings shall be cement lined and sealed in compliance with AWWA C 104.

2.05 SANITARY SEWER FORCE MAIN PIPE

A. Provide PVC pressure pipe conforming to the requirements for water service pipe, and conforming to the minimum working pressure rating specified in Section 02731 - Sanitary Sewer Force Mains.

B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting the requirements of ASTM F 477. In designated areas requiring

restrained joint pipe and fittings, use EBAA Iron Series 2000PV, Uniflange Series 1350 restrainer, or equal joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.

C. Fittings: Provide ductile iron fittings as per Paragraph 2.03, except furnish all fittings with one of the following internal linings:
   1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to the interior surface of the fitting, as manufactured by American Cast Iron Pipe "Polybond", or U.S. Pipe "Polyline".
   2. Nominal 40 mils (35 mils minimum) polyurethane, Corro-pipe II by Madison Chemicals, Inc.
   3. Nominal 40 mils (35 mils minimum) ceramic epoxy, Protecto 401 by Enduron Protective Coatings.

D. Exterior Protection: Provide polyethylene wrapping of ductile iron fittings as required by Section 02630 - Polyethylene Wrap.

E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02 E.

PART 3 E X E C U T I O N

3.01 PROTECTION

A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with the manufacturer's recommendations.

3.02 INSTALLATION

A. Conform to requirements of Section 02664 - Water Mains, Section 02730 - Gravity Sanitary Sewers, Section 02731 - Sanitary Sewer Force Mains, and Section 02763 - Point Repairs to Sanitary Sewers, as applicable.

B. Install PVC pipe in accordance with Section 02227 - Excavation and Backfill for Utilities, ASTM D 2321, and manufacturer's recommendations.

C. Water service pipe 12 inches in diameter and smaller: Installed to clear utility lines and have minimum 4 feet of cover below lowest property line grade of street, unless otherwise required by Drawings.

D. For water service, exclude use of PVC within 200 feet (along the public right-of-way) of underground storage tanks or in undeveloped commercial acreage. Underground storage tanks are primarily located on service stations but can exist at other commercial establishments.

END OF SECTION

SECTION 02622

HDPE PIPE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Furnish labor, materials, equipment and incidentals necessary to install polyethylene pipe, and complete installation in accordance with the Contract Documents. The finished pipe shall be continuous over the entire length of the sewer between manholes and be free from defects.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 QUALITY CONTROL

A. Polyethylene pipe jointing shall be performed by personnel trained in the use of the thermal butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall have received training in the proper methods for handling and installing the polyethylene pipe. Training shall be performed by a qualified representative of the pipe manufacturer. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Shop Drawings, catalog data, and manufacturer's technical data showing complete information on material composition, color, physical properties, and dimensions of new pipe and fittings. Include manufacturer's recommendation for handling, storage, and repair of pipe and fittings.

1.05 STANDARDS

A. Comply with local governing regulations if more stringent than specified herein. Piping shall meet the following standards and shall be a part of this Section as if written here in their entirety.

1. American Society for Testing and Materials (ASTM) Standards:

a. ASTM F1473 – Test method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipe and Resins

b. ASTM D2122 – Determining Dimensions of Thermoplastic Pipe and Fittings

c. ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

d. ASTM D2837 – Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

e. ASTM D3035 – Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter (up to 3-Inch IPS)

f. ASTM D3350 – Specification for Polyethylene Plastics Pipe and Fitting Material

g. ASTM F714 – Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter (4-Inch IPS and larger)

2. American Water Works Association (AWWA) Standards:

a. AWWA C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 through 64 Inches, for Water Distribution

b. AWWA M55 – Polyethylene (PE) Pipe Design and Installation

B. Domestic water piping shall be approved by the Underwriters Laboratory and shall be accepted by the State Fire Insurance Commission for use in water distribution systems. HDPE water pipe shall bear the seal of approval (or “NSF" mark) of the National Sanitation Foundation Testing laboratory for potable water pipe.

1.06 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

A. Transport, handle, and store pipe and fittings as recommended by manufacturer.

B. If new pipe and fittings become damaged before or during installation, it shall be repaired as recommended by the manufacturer or replaced as required by the Owner's Project Representative at the Contractor's expense, before proceeding further.

C. Deliver, store, and handle other materials as required to prevent further damage.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Pipe: Polyethylene Plastic Pipe shall be high density polyethylene pipe (HDPE).

1. Appropriate for use as a gravity sanitary sewer and meet the applicable requirements of ASTM F714 “Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter", ASTM D3350, Ductile Iron Pipe Sizing.

2. Solid wall high density polyethylene for pressure water pipe shall meet the requirements of AWWA C906 "Polyethylene (PE) Pressure Pipe and Fittings, 4 through 64 Inches, for Water Distribution" (Ductile Iron Pipe Sizing).

B. All pipe shall be made of virgin material. No rework except that obtained from the manufacturer's own production of the same formulation shall be used.

1. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

2. Dimension Ratios: The minimum wall thickness of the polyethylene pipe shall meet the following:

a. Pressure Applications: AWWA C906 DR-13.5 Pressure Class 128 psi, DR-11 Pressure Class 160, DR-9 Pressure Class 200- DR-7.3 Pressure Class 254.

3. All HDPE shall be carbon black or solid gray stabilized throughout the structural wall for ultra-violet protection. The pipe shall have a near white inside diameter to facilitate future TV inspection.

C. Polyethylene Fittings: The polyethylene fittings shall be manufactured from a polyethylene compound which conforms to ASTM D3350 cell class PE445574C or E material. Fittings shall be manufactured by the same manufacturer as the pipe.

1. Pipe fittings shall have a long-term hydrostatic strength rating of 1600 psi or more at 23 degrees Celsius, in accordance with ASTM D2837.

2. Environmental stress crack resistance (ESCR) of the material shall meet the requirements as specified in ASTM 03350 Cell Classification of 7 for a 500-hour PENT material using ASTM F1473 (PENT).

D. Select Material: Selected or processed excavated trench material shall be Class 10 Aggregate Fill in accordance with Section 2227 – Excavation and Backfill for Utilities.

2.02 MATERIALS TEST

A. Tests for compliance with this Section shall be made as specified herein and in accordance with the applicable ASTM Specification. A certificate of compliance with ISO 9000 shall be furnished, by the manufacturer for all material furnished under this Section. Polyethylene plastic pipe and fittings may be rejected for failure to meet any of the requirements of this Section.

PART 3 E X E C U T I O N

3.01 HANDLING

A. The joints shall be handled near the middle with wide web slings and spreader bars. Rope slings also work well with straight lengths. The use of chains, end hooks or cable slings that may scar the pipe are not permitted. The following procedures shall be observed when handling HDPE pipe.

1. Always stack the heaviest series of pipe at the bottom.

2. Protect the pipe from sharp edges when overhanging the bed of a truck or trailer by placing a smooth, rounded protecting strip on the edge of the bed.

3. The load should be anchored securely to prevent slippage.

B. Lengths of small-diameter, lightweight pipe can be unloaded manually.

C. Pipe applications shall normally be handled by:

1. Unloading the pipe from the truck in a row along the side of the installation area and moving the fusion unit along the row of joints.

2. Stacking the pipe beside the fusion unit and trailing the pipe out after fusion, then dragging the long length of pipe into place for installation. It is suggested that as the pipe is fused and moved through the fusion machine, additional joints of pipe should be placed in the moveable jaw side of the machine for each subsequent fusion. This prevents the hydraulic system of the machine from having to pull the previously fused long length.

D. Dragging the pipe into place is permitted provided the pipe isn't damaged from sharp rocks or excessive abrasion created by pulling the pipe great distances.

3.02 STORAGE

A. If the pipe must be stacked for storage, avoid excessive stacking heights. Out-of-roundness can be created in the lower rows of pipe, due to excessive stacking heights. The limitation on storage height is 8 rows for pipe 6 inches or less, 3 rows for pipe 8 inches or less, 2 rows for pipe 32 inches or less and 1 row for pipe 63 inches or less.

B. Care shall be taken to ensure that the pipe is stacked in straight rows. The expansion and contraction caused by uneven heating by the sunlight shall be prevented by restraining the racks.

C. Pipe laid directly on the ground shall be placed on an area free of loose stones or sharp objects. Scarring or gouging of the pipe shall be avoided.

3.03 PIPE JOINING

A. The polyethylene pipe shall be assembled and joined at the Site using the thermal butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted. All equipment and procedures used shall be in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.

B. The butt-fused joint shall be in true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. When cool, all weld beads shall then be removed from both the inside and outside surface such that the joint surfaces shall be smooth. The fused joint shall be watertight and shall have a tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Owner's Project Representative. All defective joints shall be cut out and replaced at no cost to the Owner. Any section of the pipe with a gash, blister, abrasion, nick, scar or other deleterious fault greater in depth than 10 percent of the wall thickness, shall not be used and must be removed from the Site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Owner's Project Representative shall be discarded and not used.

<u>Note to Specifier: Removal of weld beads is often protested by the Contractor but many Owners require it. Discuss with Owner prior to construction.</u>

3.04 BENDING PIPE

A. HDPE may be cold-bent to a minimum radius of 40 times the pipe diameter as it is installed, eliminating the need in many cases for elbows for slight bends. The minimum bending radius that can be applied to the pipe without kinking varies with the diameter and wall thickness of the pipe. Contractor shall conform to manufacturer's recommendations. If adequate space is not available for the required radius, a fitting of the desired angle shall be fused into the piping system to obtain the necessary change in direction.

3.05 INSTALLATION BELOW GROUND

A. Pipe Laying:

1. When pulling pipe, either a pulling head or a suitable wraparound sleeve with rubber protective cover shall be used to prevent the pulling cables from damaging the pipe. The pipe shall not be pulled by the flanged end.

2. Open cut installations shall be in accordance with Section 2227 – Excavation and Backfill for Utilities.

B. Grouting (Continuous or at Manholes): Pipe running through a manhole wall shall be anchored by attaching a collar or side fused branch saddles to the pipe and encasing them in the wall of the manhole.

3.06 FIELD QUALITY CONTROL

A. Testing shall be as specified in Section 02676 – Hydrostatic Testing of Pipelines.

B. Hydrostatic Testing for pressure piping systems shall be performed in accordance with ASTM F2164. Testing pressure shall not exceed 1.5 times the system design pressure and total testing time including the time required to pressurize, stabilize, hold test pressure, and depressurize should not exceed 8 hours. If 5 psi is lost during testing pipeline must be re-pressurized.

C. HDPE pipe deflection shall not exceed deflection percentages identified in ASTM F1962 or manufacturer's maximum allowable deflection, whichever is lower. Allowable pipe deflection varies based on DR rating. The following maximum deflection percentages can be used for the following OR ratings: DR21-7.5 percent, DR17 -6.0 percent, DR15.5-6.0 percent, DR13 .5 - 6.0 percent, DR11 - 5.0 percent, DR9 - 4.0 percent, DR7 .3 - 3.0 percent. Deflection measurements can be taken by mandrel or by measurement of inside diameter before and after backfill operations.

D. Do not enclose or cover any Work until inspected.

3.07 CLEAN AND ADJUST

A. Remove surplus pipeline materials, tools, rubbish and temporary structures and leave the construction site clean, to the satisfaction of the Owner's Project Representative.

END OF SECTION

SECTION 02626

TAPPING SLEEVES AND VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Tapping sleeves and valves for connections to existing water system.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submit product data in accordance with requirements of Section 01300 - Submittals.

1.04 QUALITY CONTROL

A. Provide manufacturer's affidavit that all valves purchased for tapping of existing waterlines conform to Section 02640 - Gate Valves and to applicable requirements of AWWA C500 and that they have been satisfactorily tested in accordance with AWWA C500.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Tapping Sleeves:

1. Tapping Sleeve Bodies: AWWA C110 cast or ductile iron; AWWA C200 carbon steel; in two sections to be bolted together with high-strength, corrosion-resistant, low-alloy, steel bolts; mechanical joint ends.

2. Branch Outlet of Tapping Sleeve: Flanged; machined recess; AWWA C207, Class D, ANSI 150 pound drilling. Gasket: Affixed around recess of tap opening to preclude rolling or binding during installation.

B. Welded-steel tapping-sleeve bodies may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions.

1. Flange: AWWA C207, Class D, ANSI 150 pound drilling. Gasket: Affixed around recess of tap opening to preclude rolling or binding during installation.

2. Steel sleeves are restricted to use on pipe sizes 6-inch and larger.

3. Body: Heavy, welded-steel construction; top half grooved to retain neoprene O-ring seal permanently against O.D. of pipe.

4. Bolts: AWWA C500 Section 3.5; coated with 100 percent vinyl resin or corrosive resistant material.

5. Steel Sleeves: Fusion-bonded epoxy coated to minimum 12-mil thickness. Finished epoxy coat: Free of laminations and blister; not peel; and remain pliant and resistant to impact. Ship steel sleeves in wooden crates that provide protection from damage to epoxy coating during transport and storage.

6. Acceptable steel tapping sleeve manufacturers are JCM and Rockwell, or approved equal.

7. Tapping Sleeves: Provide with 3/4-inch NPT test opening for testing prior to tapping. Provide 3/4-inch bronze plug for opening.

8. Do not use steel sleeves for taps greater than 75 percent of pipe diameter.

9. Comply with AWWA C223 - Fabricated Steel and Stainless Steel Tapping Sleeves.

C. Tapping Valves: Meet all requirements of Section 02640 - Gate Valves with following exceptions:

1. Inlet Flanges:

a. AWWA C110; Class 125.

b. AWWA C110; Class 150 and higher: Minimum eight hole flange.

2. Outlet: Standard mechanical joint; to fit any standard tapping machine.

3. Valve Seat Opening: Accommodate full-size shell cutter for nominal size tap without any contact with valve body.

D. Valve Boxes: Furnish and install according to Section 02604 - Valve Boxes, Meter Boxes, and Meter Vaults.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Install tapping sleeves and valves at locations and of sizes as shown on Drawings.

B. Thoroughly clean tapping sleeve, tapping valve and pipe prior to installation and in accordance with manufacturer's instructions.

C. Hydrostatically test installed tapping sleeve to 150 psig for a minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.

D. When tapping concrete pressure pipe, size on size, use shell cutter one standard size smaller than waterline being tapped.

E. Do not use Large End Bell (LEB) increasers with a next size tap unless existing pipe is asbestos-cement.

3.02 INSTALLATION

A. Tighten bolts in proper sequence so that undue stress is not placed on pipe.

B. Align tapping valve properly and attach it to tapping sleeve.

C. Make tap with sharp, shell cutter:

1. For 12-inch and smaller tap, use minimum cutter diameter one-half inch less than nominal tap size.

2. For 16-inch and larger tap, use manufacturer's recommended cutter diameter.

D. Withdraw coupon and flush all cuttings from newly made tap.

E. Wrap completed tapping sleeve and valve in accordance with Section 02664 - Water Mains.

F. Place concrete thrust block behind tapping sleeve (NOT over tapping sleeve and valve).

G. Request inspection of installation prior to backfilling.

H. Backfill in accordance with Section 02227 - Excavation and Backfill for Utilities.

END OF SECTION

SECTION 02627

WATER METERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Water meters, submeters, and fire service meters.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

PART 2 P R O D U C T S

2.01 GENERAL

A. Water meters shall be furnished by the Owner.

2.02 CONNECTIONS AND FITTINGS

A. Connections: Provide pipe in accordance with Section 02610 and Section 02620. Use restrained joints and flanged joints only.

B. Fittings:

1. For meters 2 inches and smaller: Same type of fittings as Outlet End fittings for Curb Stop in accordance with Section 02665.

2. For meters 3 inches and larger: Restrained ductile iron; push-on bell joints or mechanical joint fittings between water line and meter vault; Class 125 flanged inside meter vaults; cement mortar lined and sealed.

2.03 LAYING LENGTHS

A. The minimum length (with 1 inch tolerance) for meter and standard strainer shall be shown as indicated on the detail drawing for water meters.

PART 3 E X E C U T I O N

3.01 TAPPING AND SERVICE LINE INSTALLATION

A. Refer to Section 02626 for tapping requirements.

B. Meter Service Line:

1. Use pipe and fittings conforming to requirements of Section 02610 - Ductile Iron Pipe and Fittings, or Section 02620 - PVC Pipe.

2. Limit pulling and deflecting of joints to limits recommended by manufacturer.

3. Make vertical adjustments with offset bends where room will permit. Minimize number of bends.

4. Provide minimum of ten pipe diameters of straight pipe length upstream and downstream of meter vault.

3.02 METER FITTING HOOKUP

A. Support meter piping and meter, level and plumb meter during and after installation. Meters 3 inches and larger support at a minimum two locations with concrete.

B. Use round flanged fittings inside meter box or vault except for mechanical joint to flange adapter. Provide full-face 1/8-inch black neoprene or red rubber gasket material on flanged joints. Provide bolts and nuts made from approved corrosion-resistant material.

C. Tighten all bolts in proper sequence and to correct torque.

D. Visually check for leaks under normal operating pressure following installation. Repair or replace any leaking components.

END OF SECTION

SECTION 02629

POLYURETHANE COATINGS ON STEEL OR DUCTILE IRON PIPE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Two-component polyurethane coating system for use as an internal or external coating for steel or ductile iron pipe.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this section. Include cost of polyurethane coatings in contract unit prices for steel pipe or ductile iron pipe.

1.03 SAFETY

A. Secure, from manufacturer, Material Safety Data Sheet (MSDS) for polyurethane coatings and repair materials listed in this section.

B. Safety requirements stated in this specification and in related sections apply in addition to applicable federal, state and local rules and regulations. Comply with instructions of coating manufacturer and requirements of insurance underwriters.

C. Adhere to handling and application practices of SSPC-PA Guide 3; SSPC-PS Guide 17.00; Coating Manufacturer's Material Safety Data Sheet.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals

B. Submit coating manufacturer's catalog sheets and technical information for approval, prior to delivery of pipe.

C. Obtain from coating manufacturer and furnish to Engineer, a coating "affidavit of compliance" to requirements of this section stating that coatings were applied in factory and in accordance with manufacturer's minimum requirements.

PART 2 P R O D U C T S

2.01 COATING MATERIAL

A. Coating Standard: ASTM D16.

B. Coating System: Use a Coating Standard ASTM D16 Type, V system which is a 2-package polyisocyanate, polyol-cured urethane coating. The components are mixed in 1:1 ratio at time of application. The components are balanced viscosities in their liquid state and do not require agitation during use.

C. Exterior Coating Material: CORROPIPE II-TX and Joint Coating Material CORROPIPE II-PW, as manufactured by Madison Chemical Industries, Inc., 5673 Old Dixie Road, Forest Park, Georgia 30050, or approved equal.

D. Internal Coating Material: Exterior Coating Material, CORROPIPE II-TX and Joint Coating Material CORROPIPE II-PW, as manufactured by Madison Chemical Industries, Inc., 5673 Old Dixie Road, Forest Park, Georgia 30050, or approved equal.

E. Cured Coating Properties:

1. Conversion to Solids by Volume: 97 percent plus or minus 3 percent.

2. Temperature Resistance: Minus 40 degrees F and plus 130 degrees F.

3. Minimum Adhesion: 500 psi, when applied without primer to ductile iron pipe which has been blasted to comply with SSPC-SP10.

4. Cure Time: For handling in 1 minute at 120 degrees F, and full cure within 7 days at 70 degrees F.

5. Maximum Specific Gravities: Polyisocyanate resin, 1.20. Polyol resin, 1.15.

6. Minimum Impact Resistance: 80 inch-pounds using 1-inch diameter steel ball where coating is applied at 30 mils to ductile iron pipe surface which has been blasted to SSPC No. 10 finish.

7. Minimum Tensile Strength: 2000 psi.

8. Hardness: 55 plus or minus 5 Shore D at 70 degrees F.

9. Flexibility Resistance: ASTM D1737 using 1-inch mandrel. Allow coating to cure for 7 days. Perform testing on test coupons held for 15 minutes at temperature extremes specified in Paragraph 2.01E.

2.02 REPAIR AND/OR TOUCHUP MATERIAL

A. CORROPIPE II PW - TOUCHUP (two-component, brush applied); mix in accordance with coating manufacturer's recommendations.

2.03 PACKAGING AND LABELING

A. Containers: Standard containers to prevent gelling, thickening deleteriously or forming of gas in closed containers within period of one year from date of manufacture.

B. Labeling: Label each container of separately packaged component clearly and durably to indicate date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name or formula specification number of coating together with special instructions. Do not use coating components older than one year.

2.04 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver coating materials to pipe manufacturer in sealed containers showing designated name, batch number, color, date of manufacture and name of coating manufacturer.

B. Storage: Store material on site in enclosures, out of direct sunlight in warm, ventilated and dry area.

C. Protection: Prevent puncture, inappropriate opening or other action which may lead to product contamination.

PART 3 E X E C U T I O N

3.01 SURFACE PREPARATION

A. Remove deposits of oil, grease or other organic contaminates before blast cleaning by using solvent wash as specified in SSPC-SP1. Clean and dry surfaces making them completely dry, free of moisture, dust, grit, oil, grease or any other deleterious substances prior to application of coating.

B. Exterior and Interior Surfaces: SSPC-SP10; near-white metal blast cleaning. The blasting shall be done with clean, hard, sharp cutting abrasives with no steel or cast iron shot in the mix.

C. Ductile Iron Pipe: Prior to the start of production blasting, the Contractor shall prepare specimens for a white metal blast and a near-white metal blast using the equipment and abrasives proposed for the work. During preparation of the specimens, the blasting intensity and abrasive shall be changed as necessary to provide the degree of cleaning required by SSPC-SP10, except that the color of the blasted substrate is not expected to match the color of blasted steel. After examination and concurrence by the Engineer, the production blasting may begin. The production blasting shall be monitored and controlled by the Contractor so that production pipe surfaces match the surface of the approved blasting specimens.

3.02 THICKNESS

A. External Coatings: Minimum DFT of 25 mils (0.025 inch).

B. Internal Coatings: Minimum DFT of 35 mils.

C. Thickness Determinations: Use Type 1 magnetic thickness gage as described in SSPC-PA2 specification. Individual readings below 90 percent of specified minimum are not acceptable. Average individual spot readings (consisting of three point measurements within 3 inches of each other) less than 95 percent of minimum are not acceptable. Average of all spot readings less than minimum thickness specified are not acceptable.

3.03 FACTORY APPLICATION OF POLYURETHANE COATING

A. Equipment: Two-component, 1:1 mix ratio, heated airless spray unit.

B. Temperature: Minimum 5 degrees F above dew point temperature. The temperature of the surface shall not be less than 60 degrees F during application.

C. Humidity: Heating of pipe surfaces may be required to meet requirements of 2.01E if relative humidity exceeds 80 percent.

D. Do not thin or mix resins; use as received. Store resins at a temperature above 55 degrees F at all times.

E. Application: Conform to coating manufacturer's recommendations. Apply directly to substrate to achieve specified thickness. Multiple-pass, one-coat application process is permitted provided maximum allowable recoat time specified by coating manufacturer is not exceeded.

F. Recoating: Recoat only when coating has cured less than maximum time specified by coating manufacturer. When coating has cured for more than recoat time, brush-blast or thoroughly sand coating surface. Blow-off cleaning using clean, dry, high-pressure compressed air.

G. Curing: At ambient temperature above 0 degrees F. Do not handle pipe until coating has been allowed to cure as follows:

Ambient Temperature	Minimum Full Cure Time
Over 70˚F	7 days
50 to 70˚F	9 days
0 to 50˚F	12 days

3.04 JOINTS

A. Apply coating to unlined pipe surfaces including inside of bell socket and outside of spigot.

B. Joint Coating Materials: CORROPIPE II PW (instant-set, two-component material, plural component spray applied), or CORROPIPE II PW -TOUCHUP (two-component, brush applied).

C. Coating thickness on sealing areas of spigot end of pipe exterior: Minimum 8 mils (0.008 inch), maximum of 10 mils (0.010 inch). Maximum 10 mils may be exceeded in spigot end provided maximum spigot diameter as specified by pipe manufacturer is not exceeded.

3.05 INSPECTION

A. Engineer may inspect coatings at coating applicator's facilities.

B. Holiday Inspection: AWWA C210, Section 5.3.3.1. Follow coating manufacturer's recommendation. Conduct inspection any time after coating has reached initial cure. Repair in accordance with paragraph 3.07, Repair and Field Touchup.

3.06 PIPE INSTALLATION

A. For wastewater projects, provide services of manufacturer's representative for period of not less than 2 weeks at beginning of actual pipe laying operations to advise Contractor regarding installation including but not limited to handling and storing, cleaning and inspecting, coatings repairs, and general construction methods as to how they may affect pipe coatings.

B. Handling, Shipment, and Storage: Nylon straps, padded lifts and padded storage skids are required. Field cuts should be kept to minimum. Repair damage to coating due to handling or construction practices at no additional cost to. See Section 02610 - Ductile Iron Pipe and Fittings and Section 02611 - Steel Pipe and Fittings for additional requirements.

C. Just before each section of pipe is to be placed into the trench, conduct a visual and holiday inspection. Defects in the coating system shall be repaired before the pipe is installed.

3.07 REPAIR AND FIELD TOUCHUP

A. Apply repair/touchup materials in conformance with factory application of polyurethane coating requirements specified in this section, excluding equipment requirements.

B. Repair Procedure - Holidays:

1. Remove all traces of oil, grease, dust, dirt, etc.

2. Roughen area to be patched by sanding with rough grade sandpaper (40 grit).

3. Apply one coat of repair material described above. Work repair material into scratched surface by brushing.

C. Repair Procedure - Field Cuts or Large Damage:

1. Remove burrs from field cut ends or handling damage and smooth out edge of polyurethane coating.

2. Remove all traces of oil, grease, dust, dirt, etc.

3. Roughen area to be patched with rough grade sandpaper (40 grit). Feather edges and include overlap of 1 inch to 2 inches of roughened polyurethane in area to be patched.

4. Apply thick coat of repair material described above. Work repair material into scratched surface by brushing. Feather edges of repair material into prepared surface. Cover at least 1 inch of roughened area surrounding damage, or adjacent to field cut.

D. For Wastewater Projects; Repair Procedure - Thermite Brazed Connection Bonds:

1. Remove polyurethane coating from area on metal surface which is to receive thermite brazed connection with power wire brush.

2. Grind metal surface to shiny metal with power grinder and coarse grit grinding wheel.

3. Apply thermite brazed connection using equipment, charge and procedure recommended by manufacturer of thermite equipment.

4. After welded surface has cooled to temperature below 130 F, apply protective coating repair material to weld, exposed pipe surface and damaged areas of polyurethane coating.

5. Do not cover or backfill freshly repaired areas of coating at thermite brazed connection until repair material has completely cured. Allow material to cure in conformance with manufacturer's recommendations.

END OF SECTION

SECTION 02630

POLYETHYLENE WRAP

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Polyethylene wrap for cast and ductile iron pipe to be used only in open-cut construction when cathodic protection system is not required by Drawings.

1.02 UNIT PRICES

A. No separate payment will be made for polyethylene wrap. Include cost of polyethylene wrap in unit price for items wrapped.

1.03 SUBMITTALS

A. Submit product data in accordance with Section 01300 - Submittals.

B. Submit product data for proposed film and tape for approval.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Polyethylene Film: Tubular or sheet form without tears, breaks, holidays or defects; conforming with requirements of AWWA C 105, 2.5 to 3 percent carbon black content, either low- or high-density:

1. Low-density polyethylene film. Low-density polyethylene film shall be manufactured of virgin polyethylene material conforming to the following requirements of ASTM D 1248.

a. Raw material.

(1) Type : I

(2) Class: C (black)

(3) Grade: E-5

(4) Flow rate (formerly melt index): 0.4 g/10 minute, maximum

(5) Dielectric strength: Volume resistivity, 10^{15} ohm-cm, minimum

b. Physical properties.

(1) Tensile strength: 1200 psi, minimum

(2) Elongation: 300 percent, minimum

(3) Dielectric strength: 800 V/mil thickness, minimum

c. Thickness: Low-density polyethylene film shall have a nominal thickness of 0.008 inch. The minus tolerance on thickness is 10 percent of the nominal thickness.

2. High-density, cross-laminated polyethylene film: High-density, cross laminated polyethylene film shall be manufactured of virgin polyethylene material conforming to the following requirements of ASTM D 1248
   a. Raw material.
      (1) Type: III
      (2) Class: C (black)
      (3) Grade: P33
      (4) Flow rate (formerly melt index): 0.4 to 0.5g/10 minute, maximum
      (5) Dielectric strength: Volume resistivity, 10^{15} ohm-cm, minimum
   b. Physical properties.
      (1) Tensile strength: 5000 psi, minimum
      (2) Elongation: 100 percent, minimum
      (3) Dielectric strength: 800 V/mil thickness, minimum
   c. Thickness: Film shall have a nominal thickness of 0.004 inch. The minus tolerance of thickness is 10 percent of the nominal thickness.

B. Polyethylene Tape: Provide 3-inch wide, plastic-backed, adhesive tape; Polyken No. 900, Scotchwrap No. 50, or equal.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Preparation:
   1. Remove all lumps of clay, mud, cinders, etc., on pipe surface prior to installation of polyethylene encasement. Prevent soil or embedment material from becoming trapped between pipe and polyethylene.
   2. Fit polyethylene film to contour of pipe to effect a snug fit, but not tight; encase with minimum space between polyethylene and pipe. Provide sufficient slack in contouring to prevent stretching polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints or fittings, and to prevent damage to polyethylene due to backfilling operations. Secure overlaps and ends with adhesive tape to hold polyethylene encasement in place until backfilling operations are complete.
   3. For installations below water table and/or in areas subject to tidal actions, seal both ends of polyethylene tube with adhesive tape at joint overlap.

B. Tubular Type (Method A):
   1. Cut polyethylene tube to length approximately 2 feet longer than pipe section. Slip tube around pipe, centering it to provide 1-foot overlap on each adjacent pipe section, and bunching it accordion-fashion lengthwise until it clears pipe ends.
   2. Lower pipe into trench and make up pipe joint with preceding section of pipe. Make shallow bell hole at joints to facilitate installation of polyethylene tube.
   3. After assembling pipe joint, make overlap of polyethylene tube. Pull bunched polyethylene from preceding length of pipe, slip it over end of new length of pipe, and secure in place. Then slip end of polyethylene from new pipe section

over end of first wrap until it overlaps joint at end of preceding length of pipe. Secure overlap in place. Take up slack width at top of pipe to make a snug, but not tight, fit along barrel of pipe, securing fold at quarter points.

4. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

C. Tubular Type (Method B):

1. Cut polyethylene tube to length approximately 1 foot shorter than pipe section. Slip tube around pipe, centering it to provide 6 inches of bare pipe at each end. Take up slack width at top of pipe to make a snug, but not tight, fit along barrel of pipe, securing fold at quarter points; secure ends.
2. Before making up joint, slip 3-foot length of polyethylene tube over end of preceding pipe section, bunching it accordion-fashion lengthwise. After completing joint, pull 3-foot length of polyethylene over joint, overlapping polyethylene previously installed on each adjacent section of pipe by at least 1 foot; make each end snug and secure.
3. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

D. Sheet Type:

1. Cut polyethylene sheet to a length approximately 2 feet longer than pipe section. Center length to provide 1-foot overlap on each adjacent pipe section, bunching it until it clears pipe ends. Wrap polyethylene around pipe so that it circumferentially overlaps top quadrant of pipe. Secure cut edge of polyethylene sheet at intervals of approximately 3 feet.
2. Lower wrapped pipe into trench and make up pipe joint with preceding section of pipe. Make shallow bell hole at joints to facilitate installation of polyethylene. After completing joint, make overlap and secure ends.
3. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

E. Pipe-shaped Appurtenances: Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in same manner as pipe.

F. Odd-shaped Appurtenances: When it is not practical to wrap valves, tees, crosses, and other odd-shaped pieces in tube, wrap with flat sheet or split length of polyethylene tube by passing sheet under appurtenance and bringing it up around body. Make seams by bringing edges together, folding over twice, and taping down. Tape polyethylene securely in place at valve stem and other penetrations.

G. Repairs: Repair any cuts, tears, punctures, or damage to polyethylene with adhesive tape or with short length of polyethylene sheet or cut open tube, wrapped around pipe to cover damaged area, and secured in place.

H. Openings in Encasement: Provide openings for branches, service taps, blowoffs, air valves, and similar appurtenances by making an X-shaped cut in polyethylene and

temporarily folding back film. After appurtenance is installed, tape slack securely to appurtenance and repair cut, as well as other damaged area in polyethylene, with tape. Service taps may also be made directly through polyethylene, with any resulting damaged areas being repaired as described above.

I. Junctions between Wrapped and Unwrapped Pipe: Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend polyethylene wrap to cover adjacent pipe for distance of at least 3 feet. Secure end with circumferential turns of tape. Wrap service lines of dissimilar metals with polyethylene or suitable dielectric tape for minimum clear distance of 3 feet away from cast or ductile iron pipe.

END OF SECTION

SECTION 02640

GATE VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Furnishing and installing gate valves and boxes.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's product data for proposed valves for approval.

1.04 QUALITY CONTROL

A. Provide manufacturer's affidavit that all gate valves have been satisfactorily tested in the United States in accordance with AWWA C500, C509, and C515.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Gate Valves: AWWA C500, C509, C515 and additional requirements of this Section; direct bury and in subsurface vaults open counterclockwise.

B. If type of valve is not indicated on Drawings, gate valves shall be used as line valves for sizes less than 16-inches. When type of valve is specified, no substitute will be allowed.

C. Gate Valves 1-1/2-inches in diameter and smaller: 125 psig; bronze; non-rising-stem; single-wedge; disc type; screwed ends; Nibco T-133, or equal.

D. Coatings for Gate Valves 2-inches and larger: AWWA C550; Indurall 3300 or approved equal; non-toxic; not impart taste to water; function as physical, chemical, and electrical barrier between base metal and surroundings; minimum 8-mil-thick; fusion-bonded epoxy; prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.

E. Gate Valves 2-inches and 2-1/2-inches in diameter: Iron body; double disk gate; non-rising stem; 200-pound test; 2-inch square nut, Mueller, American Darling or approved equal, operating counterclockwise to open (open left).

F. Gate Valves 4-inches to 12-inches in diameter: Non-directional; resilient wedge gate valves (AWWA C509 or C515); 200 psig; bronze mounting; mechanical joint and nut operated unless otherwise specified; Mueller or American Darling resilient wedge valve or approved equal; and comply with following:

1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.

2. Body: Cast or ductile iron; flange bonnet and stuffing box together with ASTM A307 Grade B bolts. Cast in body manufacturer's initials, pressure rating, and year manufactured.

3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.

4. Stems: ASTM B763 bronze, alloy number 995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12%; non-rising.

5. "O" Rings: AWWA C509, Sections 2.2.6 and 4.8.2 or AWWA C515, Section 4.2.2.5.

6. Stem Seals: Consist of three "O" rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.

7. Stem Nut: Independent or integrally cast of ASTM B62 bronze.

8. Resilient Wedge: Molded; synthetic rubber; vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D429 Method B; seat against epoxy-coated surface in valve body.

9. Bolts: AWWA C509, Section 4.4 or AWWA C515, Section 4.4.4; stainless steel; cadmium plated, or zinc coated.

G. Gate Valves 14-inches to 24-inches in diameter: Non-directional; resilient wedge gate valves (AWWA C515); 250 psig; bronze mounting; mechanical joint and nut operated unless otherwise specified; Mueller or American Darling resilient wedge valve or approved equal; and comply with following:

1. Body: Ductile iron; flange together bonnet and stuffing box with ASTM A307 Grade B bolts. Cast in body manufacturer's initials, pressure rating, and year manufactured.

2. Stems: ASTM B763 bronze, alloy number 995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12%; non-rising.

3. Stem Seals: Consist of three "O" rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.

4. "O" Rings: AWWA C515, Section 4.2.2.5.

5. Stem Nut: Independent or integrally cast of ASTM B62 bronze.

6. Resilient Wedge: Molded; synthetic rubber; vulcanized and bonded to ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D429 Method B; seat against epoxy-coated surface in valve body.

7. Bolts: AWWA C515, Section 4.4.4; stainless steel; cadmium plated, or zinc coated.

H. Gate Valves 20-inches and larger: Furnish and equip with bypass valves.

1. Sizes: Provide 3-inch bypass valves for 20-inch gate valves. Provide 4-inch bypass valves for 24-inch gate valves.

I. Valves 4-inches through 12-inches for Installation in Vertical Pipe Lines: Double disc, square bottom.

J. Valves 14-inches and Larger for Installation in Horizontal Pipe Lines: Equipped with bronze shoes and slides.

K. Gate Valves Installed at Greater than 4-foot Depth: Provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade.

L. Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.

M. Provide flanged joints when valve is connected to steel.

PART 3 E X E C U T I O N

3.01 EARTHWORK

A. Conform to applicable provisions of Section 02227 - Excavation and Backfilling for Utilities.

3.02 SETTING VALVES AND VALVE BOXES

A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that all parts are in satisfactory working condition.

B. Install valves and valve boxes where shown on Drawings or as located by the Engineer. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth

around each valve box for minimum radius of 4 feet, or to undisturbed trench face if less than 4 feet. Install valves completely closed when placed in water line.

C. For pipe section of each valve box riser, provide 6-inch PVC, Class 150, DR 18, riser pipe, unless noted as ductile iron pipe on the project details, pipe cut to proper length. Riser must be installed to allow complete access for future operation of valve. Assemble and brace box in vertical position as indicated on drawings.

3.03 DISINFECTION AND TESTING

A. Disinfect valves and appurtenances as required by Section 02675 - Disinfection of Water Lines.

3.04 PAINTING OF VALVES

A. Paint valves in vaults, stations and aboveground using ACRO Paint No. 2215 or approved equal, unless otherwise directed.

3.05 OPERATION

A Once the water valve is in operation the City must be contacted in order to operate the valve. Only personnel designated by the City shall operate water valves once they are placed in service.

END OF SECTION

SECTION 02642

AIR RELEASE AND VACUUM RELIEF VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Air release and vacuum relief valves.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's product data for proposed valves for approval.

1.04 QUALITY CONTROL

A. Provide manufacturer's affidavit that air release and vacuum relief valves purchased for Work conform to applicable requirements of this Section.

PART 2 P R O D U C T S

2.01 GENERAL

A. Combination air valve called for on Drawings means combination valve designed to fulfill functions of air release (permit escape of air accumulated in line at high point of elevation while line is under pressure) and vacuum relief. Air release and vacuum relief valves 8 inches and smaller in diameter shall be self-contained in one unit.

2.02 MATERIALS

A. Air Release Valves for Potable Water Service: Apco No. 200, GA Industries Fig. 2-AR, or equal. Materials: body and cover, ASTM A48, Class 30, cast iron; float and leverage mechanism, ASTM A240 or A276 stainless steel; orifice and seat, stainless steel against Buna-N or Viton mechanically retained with hex head nut and bolt; other valve internals, stainless steel or bronze. Provide inlet and outlet connections, and orifice as shown on Drawings.

B. Combination Air Release and Vacuum Valves for Potable Water Service: Provide single-body, standard combination or duplex-body custom combination valves as indicated on Drawings.

1. For 2-inch and 3-inch, single-body valves, provide inlet and outlet sizes as shown on Drawings and orifice sized for 100 psi working pressure. Valve materials: body, cover and baffle, ASTM A48, Class 35, or ASTM A126, Grade B cast iron; plug or poppet, ASTM A276 stainless steel; float, ASTM A240 stainless steel; seat, Buna-N; other valve internals, stainless steel. Valve exterior: Painted with shop-applied primer suitable for contact with potable water. Provide Apco Model 145C or 147C, Val-Matic Series 200, or equal valves.

2. For 3-inch and larger duplex body valves as shown on Drawings, provide Apco Series 1700 with No. 200 air release valve, GA Industries Fig. No. AR/GH-21K/280, or equal. Air and vacuum valve materials: body and cover, ASTM A48, Class 35, cast iron; float, ASTM A240 stainless steel; seat, Type-304, stainless steel and Buna-N; other valve internals, stainless steel or bronze. Air release valve: Constructed as specified in paragraph above on Air Release Valves.

C. Vacuum Relief Valves for Potable Water Service: Provide air inlet vacuum relief valves with flanged inlet and outlet connections as shown on Drawings. Provide air release valves in combination with inlet and outlet, and orifice as shown on Drawings. Valve shall open under pressure differential not to exceed 0.25 psi. Provide Apco Series 1500 with a No. 200A air release valve, GA Industries Fig. No. HCARV, or equal. Materials for vacuum relief valves: valve body, ASTM A48, Class 35, cast iron; seat and plug, ASTM B584 bronze, copper alloy 836; spring, ASTM A313, Type-304, stainless steel; bushing, ASTM B584 bronze, copper alloy 932; retaining screws, ASTM A276, Type-304, stainless steel.

D. Air Release Valves for Wastewater Service: Valmatic Model VA-49ASV-M (SuperValve) or equal. Materials: body and cover, ASTM A126, Class B, cast iron (interior/exterior fusion bonded epoxy); float and leverage mechanism, ASTM A240 stainless steel T316; orifice and seat, stainless steel against Buna-N mechanically retained with hex head nut and bolt; other valve internals, stainless steel. Provide inlet and outlet connections, and orifice as shown on Drawings.

E. Combination Air Valves for Wastewater Service: Valmatic Model VM-801ASV-M (SuperValve) or equal. Materials: body and cover, ASTM A126, Class B, cast iron (interior/exterior fusion bonded epoxy); float and leverage mechanism, ASTM A240 stainless steel T316; orifice and seat, stainless steel against Buna-N mechanically retained with hex head nut and bolt; other valve internals, stainless steel. Provide inlet and outlet connections, and orifice as shown on Drawings.

F. Air Release Valve Vault or Manhole as detailed in Drawings.

PART 3 E X E C U T I O N

3.01 EARTHWORK

A. Conform to applicable provisions of Section 02227.

3.02 SETTING VALVES AND VALVE BOXES

A. Provide services of technical representative of valve manufacturer available on site during installation of valves.

B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that all parts are in satisfactory working condition.

C. Install valves and valve boxes where indicated on Drawings or as located by Engineer. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face if less than 4 feet. Provide above-ground vents for valve boxes as indicated on drawings.

3.03 DISINFECTION AND TESTING

A. Disinfect valves and appurtenances as required by Section 02675 and test as required by Section 02676.

3.04 PAINTING OF PIPING

A. Paint valves located in vaults, stations, and aboveground using ACRO Paint No. 2215 or approved equal, unless otherwise directed by Engineer.

END OF SECTION

SECTION 02645

FIRE HYDRANT ASSEMBLY

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Fire hydrants.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submit product data in accordance with Section 01300 - Submittals.

1. Control drawing(s) for proposed hydrant: Include model number, parts list, and material specifications, unique drawing number and descriptive legend identifying hydrant. Such drawing(s) should be same as approval drawing(s) on file with the Owner.

2. Material safety data sheets for lubricants.

3. Affidavit of compliance for coating materials.

4. Certified hydraulic performance test report for proposed hydrant.

PART 2 P R O D U C T S

2.01 HYDRANTS

A. Provide fire hydrants in conformance with AWWA C502, Standard for Dry Barrel Fire Hydrants, latest edition. Fire hydrants shall be Mueller Super Centurian 250, 3-way, Model A-423, 5-1/4 inch main valve opening with reversible main valve, 6 inch mechanical joint inlet.

B. Field Replaceable Nozzles: Provide two (2) 2-1/2 inch NST hose nozzles and one (1) 4 inch pumper nozzle, 4 threads per inch and 4.84 pitch diameter thread configuration.

C. Operating Nut and Hold-down Nuts: Operating nut shall be 1-1/2 inch pentagon and shall open counter-clockwise (left). Hold down nut shall be of bronze construction, octagon in shape and shall be able to be removed without the use of special tools or adapters.

D. Provide traffic model hydrants equipped with safety flange on hydrant barrel and stem. Equip body of hydrant with breakable flange, or breakable bolts, above finish grade.

E. Hydrant Painting: Shop coated as follows:

1. Exterior Above Traffic Flange (including bolts and nuts)

a. Surface Preparation: SSPC-SP10 (NACE 2); near white blast cleaned surface.

b. Coat with a three (3) coat alkyd/silicone alkyd system with a total dry film thickness (DFT) of 6 - 9 mils as follows:

(1). Prime Coat: Oil Modified Alkyd Primer to be in conformance with SSPC Paint Specification No. 25. Total dry film thickness (DFT): 2 - 3 mils.

(2). Intermediate Coat: Heavy Duty Industrial Alkyd Enamel to be in conformance with SSPC Paint Specification No. 104 and Federal Standard A-A-2962A. Total dry film thickness (DFT): 2 - 3 mils.

(3). Finish Coat: Silicone Alkyd Resin Enamel to be in conformance with SSPC Paint Specification No. 21. Total dry film thickness (DFT): 2 - 3 mils.

(4). Colors: Primer: Manufacturer's standard color. Finish coat of hydrant body: Blue (Acro 555 Crystal Blue or equivalent) unless the fire hydrant is at the dead end of the line which those will be solid red, including the bonnets. Intermediate coat: Contrasting color to blue finish, such as white.

(5). Bonnet and connection caps: Finish coat color to meet NFPA color codes. Paint white band of finish coat two inches in width on hydrant body approximately six inches above traffic flange and parallel thereto.

The National Fire Protection Association standard calls for bonnets and caps to be color-coded to indicate the hydrant's available flow at 20 p.s.i. Standard color codes are as follows:

NFPA 291, Chapter 5		
Class C	Less than 500 GPM	Red
Class B	500-999 GPM	Orange
Class A	1,000-1,499 GPM	Green
Class AA	1,500 GPM & above	Light Blue

2. Exterior Below Traffic Flange:

   a. Surface Preparation: SSPC-SP10 (NACE 2); near white blast cleaned surface.

   b. Coat with a three (3) coat system as follows:

      (1). Primer and Intermediate Coat: Coal tar epoxy to be in conformance with SSPC Paint Specification No. 16. Apply two (2) coats with a dry film thickness (DFT) of 8 - 10 mils each for a total dry film thickness (DFT) of 16 - 20 mils.

      (2). Finish Coat: Water based vinyl acrylic mastic. Apply one (1) coat with a dry film thickness (DFT) of 6 - 8 mils. Finish coat color to be same as finish coat for exterior above traffic flange, i.e. blue (Acro 555 Crystal Blue or equivalent).

3. Interior Surfaces Above and Below Main Valve:

   a. All materials used for internal coating of hydrant interior ferrous surfaces must conform to ANSI/NSF Standard 61-G as suitable for contact with potable water as required by Chapter 290, Rules and Regulations for Public Water Systems, Texas Commission on Environmental Quality (TCEQ).

   b. Surface Preparation: SSPC-SP10 (NACE 2); near white blast cleaned surfaces.

   c. Coating: Liquid or powder epoxy system; AWWA Standard C550, latest revision. Coating may be applied in two (2) or three (3) coats, according to manufacturer's recommendations, for a total dry film thickness (DFT) of 12 - 18 mils.

4. General Coating Requirements:

   a. Coatings: Applied in strict accordance with the manufacturer's recommendations. No requirements of this specification shall cancel or supersede written directions and recommendations of specific manufacturer so as to jeopardize integrity of applied system.

   b. Hydrant supplier shall furnish an affidavit of compliance that all materials and work furnished complies with requirements of this specification and applicable standards referenced herein.

2.02 HYDRANT PERFORMANCE STANDARDS

A. Hydraulic Performance Standards:

1. Provide hydrants capable of a free discharge of 1,500 gpm or greater from single pumper nozzle at a hydrant inlet static pressure not exceeding 20 PSIG as measured at or corrected to hydrant inlet at its centerline elevation.

2. Provide hydrants capable of a discharge of 1,500 gpm or greater from single pumper nozzle at a maximum permissible head loss of 8.0 psig (when corrected for inlet and outlet velocity head) for an inlet operating pressure not exceeding 37 psig as measured at or corrected to hydrant inlet at its centerline elevation.

B. Hydraulic Performance Testing: AWWA C502; conduct certified pressure loss and quantity of flow test by qualified testing laboratory on production model (5-foot bury length) of hydrant (same catalog number) proposed for certification. Submit certified test report containing following information:

1. Date of test, no more than five years prior to date of proposed use, on fire hydrant with similar hydraulic characteristics.

2. Name, catalog number, place of manufacture, and date of production of hydrant(s) tested.

3. Schematic drawing of testing apparatus, containing dimensions of piping elements including:

a. Inside diameter and length of inlet piping.

b. Distance from flow measuring points to pressure measurement point.

c. Distance from flow and pressure monitoring points to hydrant inlet.

d. Distance from pressure monitoring point to nozzles.

e. Inside diameter and length of discharge tubing.

4. Elevation of points of measurement, inlet, and reports or certificates documenting accuracy of measuring devices used in test.

5. Reports, or certificates documenting accuracy of measuring devices used in test.

6. Conduct test on at least three separate hydrants of same fabrication design. Inlet water temperature: 70° F ± 5° F.

C. Provide hydrants equipped with breakable barrel feature and breakable valve stem coupling such that vehicular impact will result in clean and complete break of barrel and valve stem at breakable feature. Provide hydrant shutoff valve which remains closed and tight against leakage upon impact.

2.03 LEADS

A. Branches (Leads): Conform to requirements of Section 02610 - Ductile-Iron Pipe and Fittings, Section 02611 - Steel Pipe and Fittings, and Section 02620 - PVC Pipe.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Set fire hydrant plumb and brace at locations and grades as shown on Drawings. When barrel of hydrant passes through concrete slab, place a piece of standard sidewalk expansion joint material, 3/4-inch thick, around section of barrel passing through concrete.

B. Fire hydrant grade should be set to the bury depth line marking on the fire hydrant barrel.

C. Locate nozzle centerline minimum 18 inches above finish grade.

D. Place black plastic around bonnet and pumper nozzles of new or relocated fire hydrants installed on new mains not in service. Remove plastic after new main is tested and approved by Engineer.

E. Do not cover drain ports when placing concrete thrust block.

F. All changes in profile from approved plans due to obstructions not shown on plans which require a change in depth of bury of fire hydrant shall be approved in writing by Engineer for design prior to installation of hydrant. Any adjustment required in flow line of water main or to barrel length of fire hydrant shall be incidental to unit price of fire hydrant and no separate payment shall be made for such adjustments.

G. Remove and salvage existing fire hydrants shown on Drawings.

H. Owner may, at any time prior to or during installation of hydrants for a specific project, randomly select a furnished hydrant for disassembly and laboratory inspection, at Owner's expense, to verify compliance with Owner's requirements. If such hydrant is found to be non-compliant, replace at Contractor's expense, all or a portion of furnished hydrants with hydrants that comply with Owner's requirements.

I. Install branches (leads) in accordance with Section 02664 - Water Mains.

END OF SECTION

SECTION 02664

WATER MAINS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of water mains.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Conform to submittal requirements of applicable specification section for type of pipe used.

C. Submit preconstruction and post construction photographs conforming to requirement of Section 01380 - Construction Photographs.

PART 2 P R O D U C T S

2.01 PIPE MATERIALS

A. Install pipe materials (as per this section) which conform to following:

1. Section 02610 - Ductile Iron Pipe (DIP) and Fittings.

2. Section 02611 - Steel Pipe and Fittings.

3. Section 02620 - Polyvinyl Chloride (PVC) Pipe.

B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61-G and have certified by an organization accredited by ANSI. Plastic pipe must bear the National Sanitation Foundation Seal of Approval (NSF pw-G).

C. Type of pipe materials used are identified on Drawings.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Conform to applicable specification sections for types of pipe used.

B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints. Lay pipe with bell ends facing in direction of laying.

C. Lay pipe to lines and grades shown on drawings. Use adequate surveying methods and equipment and employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record "as-built" horizontal alignment and vertical grade at maximum of every 50 feet on site record drawings.

D. Confirm that separation from gravity sanitary sewers and manholes or force mains have minimum clearance of nine feet in all directions unless a special design is provided for on the drawings.

E. Where above clearance cannot be attained, and a special design has not been provided on Drawings, obtain direction from Engineer before proceeding with construction.

F. Inform Engineer if any unmetered sprinkler or fire line connections exist which are not shown on Drawings to be transferred to new main. Make transfer only after approval by Engineer.

G. Keep pipe trenches free of water which might impair pipe laying operations. Prevent pipe bells from coming in contact with subgrade. Grade pipe trenches to provide uniform support along bottom of pipe. Excavate for bell holes for proper sealing of pipe joints after bottom has been graded and in advance of placing pipe. Lay not more than a nominal city block length of not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place all backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.

H. Owner will handle, at no cost to Contractor, all operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling all necessary installations and removal of all chlorination and testing taps and risers.

I. If asbestos-cement (A.C.) pipe is encountered, follow safety practices outlined in American Water Works Association's publication, "Work Practices for Asbestos-Cement Pipe." Contractor shall also strictly adhere to OSHA Standards regarding A.C. pipes. Contractor is responsible for the proper handling and disposal of the A.C. pipes.

3.02 HANDLING, CLEANING AND INSPECTION

A. Handling:

1. Place pipe along project site where storm water or other water will not enter or pass through pipe.

2. Pipe and Fittings: Loaded, transported, unloaded and otherwise handled in manner and by methods which will prevent damage of any kind thereto. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.

3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.

4. Use every precaution to prevent injury to pipe, protective linings and coatings.

   a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.

   b. Pad fork trucks using carpet or some other suitable type of material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.

   c. Do not lift pipe using hooks at each end of pipe.

5. Repair damage to pipe or protective lining and coating before final acceptance by Owner at no additional cost to Owner.

6. Reject pipe with visible cracks and remove from project site.

B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After all pipe laying and joining operations are completed, clean inside of pipe and remove all debris.

C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

3.03 EARTHWORK

A. Conform to applicable provisions of Section 02227 - Excavation and Backfill for Utilities and Section 02317 - Augering Pipe for Water Lines.

B. Bedding: Use bedding materials in conformance with Section 02229 - Utility Backfill Materials and details in Drawings.

C. Backfill: Use bank run sand or earth or native soil as specified in Section 02229 - Utility Backfill Materials and in accordance with details in Drawings. Backfill excavated areas in same day excavated. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.

D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density. Take laboratory field density tests at Engineer's discretion.

E. Pipe Zone: Including 6-inch pipe bedding and backfill to 12-inches above top of pipe.

3.04 PIPE CUTTING

A. Cut pipe 12-inch and smaller with standard wheel pipe cutters. Cut pipe larger than 12-inch in manner approved by Engineer. Make all cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

3.05 PIPING INSTALLATION

A. Do not lay pipe unless subgrade is free of water. Do not lay pipe when it is raining or when trench is muddy or soft. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material. Wedging or blocking up bell will not be acceptable.

B. Install pipe continuously and uninterrupted along each street on which work is to be performed.

C. Do not install pipe at greater depth than its design allows.

D. Protection of Pipeline: Securely place stoppers or bulkheads in all openings and in end of line when construction is stopped temporarily and at end of each day's work.

E. Perform Critical Locations as shown on Drawings. Refer to Section 02227 - Excavation and Backfill for Utilities for additional requirements at Critical Locations.

F. For nonmetallic pipe, install tracer wire or magnetic locator tape continuously along the top of the pipe.

3.06 JOINTS AND JOINTING

A. Rubber Gasketed Bell-and-Spigot Joints (PVC and DIP):

1. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.

2. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.

3. After the pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary before remaking joint.

4. Where preventing movement of pipe due to thrust is necessary, use restrained joints as shown on Drawings as follows:

   a. Ductile-Iron Pipe:

      (1). Super-Lock Joint by Clow Corporation.

      (2). Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.

      (3). TR-Flex or Field-Lok Joint by U.S. Pipe and Foundry Company

      (4). MEGALUG by EBAA Iron Sales, Inc.

   b. PVC Pipe:

      (1). Fittings: Series 2000PV Fitting Restrainer by EBAA Iron Sales, Inc. (MEGALUG), or approved equal.

      (2). Bell and Spigot: Series 1600 (C900) or Series 2800 (C905) Restraint Harness by EBAA Iron Sales, Inc., or approved equal.

   c. Steel Pipe: Welded joints (see Part 3.05C)

B. Flanged Joints (DIP, Steel):

1. AWWA C207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal or north-south centerline. Do not exceed 3/64-inch per foot inclination of flange face from true alignment.

2. Use full-face gaskets for all flanged joints. Provide 1/8-inch thick cloth inserted rubber gasket material. Cut gaskets at the factory to proper dimensions.

3. Use galvanized or black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets.

C. Welded Joints (Steel):

1. Joints: AWWA C206. Full-fillet, single lap-welded slip type either inside or outside, or double butt-welded type; use automatic or hand welders; provide complete penetration of deposited metal with base metal; provide filler metal suitable for use with base metal; keep inside of fittings and joints free from globules of weld metal which would restrict flow or become loose. Do not use mitered joints. For interior welded joints, complete backfilling before welding. For exterior field-welded joints, provide adequate working room under and beside pipe. Use exterior welds for 30-inch diameter lines and smaller.

2. Bell-and-Spigot, Lap-Welded Slip Joints: Deflection may be taken at joint by pulling joint up to 3/4-inch as long as 1-1/2-inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as proper joint tolerances are maintained. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 5 degrees.

3. Align piping and equipment so that no part is offset more than 1/8-inch. Set all fittings and joints square and true, and preserve alignment during welding operation. For butt-welded joints, align abutting ends to minimize offset between surfaces. For pipe of same nominal wall thickness, do not exceed 1/16-inch offset. Use line-up clamps for this purpose; however, care shall be taken to avoid damage to linings and coatings.

4. Protect coal-tar-epoxy lining during welding by draping an 18-inch wide strip of heat-resistant material over top half of pipe on each side of lining holdback to avoid damage to lining by hot splatter. Protect tape coating similarly if external welding is required.

5. Welding Rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.

6. Deposit metal in successive layers to provide at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in completed weld.

7. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each individual pass with wire brush or hammer to remove dirt, slag or flux.

8. Do not weld under any weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless work is properly protected.

9. Tack weld of same material and make by same procedure as completed weld. Otherwise, remove tack welds during welding operation.

10. Remove dirt, scale and other foreign matter from inside piping before tying in sections, fittings or valves.

D. Joint Grout (Steel):

1. Mix grout by machine except when less than 1/2 cubic yard is required. When less than 1/2 cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Use grout within 20 minutes after mixing. Discard grout that has set. Retempering of grout by any means is not permitted.

2. Prepare grout in small batches to prevent stiffening before it is used. Any grout which has become so stiff that proper placement cannot be assured without retempering by any means shall be wasted. Provide grout for filling grooves of such consistency that it will adhere to ends of pipe.

3. Surface Preparation: Remove all defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces with wire brush or hammer to sound, clean surface. Remove rust and all foreign materials from all metal surfaces in contact with grout.

4. Follow established procedures for hot and cold weather concrete placement.

5. Complete joint grout operations and backfilling of pipe trenches as closely as practical to pipe laying operations. Allow grouted exterior joints to cure at least 1 hour before compacting backfill.

6. Grouting exterior joint space: Use minimum 9-inch wide Ethafoam "diaper" or wrapper placed around pipe and over joint. Hold wrapper in place on both sides of joint with minimum 5/8-inch wide steel straps or bands. Place no additional bedding or backfill material on either side of pipe until after grout band is filled and grout has mechanically stiffened. Pull ends of wrapper together at top of pipe to form access hole. Pour grout down one side of pipe until it rises on other side. Rod or puddle grout to ensure complete filling of the joint recess. Agitate for 15 minutes to allow excess water to seep through joint band. When necessary, add more grout to fill joint completely. Protect gap at top of joint band from backfill by allowing grout to stiffen or by covering with a structurally protective material. Do not remove band from joint.

7. Interior Joints for Pipe Smaller than 24-inch: Circumferentially butter bell with grout prior to insertion of spigot, strike off flush surplus grout inside pipe by pulling filled burlap bag or inflated ball through pipe with rope.

8. Protect exposed interior surfaces of steel joint bands by metallizing, by other approved coatings, or by pointing with grout. Joint pointing may be omitted on potable water pipelines if the joint bands are protected by zinc metallizing or other approved protective coatings.

9. Remove and replace all improperly cured or otherwise defective grout at no additional cost to Owner.

10. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply flexible sealer, such as Flex Protex by Gifford-Hill America, or equal, to outside joint prior to joint engagement. Clean and prime surfaces receiving sealer in accordance with manufacturer's recommendations. Apply sufficient quantities of sealer to assure complete protection of all steel in joint area. Fill interior of joint with grout in normal manner after joint closure.

E. Joint Testing:

1. In addition to testing individual joints with feeler gage approximately 1/2-inch wide and 0.015-inch thick, use any other joint testing procedure approved or

recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. These tests shall be made at no additional cost to Owner.

2. On any joint or seam welded after hydrostatic testing or not subjected to hydrostatic testing, test 100 percent of welded joint by methods as described in section on Welded Joints. Owner reserves right to require Contractor to make additional tests at Owner's expense except that if tests performed at Contractor's expense or Owner's expense indicate an unacceptable weld, then cost of test, subsequent repair of rejected weld and test of repaired weld shall be borne by Contractor.

F. Make curves and bends by deflecting joints or other method as approved by manufacturer and Engineer.

1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Drawings.

2. If deflection exceeds that specified but is less than 5 percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded.

3. If deflection is equal to or exceeds 5 percent from that specified, remove entire portion of deflected pipe section and install new pipe.

4. Contractor shall replace, repair or reapply coatings and linings as required above.

5. No additional payment will be made for above described work.

6. Assessment of deflection may be measured by Owner at any location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.

7. Contractor may submit details of other methods of providing curves and bends for consideration by Engineer, and if deemed satisfactory, shall be installed at no additional cost to Owner.

8. When rubber gasketed pipe is laid on a curve, joint pipe in a straight alignment and then deflect to curved alignment.

G. Closures and Field Modifications:

1. Apply welded-wire fabric reinforcement to interior and exterior of all exposed interior and exterior surfaces greater than 6 inches in diameter. Welded-wire fabric: minimum W1; maximum spacing 2 inches by 4 inches; 3/8-inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than 3/4-inch.

2. Fill all exposed interior and exterior surfaces with nonshrink grout.

3.07 SECURING, SUPPORTING AND ANCHORING

A. Support piping as shown on Drawings and as specified herein, to maintain line and grade and prevent transfer of stress to adjacent structures.

B. Where shown on Drawings, anchor pipe fittings and bends installed on water main by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begin upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).

C. Provide adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Provide sufficient anchorage and blocking to resist all stresses and forces encountered while tapping existing waterline.

3.08 THRUST RESTRAINT

A. For new water lines 12 inches in diameter and larger, restrain joints as specified in Part 3.06 A.4 of this section. The new water line shall also be additionally restrained with concrete thrust blocking.

B. For existing waterlines and waterlines less than 12 inches in diameter, restrain pipe joints with concrete thrust blocks or provide joints as specified in Part 3.06 A.4 of this section.

C. Prevent any lateral movement of thrust restraints throughout pressure testing and operation. Place 2,500 psi concrete conforming to Section 03305 - Concrete for Utility Construction, for blocking at each change in direction of existing water lines, and water lines 12 inches in diameter and smaller to brace pipe against undisturbed trench walls. Complete placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made 2 days after completion of blocking if Type II cement is used.

3.09 POLYETHYLENE WRAP

A. Double wrap all ductile iron pipe and appurtenances (except fire hydrants) with 8-mil polyethylene film.

B. Conform to requirements of Section 02630 - Polyethylene Wrap.

3.10 CLEANUP, RESTORATION AND PAYMENT

A. Provide "cleanup" and "restoration" crews to work closely behind pipe laying crews, and where necessary, during chlorination, testing, service transfers, abandonment of old mains, backfill and surface restoration.

B. Upon completion of water line installation in a street and prior to moving to another, chlorinate and pressure test. Provide City a sampling point every 1,000 feet of completed water line for testing. Begin transfer of services no later than seven calendar days after successful completion of chlorination and pressure testing.

C. After completion of transfer of services, but no later than 21 calendar days after successful completion of chlorination and pressure testing, begin abandonment of old mains, backfill, resod, and placement of sidewalks and pavements.

D. Do not begin construction of additional sections if above conditions are not met.

3.11 CLEANING PIPING SYSTEMS

A. Remove construction debris or foreign material and thoroughly clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning.

3.12 DISINFECTION OF WATERLINES

A. Conform to requirements of Section 02675 - Disinfection of Waterlines.

3.13 FIELD HYDROSTATIC TESTS

A. Conform to requirements of Section 02676 - Hydrostatic Testing of Pipelines.

END OF SECTION

SECTION 02665

WATER TAP AND SERVICE LINE INSTALLATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Tapping existing or proposed mains and furnishing and installing new service lines for water. Where applicable, coordinate change over of water service lines with Owner.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Short Side Connection: Service line connecting proposed curb stop, located inside water meter box, to water line on same side of street or within alley/utility easement.

B. Long Side Connection: Service line connecting proposed curb stop, located inside water meter box, to water line on opposite side of street or from center of streets where supply line is located in street center such as boulevards and streets with esplanades.

PART 2 P R O D U C T S

2.01 SERVICE SADDLE

A. Service saddles for 6-inch through 12-inch PVC pipe (AWWA C900) shall be wide band strap saddles, ductile iron epoxy coated, stainless steel straps with AWWA standard outlet thread. Provide Smith Blair (315) or Romac Industries, Inc. (101NS).

B. Service saddles for 16-inch and larger PVC pipe (AWWA C905) shall be dual wide band strap saddles, ductile iron epoxy coated, stainless steel straps with AWWA standard outlet thread. Provide Smith Blair (317) or Romac Industries, Inc. (202NS).

2.02 CORPORATION STOP

A. For sizes required, AWWA C800, AWWA/CC taper thread inlet by pack joint outlet for polyethylene service tubing. Provide Ford or Cambridge Brass.

2.03 SERVICE TUBING

A. Polyethylene Service Line: Bearing seal of approval of National Sanitation Foundation for use in potable water systems. In accordance with ASTM D2737 and AWWA C901. Use pressure class 200, having a SDR 9.

2.04 CURB STOP

A. For sizes required, AWWA C800, straight or angle ball style meter valve with padlock wing, pack joint inlet for polyethylene service tubing by meter swivel nut outlet for 3/4-inch and 1-inch meters and 2-hole meter flange outlet for 1-1/2-inch and 2-inch meters. Provide Ford or Cambridge Brass.

B. Brass fittings shall comply with the Safe Water Drinking Act for maximum allowable lead content to not exceed 0.25%.

2.05 METER BOXES

A. Per Section 02604 - Valve Boxes, Meter Boxes, and Meter Vaults.

2.06 WATER METERS

A. The City will provide the water meter to the Contractor for installation.

PART 3 E X E C U T I O N

3.01 RESIDENTIAL SERVICE CONNECTIONS

A. Where service connections are to be installed on new mains, install before main is tested and sterilized. Where service connections are to be installed on existing mains no sterilization is required. Open-cut trenches across paved surfaces will not be permitted. Install under existing paved surfaces including sidewalks in augered hole. Flush service line before installing meter.

3.02 RESIDENTIAL SERVICE REPLACEMENT

A. Provide complete new service replacement from water main (existing or proposed) to existing water meter inlet. Tubing shall be one continuous piece from corporation stop to water meter (splicing will not be permitted). Where service replacements are to be installed on new mains, install before main is tested and sterilized. Where service replacements are to be installed on existing mains, no sterilization is required. Prior to final connection to existing meter, sterilize curb stop with strong solution of chlorinating agent. Open-cut trenches across paved surfaces will not be permitted. Install under existing paved surfaces, including sidewalks, in augered hole. Flush service line before connecting to existing meter.

3.03 SERVICE LINE DEPTH

A. Maintain minimum of three foot of cover until necessary to rise for meter connection.

3.04 MEASUREMENT FOR RESIDENTIAL SERVICE REPLACEMENT

A. Measurement per each as either long or short side single replacement (either 1-inch or 2-inch as applicable). Installation to be measured to include furnishing and installing following materials:

Materials	3/4" and 1" Meters	1-1/2" and 2" Meters
Tap in Main	1 at 1-inch	1 at 2-inch
Service Clamp	As Required by Main Size	As Required by Main Size
Corporation Stop	1 at 1-inch	1 at 2-inch
Curb Stop	1 at 1-inch	1 at 2-inch
Service Line Tubing	1-inch	2-inch

END OF SECTION

SECTION 02667

WET CONNECTIONS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Wet connections for new water mains and service lines to existing water mains.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Wet connections consist of isolating sections of pipe to be connected with installed valves, draining the isolated sections, and completing the connections.

B. Connection of 2-inch or smaller lines, which may be referred to on Drawings as "2-inch tap connections" will be measured as 2-inch wet connections. This item is not to be used as any part of a 2-inch service line.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Pipe shall conform to requirements of applicable portions of Sections 02610 through 02627.

B. Corporation stops and saddles shall conform to requirements of Section 02665.

C. Valves shall conform to requirements of Section 02640.

D. Brass fittings shall conform to requirements of AWWA C800.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Plan wet connections in such manner and at such hours as to least inconvenience public. Notify Engineer at least 72 hours in advance of making connections.

B. Do not operate valves on mains in use by Owner. Owner will handle, at no cost to Contractor, all operations involving opening and closing valves for wet connections.

C. Conduct connection operations when Inspector is at job site. Connection work shall progress without interruption until complete, once existing mains have been cut or plugs has been removed for making connections.

3.02 2-INCH WET CONNECTIONS

A. Tap water main. Provide and install corporation stops; saddles; polyethylene tubing as required for line and grade adjustment; and brass fittings necessary to adapt to existing main. Provide 2-inch valves when indicated on Drawings for 2-inch connections.

END OF SECTION

SECTION 02669

CUT, PLUG AND ABANDONMENT OF MAINS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cut, plug and abandonment of water mains.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit product data for proposed plugs and clamps for approval.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete for reaction blocks: Class B conforming to requirements of Section 03305 - Concrete for Utility Construction.

B. Plugs and clamps shall be suitable for type of pipe to be plugged.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Do not begin cut, plug and abandonment operations until replacement main has been constructed, disinfected, and tested, and all service lines have been transferred to replacement main.

B. Install plug, clamp, and concrete reaction block and make cut at location shown on Drawings.

C. Main to be abandoned shall not be valved off and shall not be cut or plugged other than at supply main or as shown on Drawings.

D. After main to be abandoned has been cut and plugged, check for other sources feeding abandoned main. If sources are found, notify Engineer immediately. Cut and plug abandoned main at point of other feed as directed by Engineer.

E. Plug or cap all ends or openings in abandoned main in an acceptable manner approved by Engineer.

F. Remove and dispose of all surface identifications such as valve boxes and fire hydrants, unless otherwise indicated on Drawings. Valve boxes in improved streets, other than shell, may be poured full of concrete after removing cap.

G. Backfill all excavations in accordance with Section 02227 - Excavation and Backfill for Utilities.

H. Repair all street surfaces in accordance with Section 02571 - Pavement Repair for Utilities and the project details.

END OF SECTION

SECTION 02675

DISINFECTION OF WATER LINES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Disinfection of potable water lines.

1.02 UNIT PRICES

A. No payment will be made for disinfection of water lines. Include cost in unit price of water lines being disinfected.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 GENERAL

A. All water lines constructed shall be promptly disinfected in accordance with AWWA Standard C651 before any tests are conducted on water lines and before water lines are connected to water distribution system.

B. Water for disinfection and flushing will be furnished without charge to Contractor.

3.02 PREPARATION

A. Furnish all required temporary blind flanges, cast-iron sleeves, plugs, and other items needed to facilitate disinfection of new mains prior to connecting them to water distribution system. Normally, each valved section of waterline requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for water lines up to and including 6-inch diameter.

B. Fire hydrants shall be used as blow-offs to flush newly constructed water lines. Where fire hydrants are not available on water lines, locations and designs for blow-offs shall be as indicated on Drawings, or Contractor shall install temporary blow-off valves (no separate payment) and remove promptly upon successful completion of disinfection and testing.

C. Slowly fill each section of pipe with water in a manner approved by Engineer. Average water velocity when filling pipeline should be less than 1 fps and shall not, under any circumstance, exceed 2 fps. Before beginning disinfection operations, expel all air from pipeline.

D. All excavations made shall be backfilled immediately after installation of risers or blow-offs.

E. Install blow-off valves at end of main to facilitate flushing at all dead-end water mains. Install permanent blow-off valves as per drawing.

3.03 DISINFECTION

A. Use not less than 100 parts of chlorine per million parts of water. Introduce chlorinating material to water lines in accordance with AWWA C651. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water. Open and close valves in lines being sterilized several times during contact period.

B. If a chemical compound is used for a sterilizing agent, it shall be placed in pipes as directed by Engineer.

3.04 BACTERIOLOGICAL TESTING

A. Standard Specifications: AWWA C651-06 as applicable.

B. Bacterial Analysis: Following disinfection and flushing, the Owner will perform bacteriological analysis to check effectiveness of disinfection. Contractor will assist Owner in the performance of the bacteriological analysis. Methods of bacteriological analysis are as specified in the Standard Methods for Examination of Water and Wastewater by the American Public Health Association, latest edition. No main shall be placed in service or accepted until water samples are approved by the Texas Commission on Environmental Quality (TCEQ).

C. Test a minimum of one sample for each 1,000 feet of completed main.

D. Testing laboratories used to analyze samples must be TCEQ Accredited Laboratories.

3.05 COMPLETION

A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF SECTION

SECTION 02676

HYDROSTATIC TESTING OF PIPELINES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Field hydrostatic testing of new water pipelines.

1.02 UNIT PRICES

A. No payment will be made for hydrostatic testing of pipelines under this Section. Include cost in unit price of pipelines being tested.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 GENERAL

A. Hydrostatically test all new water pipelines in accordance with AWWA Standard C600 or C605 prior to sampling and after disinfection, if required, and before connecting to water distribution system.

B. Pipelines shall be tested in lengths between valves, or plugs, of not more than 1,500 feet unless greater length is approved by Engineer.

C. Conduct hydrostatic tests in presence of Engineer in accordance with requirements of this Section.

3.02 PREPARATION

A. Disinfect water system pipelines prior to hydrostatic testing in accordance with Section 02675 - Disinfection of Water Lines.

3.03 TEST PROCEDURES

A. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.

B. Allow pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Contractor should be aware that periods of up to 7 days may be required for mortar lining to become saturated.

C. Expel all air and apply a minimum test pressure of 125 psi or 150 psi as directed by Engineer.

D. Maintain test pressure for 8 hours. If a large quantity of water is required to maintain pressure during test, testing shall be discontinued until cause of water loss is identified and corrected.

3.04 ALLOWABLE LEAKAGE FOR WATER MAINS

A. During hydrostatic tests, no leakage will be allowed for sections of water mains consisting of welded joints.

B. Maximum allowable leakage rate for PVC pipe and appurtenances shall not exceed the amount allowed or recommended by formula in AWWA C605 as follows:

$$Q = \frac{LD\sqrt{P}}{148{,}000}$$

Where:

- Q = the quantity of makeup of water in gallons per hour,
- L = the length of the pipe section being tested, in feet,
- D = the nominal diameter of the pipe in inches, and
- P = the average test pressure during the hydrostatic test in pounds per square inch.

C. Maximum allowable leakage rate for ductile iron (DI) pipe and appurtenances shall not exceed the amount allowed or recommended by formula in AWWA C600 as follows:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

Where:

- L = the quantity of makeup of water in gallons per hour,
- S = the length of the pipe section being tested, in feet,
- D = the nominal diameter of the pipe in inches, and
- P = the average test pressure during the hydrostatic test in pounds per square inch.

3.05 CORRECTION FOR FAILED TESTS

A. Repair all joints showing visible leaks on surface regardless of total leakage shown on test. Check all valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove any cracked or defective pipes, fittings and valves discovered during pressure test and replace with new items.

B. Engineer may direct Contractor to disinfect failed lines after repair and prior to retesting. Conduct subsequent disinfection operations in accordance with requirements of Section 02675 - Disinfection of Water Lines.

C. Repeat test until satisfactory results are obtained.

3.06 COMPLETION

A. Upon satisfactory completion testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

TABLE 02676-1
ALLOWABLE WATER LOSS FOR PRESSURE TESTING NEW WATER MAINS

- Maximum allowable leakage rate for a water main with rubber gasketed joints: 10.48 gallons per inch nominal diameter per mile of pipe per 24 hours while testing at the required pressure 150 PSI test for 8 hours

10.48 / (3 x 5,280) = **0.0006616 x Length[1] (ft) x Pipe Dia (in) = Allowable loss in gallons**

	Pipe Diameter (in)				
	6	8	10	12	16
Test Length (feet)	Amount (gallons)	Amount (gallons)	Amount (gallons)	Amount (gallons)	Amount (gallons)
100	0.397	0.529	0.662	0.794	1.059
150	0.595	0.794	0.992	1.191	1.588
200	0.794	1.059	1.323	1.588	2.117
250	0.992	1.323	1.654	1.985	2.646
300	1.191	1.588	1.985	2.382	3.176
350	1.389	1.852	2.316	2.779	3.705
400	1.588	2.117	2.646	3.176	4.234
450	1.786	2.382	2.977	3.573	4.764
500	1.985	2.646	3.308	3.970	5.293
550	2.183	2.911	3.639	4.367	5.822
600	2.382	3.176	3.970	4.764	6.351
650	2.580	3.440	4.300	5.160	6.881
700	2.779	3.705	4.631	5.557	7.410
750	2.977	3.970	4.962	5.954	7.939
800	3.176	4.234	5.293	6.351	8.468
850	3.374	4.499	5.624	6.748	8.998
900	3.573	4.764	5.954	7.145	9.527
950	3.771	5.028	6.285	7.542	10.056
1,000	3.970	5.293	6.616	7.939	10.586
1,050	4.168	5.557	6.947	8.336	11.115
1,100	4.367	5.822	7.278	8.733	11.644
1,150	4.565	6.087	7.608	9.130	12.173
1,200	4.764	6.351	7.939	9.527	12.703
1,250	4.962	6.616	8.270	9.924	13.232
1,300	5.160	6.881	8.601	10.321	13.761
1,350	5.359	7.145	8.932	10.718	14.291
1,400	5.557	7.410	9.262	11.115	14.820
1,450	5.756	7.675	9.593	11.512	15.349
1,500	5.954	7.939	9.924	11.909	15.878

[1] 1,500' maximum test unless approved by Engineer

END OF SECTION

SECTION 02720

STORM SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. New storm sewers and appurtenances, modifications to existing storm sewer system and installation of roadside ditch culverts.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's literature for product specifications and installation instructions.

C. Submit test reports as specified in Part 3 of this Section. Submit proposed methods, equipment, materials, and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

1.04 QUALITY ASSURANCE

A. The condition for acceptance will be a storm sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's recommendations.

B. Handle pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks or trailers. Materials cracked, gouged, chipped, dented, or otherwise damaged will not be approved for installation.

C. Store pipe and fittings on heavy timbers or platforms to avoid contact with the ground.

D. Unload pipe, fittings, and specials as close as practical to the location of installation to avoid unnecessary handling.

E. Keep interiors of pipe and fittings completely free of dirt and foreign matter.

PART 2 P R O D U C T S

2.01 PIPE

A. Piping materials for storm sewers shall be of the sizes and types indicated on the Drawings.

B. For consideration of other materials, submit complete manufacturer's data including materials, sizes, flow carrying capacity, installation procedures, and history of similar installations to Engineer for pre-bid evaluations, if allowed, or as a substitution.

C. Existing pipe that has been removed during construction cannot be reused.

2.02 PIPE MATERIAL SCHEDULE

A. Reinforced Concrete Pipe: Conform to requirement of Section 02615 - Reinforced Concrete Pipe.

B. Precast Reinforced Concrete Box Sewers: Conform to requirements of Section 02617 - Precast Reinforced Concrete Box Sewers.

2.03 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill Material: Conform to requirements of Section 02227 - Excavation and Backfill for Utilities and Section 02229 - Utility Backfill Materials.

B. Topsoil: Conform to requirements of Section 02920 - Topsoil.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Set up street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01570 - Traffic Control and Regulation.

B. Provide barricades and warning lights and signs, for excavations. Conform to requirements of Section 01570 - Traffic Control and Regulation. Maintain barricades and warning lights for streets and intersections where work is in progress or where affected by the work and is considered hazardous to traffic movements.

C. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 - Trench Safety Systems, for excavations over 5 feet deep.

D. Immediately notify the agency or company owning any utility line which is damaged, broken or disturbed. Obtain approval from Engineer and agency for any repairs or relocations, either temporary or permanent.

E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Section 02076 - Removing Existing Pavements and Structures.

F. Install and operate necessary dewatering and surface water control measures in accordance with Section 01563 - Control of Ground Water and Surface Water.

3.02 EXCAVATION

A. Earthwork. Refer to Section 02227 - Excavation and Backfill for Utilities and as directed by the details on Drawings.

B. Line and Grade. Establish the proper line and grade in the trench as shown in the drawings. Maintain this control for a minimum of 100 feet behind and ahead of the pipe-laying operation. Use appropriately sized grade boards, as necessary, which are substantially supported. Protect the boards and location stakes from damage or dislocation. Use of a laser beam equipment to establish and maintain proper line and grade of the work is acceptable.

C. Trench Excavation. Excavate pipe trenches to a level shown on the drawings below the indicated invert. Backfill the excavation with the specified bedding material to the level of the lower one-third of the pipe barrel. Tamp and compact backfill to provide bedding at the indicated grade.

3.03 PIPE INSTALLATION

A. Install in accordance with the pipe manufacturer's recommendations and as specified in this Section.

B. Install pipe only after excavation is completed, the bottom of the trench shaped, bedding material is installed, and the trench has been approved by the Engineer.

C. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignments indicated.

D. Install pipe with the spigot ends toward the direction of flow.

E. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

F. Place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Engineer.

G. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

3.04 PIPE INSTALLATION OTHER THAN OPEN CUT

A. For installation of pipe by augering, boring, or jacking pipe, conform to requirements of Section 02315 - Pipe and Casing Augering for Sewers.

3.05 INSTALLATION OF APPURTENANCES

A. Construct manholes to conform to requirements of Section 02601 - Precast Concrete Manholes. Install frames, grates, rings and covers to conform to requirements of Section 02603 - Frames, Grates, Rings and Covers.

B. Install inlets, headwalls and wingwalls to conform to requirements of Section 02606 - Precast Concrete Inlets, Headwalls and Wingwalls.

C. Rehabilitate existing manholes to conform to requirements of Section 02764 - Manhole Rehabilitation. Adjust manhole covers to grade conforming to requirements of Section 02607 - Adjusting Manholes, Inlets and Valve Boxes to Grade.

3.06 BACKFILL AND SITE CLEANUP

A. Backfill the trench only after pipe installation is approved by the Engineer.

B. Backfill and compact soil in accordance with Section 02227 - Excavation and Backfill for Utilities.

C. Repair and replace removed or damaged pavement and sidewalks as specified in Section 02570 - Pavement Repair and Resurfacing.

D. In unpaved areas, grade surface as a uniform slope to natural grade as indicated on the Drawings. Provide a minimum of 4 inches of topsoil conforming to requirements of Section 02920 - Top Soil and sod in accordance with Section 02935 - Sodding.

E. Conform to requirements of Section 01564 - Waste Material Disposal.

END OF SECTION

SECTION 02730

GRAVITY SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Gravity sanitary sewers and appurtenances, including cleanouts, stacks, and service connections.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

1.04 QUALITY ASSURANCE

A. Qualifications. Install a sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Section 02732 - Acceptance Testing for Sanitary Sewers.

B. Regulatory Requirements.

1. Install sewer lines to meet the minimum separation distance from any potable water line, as scheduled below. The separation distance is defined as the distance between the outside of the water pipe and the outside of the sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.
2. Make notification to the Engineer if water lines are uncovered during sanitary sewer installation where the minimum separation distance cannot be maintained.
3. Lay gravity sewer lines in straight alignment and grade.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Inspect pipe and fittings upon arrival of materials at the job site.

B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along the ground. Do not roll pipe unrestrained from delivery trucks.

C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around the outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with the interior surface of the pipe to lift or move lined pipe.

PART 2 P R O D U C T S

2.01 PIPE

A. Provide piping materials for gravity sanitary sewers of the sizes and types indicated on the Drawings or as specified.

B. Reinforced concrete pipe is not acceptable.

2.02 PIPE MATERIAL SCHEDULE

A. Unless otherwise shown on the Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:

1. Section 02620 - PVC Pipe.
2. Section 02618 - Centrifugally Cast Fiberglass Pipe.
3. Section 02610 - Ductile Iron Pipe and Fittings.

B. Where shown on the Drawings, provide pipe meeting the minimum class, dimension ratio, or other criteria indicated.

C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

2.03 APPURTENANCES

A. Stacks: Conform to the requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

B. Service Connections: Conform to requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

C. Roof, street or other type of surface water drains shall not be connected or reconnected into the sanitary sewer lines.

2.04 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill: Conform to requirements of Section 02227 - Excavation and Backfill for Utilities, Section 02229 - Utility Backfill Material, and Section 02252 - Cement Stabilized Sand.

B. Topsoil: Conform to requirements of Section 02920 - Topsoil.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01570 - Traffic Control and Regulation.

B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Section 01570 - Traffic Control and Regulation. Maintain barricades and warning lights where work is in progress or where traffic is affected by the work.

C. Perform work in accordance with OSHA standards. Employ a trench safety system as specified in Section 01526 - Trench Safety System for excavations over 5 feet deep.

D. Immediately notify the agency or company owning any utility line which is damaged, broken or disturbed. Obtain approval from the Engineer and agency or utility company for any repairs or relocations, either temporary or permanent.

E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Section 02076 - Removing Existing Pavements and Structures.

F. Install and operate dewatering and surface water control measures in accordance with Section 01563 - Control of Ground Water and Surface Water.

G. Do not allow sand, debris or runoff to enter sewer system.

3.02 DIVERSION PUMPING

A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from the Engineer.

B. Design piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. No sewage shall be diverted into any area outside of the sanitary sewer.

D. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify the Engineer so that required reporting can be made to the Texas Commission on Environmental Quality and the Environmental Protection Agency by the Engineer.

3.03 EXCAVATION

A. Earthwork: Conform to requirements of Section 02227 - Excavation and Backfill for Utilities. Use bedding as indicated on Drawings.

B. Line and Grade: Establish the required uniform line and grade in the trench as shown in the drawings. Maintain this control for a minimum of 100 feet behind and ahead of the pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of the work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect the boards and location stakes from damage or dislocation.

C. Trench Excavation: Excavate pipe trenches to depths shown on Drawings and as specified in Section 02227 - Excavation and Backfill for Utilities.

3.04 PIPE INSTALLATION BY OPEN CUT

A. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in the following paragraphs.

B. Install pipe only after excavation is completed, the bottom of the trench fine graded, bedding material is installed, and the trench has been approved by the Engineer.

C. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell holes where necessary.

D. Install pipe with the spigot ends toward the direction of flow.

E. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

F. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.

G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Engineer.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

J. If a water line is encountered closer than nine feet to the proposed sewer and no special provisions are indicated on the Drawings, notify the Engineer before proceeding.

K. Where the length of stubs is not indicated, install a 10 foot length of pipe or extend to the right-of-way and seal the free end with an approved plug. No stubs are to terminate under existing pavement.

3.05 PIPE INSTALLATION OTHER THAN OPEN CUT

A. For installation of pipe by augering or jacking, conform to requirements of Section 02315 - Pipe and Casing Augering for Sewers.

3.06 INSTALLATION OF APPURTENANCES

A. Service Connections: Install service connections to conform to requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

B. Stacks: Construct stacks to conform to requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

C. Construct manholes to conform to requirements of Section 02600 - Cast-in-Place Manholes and Section 02601 - Precast Concrete Manholes, as applicable. Install frames, rings and covers to conform to requirements of Section 02603 - Frames, Grates, Rings and Covers.

D. Pipe connections to existing manholes shall be accomplished using a coring machine. The use of concrete breakers or hammers will not be allowed.

3.07 SEPARATION FROM WATER LINES

A. Water Line/New Sewer Line Separation - When new sanitary sewers are installed, they shall be installed no closer to water lines than nine feet in all directions. Sewers that parallel water lines must be installed in separate trenches. Where the nine foot separation distance cannot be achieved, the following guidelines will apply.

1. Where a sanitary sewer parallels a water line, the sewer shall be constructed of cast iron, ductile iron, or PVC pipe meeting ASTM specifications with a pressure rating for both the pipe and joints of 150 psi. The vertical separation shall be a minimum of two feet between outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the water line.
2. Where a sanitary sewer crosses a water line and the sewer is constructed of cast iron, ductile iron or PVC with a minimum pressure rating of 150 psi, an absolute minimum distance of 6 inches between outside diameters shall be maintained. In addition the sewer shall be located below the water line, where possible, and one length of the sewer pipe must be centered on the water line.

3. Where a sewer crosses under a water line and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe or concrete pipe with gasketed joints, a minimum two foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the water line. This initial backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.
4. Where a sewer crosses over a water line all portions of the sewer within nine feet of the water line shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at 5 feet intervals with spacers or be filled to the springline with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.

B. Water line/Manhole Separation - Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet of horizontal clearance from an existing or proposed water line. Where the nine foot separation distance cannot be achieved, a carrier pipe as described in subsection A.4 of this section may be used where appropriate.

3.08 INSPECTION AND TESTING

A. Visual Inspection: Check pipe alignment in accordance with Section 02732 - Acceptance Testing for Sanitary Sewers.

B. Mandrel Testing: Use a Mandrel Test to test flexible pipe for deflection. Refer to Section 02732 - Acceptance Testing for Sanitary Sewers.

C. Leakage Testing: After backfilling a line segment and prior to tie-in of service connections, test for leakage in accordance with Section 02732 - Acceptance Testing for Sanitary Sewers. Maintain piezometers installed to conform with Section 01563 - Control of Ground Water and Surface Water, until acceptance testing is completed.

D. Prior to final acceptance of newly constructed gravity sanitary sewers, perform cleaning and closed circuit television inspection in accordance with Section 02733 - Cleaning and Television Inspection.

3.09 BACKFILL AND SITE CLEANUP

A. Backfill and compact soil in accordance with Section 02227 - Excavation and Backfill for Utilities.

B. Backfill the trench in specified lifts only after pipe installation is approved by the Engineer.

C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Section 02571 - Pavement Repair for Utilities.

D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over the surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at a uniform slope to natural grade as indicated on the Drawings. Provide a minimum of 4 inches of topsoil as specified in Section 02920 - Topsoil and apply hydromulch according to requirements of Section 02932 - Hydromulch Seeding.

E. Provide sodding in areas of residential land use over the surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at a uniform slope to natural grade as indicated on the Drawings. Provide a minimum of 4 inches of topsoil per Section 02920 - Topsoil. Sod disturbed areas in accordance with Section 02935 - Sodding.

F. Conform to requirements of Section 01564 - Waste Material Disposal.

END OF SECTION

SECTION 02731

SANITARY SEWER FORCE MAINS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Sanitary sewer force mains.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittals.

B. Submit proposed methods, equipment, materials, and sequence of operations for force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

C. Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.

D. Submit test reports as specified in Part 3 of this Section.

PART 2 P R O D U C T S

2.01 PIPE MATERIAL SCHEDULE

A. Unless otherwise shown on the Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:

1. Section 02610 - Ductile Iron Pipe and Fittings.

2. Section 02620 - PVC Pipe.

3. Section 02619 - High Density Polyethylene (HDPE) Solid Wall Pipe.

2.02 THRUST RESTRAINT

A. Unless otherwise shown on the Drawings, provide concrete thrust blocking for force mains up to 12-inches in diameter, to prevent movement of buried lines under pressure at bends. Blocking shall be Portland cement concrete, as specified in Section 03305 - Concrete for Utility Construction. Place concrete in accordance with details on the Drawings. Place thrust blocks between undisturbed ground and the fittings. Anchor

fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below the pipe or fitting to 12 inches above.

B. For all force mains larger than 12 inches in diameter, and where indicated on the Drawings, provide restrained joints conforming to the requirements of the force main pipe material specifications. Restrained joints shall be installed for the length of pipe on both sides of each bend or fitting for the full length shown on the Drawings.

C. Horizontal and vertical bends between zero and 10 degrees deflection angle will not require thrust blocks or harnessed or restrained joints.

D. Horizontal and vertical bends between 10 degrees and 90 degrees deflection angle shall have thrust restraint as shown on the Drawings.

E. Reinforced concrete encasement of force main pipe and fittings may be used in lieu of manufactured joint restraint systems. Alternate joint restraint systems using reinforced concrete encasement shall conform to the following design requirements.

1. Design calculations shall be performed and sealed by a Licensed Professional Engineer registered in the State of Texas.

2. Design calculations shall be based upon soil parameters quantified in the geotechnical report for the site where the alternative thrust restraint system is to be installed. If data is not available for the site, use parameters recommended by the geotechnical engineer.

3. The design system pressure shall be the specified test pressure.

4. The following safety factors shall be used in sizing the restraint system:

   a. Apply a factor of safety equal to 1.5 for passive soil resistance.

   b. Apply a factor of safety equal to 2.0 for soil friction.

5. The encasement shall be contained entirely within the standard trench width and terminate on both ends at a pipe bell or coupling.

6. Concrete encasement reinforcement steel shall be designed for all loads including internal pressure and longitudinal forces. Concrete design shall be in accordance with ACI 318.

PART 3 E X E C U T I O N

3.01 PIPE INSTALLATION BY OPEN-CUT

A. Perform excavation, bedding, and backfill in accordance with Section 02227 - Excavation and Backfill for Utilities.

B. Wrap ductile iron pipe and fittings with polyethylene wrap in accordance with requirements of Section 02630 - Polyethylene Wrap. Polyethylene wrap shall not be installed on ductile iron pipe protected by a cathodic protection system.

C. Provide buried Detector Tape above and parallel to pipe within the trench. Detector Tape shall have lettering minimum height of 1.5 inches stating the words “Pressurized Wastewater.”

D. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in the following paragraphs.

E. Install pipe only after excavation is completed, the bottom of the trench is fine graded, bedding material is installed, and the trench has been approved by the Engineer.

F. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell holes where necessary.

G. Install pipe with the spigot ends toward the direction of flow. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

H. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.

I. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Engineer.

J. Keep excavations free of water during construction and until final inspection.

K. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

L. Where sanitary sewer force main is to be installed under an existing water line with a separation distance of less than 2 feet, install one full joint length of pipe centered on the water line and maintain a minimum 6-inch separation distance.

3.02 PIPE INSTALLATION OTHER THAN OPEN-CUT

A. For installation of pipe by augering or jacking conform to requirements of Section 02315 - Pipe and Casing Augering for Sewers.

3.03 HYDROSTATIC TESTING

A. After the pipe and appurtenances have been installed, test line and drain. Prevent damage to the Work or adjacent areas. Use clean water to perform tests.

B. The Engineer may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.

C. Test pipe in the presence of the Engineer.

D. Test pipe at 150 psig or 50 psi greater than the design pressure of the pipe, whichever is greater. Design pressure of the force main shall be the rated total dynamic head of the lift station pump.

E. Test pipe at the required pressure for a minimum of 4 hours according to requirements of UNI-B-3.

F. Maximum allowable leakage shall be as calculated by the lesser of the following two formulas:

$$L = (S)\ (D)\ (P^{0.5})\ /\ 133{,}200$$

Where:

L	=	Leakage in gallons per hour.
S	=	Length of pipe in feet.
D	=	Inside diameter of pipe in inches.
P	=	Pressure in pounds per square inch (150 psi min.)

Or: 10 gallons per inch diameter per mile per day at the design pressure plus 50 psi.

G. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by the Engineer.

H. Plug openings in the force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering the tested pipeline.

3.04 PIGGING TEST

A. After completion of hydrostatic testing and prior to final acceptance, test force mains longer than 200 feet by pigging to ensure piping is free of obstructions.

B. Pigs: Provide proving pigs manufactured of an open-cell polyurethane foam body, without any coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to 65 percent of the nominal cross-sectional area of the pipe. Pigs shall be able to pass through standard

fittings such as 45-degree and 90-degree elbows, crosses, tees, wyes, gate valves, or plug valves, as applicable to the force main being tested.

C. Test Execution: Pigging test shall be conducted in the presence of the Engineer. Provide at least 48 hour notice of scheduled pigging of the force main prior to commencing the test.

END OF SECTION

SECTION 02732

ACCEPTANCE TESTING FOR SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Acceptance testing criteria and procedures for sanitary sewers, including:

1. Visual inspection of sewer pipes.
2. Mandrel testing for flexible sewer pipes.
3. Leakage testing of sewer pipes.
4. Leakage testing of manholes.
5. Smoke testing of point repairs.
6. Post Cleaning and Television Inspection of rehabilitated sanitary sewer.

B. Tests listed in this Section are not necessarily required on this Project. Required test is named in other Sections which refer to this Section for testing criteria and procedures.

1.02 UNIT PRICES

A. No payment will be made for Acceptance Testing for Sanitary Sewers under this section. Payment for work performed as described under this section shall be included in the unite price bid for applicable work items.

1.03 PERFORMANCE REQUIREMENTS

A. Gravity flow sanitary sewers are required to have a straight alignment and uniform grade between manholes.

B. Flexible pipe, including “semi-rigid” pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of a line segment but prior to final acceptance using a standard mandrel to verify that installed pipe is within specified deflection tolerances.

C. Maximum allowable leakage for infiltration or exfiltration.

1. The total exfiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of 2 feet above the crown of the pipe at the upstream manhole or 2 feet above the groundwater elevation, whichever is greater.

2. When pipes are installed more than 2 feet below the groundwater level, an infiltration test shall be used in lieu of the exfiltration test. The total infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above the crown of the pipe at the upstream manhole.

3. Refer to Table 02732-1, Water Test Allowable Leakage, at the end of this Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria is met.

D. Perform air testing in accordance with requirements of this Section and the Texas Commission on Environmental Quality Rules Chapter 217 requirements. Refer to Table 02732-2, Time Allowed For Pressure Loss From 3.5 psig to 2.5 psig, Table 02732-3, Minimum testing Times for Low Pressure Air Test, and Table 02732-4, Vacuum Test Time Table, at the end of this Section.

1.04 SUBMITTALS

A. Conform to requirements of Section 01300-Submittals.

B. Test Plan: Before testing begins and in adequate time to obtain approval through the submittal process, prepare and submit a test plan for approval by the Engineer. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations form the Drawings and Specifications.

C. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

1.05 GRAVITY SANITARY SEWER QUALITY ASSURANCE

A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.

B. Provide testing reports.

1.06 SEQUENCING AND SCHEDULING

A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at any one time.

B. Coordinate testing schedules with the Engineer. Perform testing under observation of the Engineer.

PART 2 P R O D U C T S

2.01 DEFLECTION MANDREL

A. Mandrel Sizing. The rigid mandrel shall have an outside diameter (O.D.) equal to 95 percent 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. Dimensions shall be per appropriate standard. Statistical or other "tolerance package" shall not be considered in mandrel sizing.

B. 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 percent of the inside diameter of the pipe. The rigid mandrel diameter during testing. A proving ring shall be provided and used for verifying each size mandrel.

C. Proving Ring. Furnish a "proving ring" with each mandrel. Fabricate the ring of 2-inch-thick, 3-inch-wide bar steel to a diameter 0.02-inches larger than approved mandrel diameter.

D. Mandrel Dimensions (5% allowance). Average inside diameter and minimum mandrel diameter are specified in Table 02732-5, Pipe vs. Mandrel Diameter, at the end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in the table may be used when approved by the Engineer.

2.02 EXFILTRATION TEST

A. Test Equipment:

1. Pipe plugs.

2. Pipe risers where the manhole cone is less than 2 feet above highest point in pipe or service lead.

2.03 INFILTRATION TEST

A. Test Equipment:

1. Calibrated 90° V-notch weir.

2. Pipe plugs.

2.04 LOW PRESSURE AIR TEST

A. Minimum Requirement for Equipment:

1. Control panel.

2. Low-pressure air supply connected to control panel.

3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.

4. Air hoses from control panel to:

B. Testing Pneumatic Plugs: Place a pneumatic plug in each end of a length of pipe on the ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable if they remain in place against the test pressure without external aids.

2.05 GROUND WATER DETERMINATION

A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

2.06 SMOKE TESTING

A. Equipment:

1. Pneumatic plugs.

2. Smoke generator as supplied by Superior Signal Company, or an approved equal.

3. Blowers producing 2500 scfm minimum.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.

B. The selection of test methods and pressures for gravity sanitary sewers shall be determined based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Section 01563-Control of Ground Water and Surface Water.

3.02 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

A. Check pipe alignment visually by flashing a light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

3.03 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of the line segment.

B. Pull the approved mandrel by hand through sewer sections. Replace any section of sewer not passing the mandrel. Mandrel testing is not required for stubs.

C. Retest repaired or replaced sewer sections.

3.04 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

A. Test Options:

1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.

2. Test new or rehabilitated sanitary sewer manholes with water or low-pressure air. Manholes tested with low-pressure air shall undergo a physical inspection prior to testing.

3. Leakage testing shall be performed after backfilling of a line segment, and prior to tie-in of service connections.

4. If no installed piezometer is within 500 feet of the sewer segment, Contractor shall provide a temporary piezometer for this purpose.

B. Compensating for Ground Water Pressure:

1. Where ground water exists, install a pipe nipple at the same time sewer line is placed. Use a ½-inch capped pipe nipple approximately 10 inches long. Make the installation through manhole wall on top of the sewer line where line enters manhole.

2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect a clear plastic tube to nipple. Support tube vertically and allow water to rise in the tube. After water stops rising, measure height in feet of water over invert of the pipe. Divide this height by 2.3 feet/psi to determine the ground water pressure to be used in line testing.

C. Exfiltration test:

1. Determine ground water elevation.

2. Plug sewer in downstream manhole.

3. Plug incoming pipes in upstream manhole.

4. Install riser pipe in outgoing pipe of upstream manhole if highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.

5. Fill sewer pipe and manhole or pipe riser, if used, with water to a point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.

6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over a one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure the quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 02732-1 at the end of this section.

D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).

1. Determine ground water elevation.

2. Plug incoming pipes in upstream manhole.

3. Insert calibrated 90° V-notch weir in pipe on downstream manhole.

4. Allow water to rise and flow over weir until it stabilizes.

5. Take five readings of accumulated volume over a period of 2 hours and use average for infiltration. The average must not exceed that calculated for 2 hours from allowable leakage according to the Table 02732-1 at the end of this Section.

E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 02732-2.

1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.

2. Lines 36-inch average inside diameter and larger shall be "joint"tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during a joint test shall be 10 seconds, regardless of pipe size. "Joint Test" shall be conducted as follows:

   a. Each joint shall be tested successfully.
   b. Joint Tester shall be set over joint to be tested so that the two inflation tubes straddle the joint.
   c. Inflate "inflation tubes" to 25 psig to seal off joint to be tested.
   d. Apply air pressure into void between inflation tubes until pressure reaches 4 psig.
   e. After pressure has stabilized, bleed air pressure back to 3.5 psig.
   f. Record time required for pressure to drop from 3.5 psig to 2.5 psig.
   g. If the time in seconds for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than 10 seconds, the joint shall be presumed to be free from defect. When the time is less than 10 seconds pipe breakage, joint leakage or leaking tester seals are indicated and an inspection must be made to determine the cause. The contractor shall effect such repairs as may be required to accomplish a successful air joint test.

h. The joint shall be air tested before the pipe has been backfilled. Air testing shall be performed as pipe installation progresses.

3. For pipe sections less than 36-inch average inside diameter:

a. Determine ground water level.
b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.
c. After a manhole-to-manhole section of sanitary sewer main has been rehabilitated (sliplining, pipe bursting, cured in place lining) and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in the system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 02732-2 at the end of this Section.
e. To determine air loss, measure the time interval for pressure to drop to 2.5 psig. The time must exceed that listed in the Table 02732-2 at the end of this Section for pipe diameter and length. For rehabilated pipe, use diameter of carrier pipe.

F. Retest: Any section of pipe which fails to meet requirements shall be repaired and retested.

3.05 TEST CRITERIA TABLES

A. Exfiltration and Infiltration Water Tests: Refer to Table 02732-1, Water Test Allowable Leakage, at the end of this Section.

B. Low Pressure Air Test:

1. Times in Table 02732-2, Time Allowed for Pressure Loss From 3.5 psig to 2.5 psig, at the end of this Section, are based on the equation from Texas Commission on Environmental Quality (TCEQ) Design Criteria Chapter §217.57:

$$T = 0.0850\ (D)\ (K)/\ (Q)$$

where:

T	=	time for pressure to drop 1.0 pounds per square inch gauge in Seconds
K	=	0.000419 DL, but not less than 1.0
D	=	average inside diameter in inches
L	=	length of line of same pipe size in feet
Q	=	rate of loss, 0.0015 ft^3/min. per sq. ft. of internal surface

2. Since a K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 02732-3, Minimum Testing Times for Low Pressure Air Test.

3. Notes:

   a. When two sizes of pipe are involved, the time shall be computed by the ratio of lengths involved.
   b. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
   c. Line with an average inside diameter greater than 36 inches must be air tested for leakage at each joint.
   d. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing.
   e. For joint test, the pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum times allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

3.06 LEAKAGE TESTING FOR MANHOLES

A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.

B. Plug influent and effluent lines, including service lines, with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs a minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged if lines entering manhole have not been backfilled.

C. Vacuum Testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure; do not overinflate.

2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for the time period specified in Table 02732-4, Vacuum Test Time Table.

3. If the drop in vacuum exceeds 1 inch Hg over the specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

D. Hydrostatic Exfiltration Testing: Hydrostatic exfiltration testing shall be performed as follows:

1. Seal wastewater lines coming into the manhole with an internal pipe plug. Then, fill the manhole with water and maintain it full for at least one hour.

2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot of manhole diameter per foot of manhole depth per hour.

3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3.07 SMOKE TEST PROCEDURE FOR POINT REPAIRS

A. Application: Perform smoke test to:

1. Locate points of line failure for point repair.

2. Determine if point repairs are properly made.

3. Determine if service connections have been reconnected to the rehabilitated sewer.

4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.

B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in a single manhole section at any one time. Keep the number of open excavations to a minimum.

C. Preparation: Prior to smoke testing, give written notice to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to City's Police and Fire Departments 24 hours prior to actual smoke testing.

D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal the annular space at manhole for sliplined sections.

E. Smoke Introduction:

1. Operate equipment according to manufacturer's recommendation and as approved by the Engineer.

2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for a minimum of 5 minutes.

3. Introduce smoke into upstream and downstream manholes as appropriate. Monitor the tap/connection for smoke leaks. Note sources of leaks.

F. Repair and Retest: Repair and replace any taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at a time. If repair or replacement, testing or retesting, and backfilling of the excavation is not completed within one workday, properly barricade and cover each excavation as approved by the Engineer.

G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to the newly installed liner pipe, perform a dye test to confirm reconnection. Introduce dye into the service line through a plumbing fixture inside the structure or a sewer cleanout immediately outside the structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms a reconnection.

3.08 TELEVISION AND VIDEO INSPECTION

A. Refer to Section 02733 - Cleaning and Television Inspection.

TABLE 02732-1
WATER TEST ALLOWABLE LEAKAGE

DIAMETER OF RISER OR STACK IN INCHES	VOLUME PER INCH OF DEPTH		ALLOWANCE LEAKAGE*	
	Inch	Gallons	Pipe Size in Inches	Gallon/Minute per 100 Ft.
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	10	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value for 1" diameter.			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours.	

* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within the 25-year flood plain

TABLE 02732-2
TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG

Pipe Diameter (in)	Minimum Time (min. sec)	Length for Minimum Time (ft)	Time for Longer Length (sec/ft)	Specification Time for Length (L) Shown (min. sec)										
				100 ft.	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

TABLE 02732-3
MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

PIPE DIAMETER (inches)	MINIMUM TIME (seconds)	LENGTH FOR MINIMUM TIME (feet)	TIME FOR LONGER LENGTH (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	25.856 (L)

TABLE 02732-4
VACUUM TEST TIME TABLE

DEPTH IN FEET	TIME IN SECONDS BY PIPE DIAMETER		
	48"	60"	72"
4	10	13	16
8	20	26	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
*	5.0	6.5	8.0

* Add T times for each additional 2-foot depth.
(The values listed above have been extrapolated from ASTM C 1244)

TABLE 02732-5
PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size(Inches)	Average I.D. / Base I.D.* (Inches)	Minimum Mandrel Diameter (Inches)
PVC-Solid (SDR 26)	6	5.764 / 5.612	5.331
	8	7.715 / 7.488	7.114
	10	9.646 / 9.342	8.875
	12	11.480 / 11.102	10.547
	15	14.053 / 13.575	12.896
	18	17.177 / 16.586	15.757
	21	20.249 / 19.545	18.568
	24	23.296 / 22.480	21.356
	27	25.674 / 24.744	23.507
PVC-Truss	8	7.750	7.363
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
	48	47.500	45.125
HDPE-Profile	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
	60	60.000	57.000
Fiberglass-Centrifugally	12	12.85	11.822
	18	18.66	17.727
	20	20.68	19.646
	24	24.72	23.484
	30	30.68	29.146
	36	36.74	34.903
	42	42.70	40.565
	48	48.76	46.322
	54	54.82	52.079
	60	60.38	57.361

*Base I.D. applies to PVC-Solid (SDR 26) only

END OF SECTION

SECTION 02733

CLEANING AND TELEVISION INSPECTION

1.0 GENERAL

A. The purpose of the cleaning and television inspection of the sewer line is to remove all debris, solids, sand, grease, grit, etc. from the sewer and manholes thus improving pipe flow and performing television inspection for sewer evaluation.

B. Television inspecting the line to obtain quality video and Television Inspection Reports upon which the Engineer can make decisions on condition and regarding needed sewer rehabilitation, and confirm recommended rehabilitation.

2.0 EXECUTION

A. The designated sanitary sewers and manholes shall be cleaned using mechanical, hydraulically propelled and/or high velocity sewer cleaning equipment. The cleaning process shall remove all grease, sand, silt, solids, rags, debris, etc., from each sewer segment, including manholes. Selection of cleaning equipment and the method for cleaning, shall be based on the condition of the sanitary sewer mains at the time work commences and will be subject to the Engineer's approval. All cleaning equipment and devices shall be operated by experienced personnel. Satisfactory precautions shall be taken to protect the sanitary sewer mains and manholes from damage that might by inflicted by the improper use of the cleaning process or equipment. Any damage done to a sewer by the Contractor due to his negligence shall be repaired by him at no additional cost and to the satisfaction of the Engineer. Cleaning shall also include the initial manhole wall, washing by high pressure water jet.

B. The Contractor, when instructed by the Engineer, will be required to demonstrate the performance capabilities of the cleaning equipment proposed for use on the project. If the results obtained by the proposed sanitary sewer cleaning equipment are not satisfactory, the Contractor shall use different equipment and/or attachments, as required, to meet specifications. More than one type of equipment/attachments may be required at a location. When hydraulic or high velocity cleaning equipment is used a suitable sand trap, weir, dam or suction shall be constructed in the downstream manhole in such a manner that all the solids and debris are trapped for removal.

3.0 WATER USAGE

A. The Contractor shall be responsible for obtaining transient water meters from the Owner which shall be installed on the trucks or at fire hydrants. All related charges for the set-up and the water bill shall be considered incidental to the cleaning and television inspection of the existing sanitary sewer mains. Care shall be exercised to prevent contamination of the potable water system. Backflow preventers and/or an 18-inch air gap shall be used by the Contractor when drawing water from a public hydrant. No fire hydrant shall be obstructed or used when there is a fire in the area. The Contractor shall remove the water meters/piping, etc., from all fire hydrants at

the end of each working day. At no time shall water be wasted on streets or plugs left opened.

4.0 HYDRAULIC CLEANING

A. Hydraulically propelled devices which require a head of water to operate, must utilize a collapsible dam. The dam must be easily collapsible to prevent damage to the sewer, property, etc. When using hydraulically propelled devices, precautions shall be taken to insure that the water pressure created does not cause damage or flooding to public or private property, The Contractor shall not increase the hydraulic gradient of the sanitary sewers beyond the elevation that could cause overflow of sewage into area waterways. The flow of wastewater present in the sanitary sewer main shall be utilized to provide necessary fluid for hydraulic cleaning devices whenever possible. The Contractor shall clean and disinfect the areas where spillage/overflow has occurred to the Engineer's satisfaction.

5.0 HIGH VELOCITY CLEANING

A. Cleaning equipment that uses a high velocity water jet for moving debris shall be capable of producing a minimum volume of 50 gpm with a pressure of 1500 psi at the pump. Any variations to this pumping rate must be approved, in advance, by the Engineer. A working pressure gauge shall be used on the discharge or all high pressure water pumps. The Contractor shall use in addition to conventional nozzles, a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18-inch and larger. The Contractor shall operate the equipment so that the pressurized nozzle continues to move at all times. The pressure nozzle shall be turned off or reduced anytime the hose is held or delayed in order to prevent damage to the line.

6.0 MECHANICAL CLEANING

A. Mechanical cleaning, in addition to normal cleaning when required by the Engineer, shall be by approved equipment and accessories driven by power winching devices. The Contractor shall submit the equipment manufacturer's operational manual and guidelines to the Engineer which shall be followed strictly, unless modified by the Engineer. All equipment and devices shall be operated by experienced operators so that they do not damage the pipe in the process of cleaning. Buckets, scrappers, scooters, porcupines, kits, heavy duty brushes, metal pigs and other debris-removing equipment/accessories shall be used as appropriate and necessary in the field, in conjunction with the approved power machines. The use of cleaning devices such as rods, metals pigs, porcupines, root saws, snakes, scooters, sewer balls, kits and other approved equipment, in conjunction with hand winching device, and/or, gas, electric rod propelled devices shall be considered normal cleaning equipment.

7.0 REMOVAL AND DISPOSAL OF DEBRIS

A. All sludge, dirt, sand, rocks, grease and other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing of debris from upstream manhole section to

downstream manhole section will not be allowed. All debris from the manholes shall be loaded into an enclosed container that is permitted by the City for liquid waste hauling.

B. All solids or semi solids resulting from the cleaning operations shall be removed from the site and disposed of at the end of each work day. The Contractor must submit a list of legal disposal sites for dumping. The Contractor shall not be allowed to accumulate debris, and/or liquid waste, sludge, etc., on the site except in totally enclosed containers approved by the Engineer. All waste shall be disposed at a legally permitted disposal site by a transporter which has a valid City Liquid Waste Transporter Permit. The Owner's and Regulator's copies of the completed manifest shall be sent to the Engineer within 24 hours after the disposal of the waste materials.

C. UNDER NO CIRCUMSTANCES SHALL SEWAGE OR SOLIDS REMOVED IN THE CLEANING PROCESS BE DUMPED ONTO STREETS OR INTO DITCHES, CATCH BASINS, STORM DRAINS, SANITARY SEWER MANHOLES, CLEANOUTS OR DUMPS. NO CLEANING SHALL BE DONE PRIOR TO CHECKING BOTH UPSTREAM AND DOWNSTREAM MANHOLES FOR FLOW MONITORS OR OTHER MECHANICAL DEVICES.

8.0 TELEVISION INSPECTION

Prior to pre-construction television (TV) inspection of any sanitary sewer, the Contractor shall clean that sewer as described above. TV inspection of sanitary sewer shall be required as follows:

A. The Contractor shall televise existing sanitary sewers to evaluate lines and provide the video data to the Engineer who will confirm the rehabilitation methodology and identify any additional repairs that would be necessary prior to performing the rehabilitation. It shall be performed on the sanitary sewer lines requiring rehabilitation as shown on the plans/specifications or as directed by the Engineer.

B. Pre-installation TV is an inspection of sewer lines specified for rehabilitation. Use pre-installation TV to confirm cleaning, location of service connections, and constructability of line rehabilitation as shown on the drawings and described in the specifications.

C. Post-installation TV is an inspection to determine that rehabilitation of a sanitary sewer has been completed according to drawings and specifications. The post TV video policy will allow payment for work based on the inspector's daily reports, but still requires the Contractor to submit post rehabilitated television video within one calendar month after the date of the pay estimate in which the segment was completed. If no video data is received within that period, credit for that line segment will automatically be deleted from the following months pay estimate.

D. Contractor shall use the attached Television Inspection Report form to document results of TV inspections. Immediately after cleaning, the sanitary sewer line shall be televised to determine the condition of the line and to locate existing service

connections. It is the Contractor's responsibility to use the proper closed-circuit television inspection equipment to produce a color video. The Contractor shall submit video data and evaluation reports to the City for review. The videos shall be DVD format. Each DVD shall be permanently labeled with the following information:

Project No:_____ Contractor's Name:

Inspection Type: [ ] Survey [ ] Pre-Installation [ ] Post-Installation

DVD No.:_____ Date Televised:_____ Date Submitted:

Street/Easement/Alley (Location):

Pipe Diameter:_____
Pipe Material:_____
Pipe Length: _____

Manhole Station: From:_____ Depth:_____ft._____in.
To:_____ Depth:_____ft._____in.

All video data will become the property of the City. Video shall be a quality sufficient for the Engineer to evaluate the condition of the sanitary sewer, locate the sewer service connections, or verify cleaning.

If quality is not sufficient, the Contractor shall be required to re-televise the sanitary sewer and provide a new DVD at no additional cost to the City. Camera distortions, inadequate lighting, dirty lens or blurred/hazy picture will be cause for rejection of the DVD. Upon completion of the review, the Engineer will notify the Contractor of which sanitary sewers will be rehabilitated or will need additional work. The Engineer reserves the right to delete from the project any or all of the sanitary sewer which do not require rehabilitation in the opinion of the Engineer, however, payment shall be made for the accepted TV inspection video.

E. The Contractor shall provide the City a color video showing the completed work, including the condition of the restored service connection. The video shall be taken by a pan and tilt radial viewing pipe inspection camera that pans ± 275º and rotates 360º. The camera should have an accurate footage counter which shall display on the monitor the exact distance of the camera from the center line of the starting manhole. The camera height shall be adjusted such that the camera lens is always centered (½ I.D. or higher) in the pipe being televised.

In no case, will the television camera be pulled or propelled through the line at a speed greater than (thirty) 30-feet per minute. A lighting system will be necessary for quality pictures. A reflector in front of the camera will enhance lighting in black pipe.

F. Each video shall be accompanied by a TV inspection report, which shall be a written log of all pipe defects, sags, service connection locations and conditions, etc., recorded on a footage basis. These items shall also be recorded on the video by narrative. The pipe defects shall include separate codes for the following: radial cracks, longitudinal cracks, misaligned joints, broken joints, laterals, root intrusion, debris and infiltration. The size/length of the defect shall be reported. The beginning of all sags of ¼ pipe, ½ pipe and underwater as well as where the camera pulls out of the sag shall be reported. The clock position of each service connection and the condition shall be reported. The condition of each service connection will include the distance protruding when appropriate and the type. All other information required for analysis such as degrees of deterioration, deformation or collapsed pipe shall be reported. This log shall also identify the manhole section being televised (defined as the distance in linear feet from the center line of the starting manhole to the center line of the ending manhole), flow and camera direction, type of pipe, pipe condition, weather conditions, type of surface cover, cleaning information or any other information required by the Engineer. The Engineer may provide the Contractor a log form that utilizes codes for the above mentioned defects. At the end of the job, the Contractor shall provide a summary listing of all TV videos provided under this project.

9.0 FLOW CONTROL

TV inspection shall be done one manhole section at a time, and the flow in the section being televised shall be adequately controlled. The depth of wastewater flow shall not exceed that shown below:

Pipe Diameter (Inches)	Depth of Flow (Percent of Pipe Diameter)
6-10	10
12-24	15
Over 24	20

If the wastewater flow depth, during TV inspection of a manhole section, exceeds the maximum allowable previously stated, the Contractor shall reduce the flow depth to an acceptable level by performing the TV inspection during minimum flow hours, by diversion pumping, and/or by pulling a camera with swab or high velocity jet nozzle, as approved by the Engineer. The Contractor shall not be allowed to float the camera as a means to control the flow unless permitted by the Engineer.

10.0 PASSAGE OF TV CAMERA

There may be occasions during the TV inspection of a manhole section when the camera is unable to pass an obstruction even though flow is unobstructed. The Contractor shall televise the manhole section from the other direction in order to obtain a complete video. Whenever such condition arises, the Engineer shall be notified to determine if a repair is necessary. If a repair is required, the Contractor will repair the pipe at the designated location and then re-televise the manhole section to verify completion of the repair unless waived by the Engineer. TV inspection data, when submitted, shall include continuous manhole sections.

When the camera is being pulled from the "other end" of the above manhole section and a second repair location is encountered away from the first repair/obstruction location, the Contractor shall notify the Engineer to review the TV video at the site in a timely manner. The Engineer will direct the Contractor to make one or both repairs. No downtime shall be allowed.

If the two repairs are allowed and completed, the Contractor shall again proceed to re-televise the manhole section. Generally, up to 20-feet of the sewer pipe from the finished end of the first point repair to the starting end of the second point may be lamped, and/or physically inspected at the site, to verify the condition of the sewer without further TV inspection. However, if TV inspection video is required by the Engineer, it shall be submitted at no additional cost to the City.

There is no guarantee that all of the sanitary sewer specified or rehabilitated are clear for the passage of the camera set up. The Contractor shall use his discretion to select the right and safe equipment, tools and methods for securing the passage of the camera, with the approval of the Engineer. The Engineer will always be the one who decides whether a pipe defect is to be repaired or not.

11.0 BYPASS PUMPING

Provide bypass pumping during cleaning and television inspection in accordance with applicable specification item.

TABLE 02733A
TELEVISON INSPECTION CODES

HEADER INFORMATION

LOCATION

A	STREET ROW, HEAVY TRAFFIC
B	STREET ROW, LIGHT TRAFFIC
C	EASEMENT, POOR ACCESS
D	EASEMENT, GOOD ACCESS
E	PARKING LOT, POOR ACCESS
F	PARKING LOT, GOOD ACCESS
G	ALLEY, POOR ACCESS
H	ALLEY, GOOD ACCESS
I	OPEN AREA, POOR ACCESS
J	OPEN AREA, GOOD ACCESS

SURFACE COVER

A	ASPHALT STREET
B	CONCRETE STREET
C	SHELL STREET
D	SIDEWALK
E	TREES/SHRUBS
F	CLOSE TO FENCE
G	OPEN AREA
H	MOVABLE BUILDING
I	UNMOVABLE BUILDING
J	OVERHEAD UTILITIES
K	WATERWAY OR RAILWAY
L	HIGHWAY OR RUNWAY
M	PIPE ABOVE GROUND

PIPE TYPE

ABS	ACRYLONITRILE BUTADIENE STYRENE
BRK	BRICK
CIP	CAST IRON PIPE
CMP	CORRUGATED METAL PIPE
CON	POURED IN PLACE CONCRETE
CPP	CURED IN PLACE PIPE
DIP	DUCTILE IRON PIPE
FRP	FIRBERGLASS REINFORCED PIPE
PLP	PLASTIC LINED CONCRETE PIPE
PEP	POLYETHYLENE PIPE
PVC	POLYVINYLCHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
RPM	REINFORCED PLASTIC MORTAR PIPE
URC	UNREINFORCED CONCRETE PIPE
VCP	VITRIFIED CLAY PIPE

WEATHER

DRY - WET

CODE DESCRIPTIONS

CRACKS

RC-RADICAL LC-LONGITUDINAL

CODES	DESCRIPTION	USE IN
A (1)	<1/2" W, < 1' L	CRK
B (2)	<1/2" W, 1' – 2' L	CRK
C (3)	<1/2" W, > 2' L	CRK
D (4)	>1/2" W, < 1' L	CRK
E (5)	>1/2" W, 1' – 2' L	CRK
F (6)	>1/2" W, > 2' L	CRK
G (7)	HOLE IN PIPE – SMALL	
H (8)	PIPE MISSING - < 60°	
I (9)	PIPE MISSING - > 60°	

JOINTS

MJ – MISALIGNED JOINT BJ – BROKEN JOINT

CODES	DESCRIPTION	USE IN
A (3)	DRP JT > 90% CLEAR	MJ
B (6)	DRP JT 80 – 90% CLEAR	MJ
C (9)	DRP JT < 80% CLEAR	MJ
D (3)	SHF JT > 90% CLEAR	MJ
E (6)	SHF JT 80 – 90% CLEAR	MJ
F (9)	SHF JT < 80% CLEAR	MJ
G (1)	WD JT 2" – 3"	MJ
H (2)	WD JT 3" – 4"	MJ
I (3)	WD JT > 4"	MJ
J (2)	BRK JT – LIGHT	BJ
K (4)	BRK JT – MEDIUM	BJ
L (6)	BRK JT – HEAVY	BJ
N (0)	VISIBLE GASKET	MJ
O (0)	LEAKING AT JOINT	MJ

LATERALS (L)

CODES	DESCRIPTION
A (1)	PRT SER 0" – 1"
B (2)	PRT SER 1" – 2"
C (3)	PRT SER 2" – 3"
D (4)	PRT SER 3" +
E (5)	DEFECTIVE – SERVICE CONN.
F (6)	DEAD/UNUSED SERVICE
G (7)	FACTORY SERVICE
H (0)	PLUMBER SERVICE

ROOTS (R)

CODES	DESCRIPTION
A (1)	ROOTS – LIGHT
B (2)	ROOTS – MEDIUM
C (3)	ROOTS – HEAVY

DEBRIS (D)

CODES	DESCRIPTION
A	DEBRIS – LIGHT
B	DEBRIS – MEDIUM
C	DRBRIS – HEAVY
D	GREASE – LIGHT
E	GREASE – MEDIUM
F	GREASE – HEAVY

INFLOW/INFILTRATION (I)

CODES	DESCRIPTION
A (3)	I/I – LIGHT (0-1 GPM)
B (6)	I/I – MEDIUM (1-5 GPM)
C (9)	I/I – HEAVY (>5 GPM)
D (2)	I/I – SOME EVIDENCE
E (4)	I/I – CONSIDERABLE EVIDENCE
F (6)	I/I – GREAT EVIDENCE
G (0)	I/I – NO EVIDENCE

ALIGNMENT (A)

CODES	DESCRIPTION
A	BEGIN 1/4 PIPE WATER
B	BEGIN 1/2 PIPE WATER
C	CAMERA UNDERWATER
D	END CAMERA UNDERWATER
E	END 1/2 PIPE WATER
F	END 1/4 PIPE WATER

STRUCTURAL

DS – DETERIORATED; OS – OVALITY; CS - COLLAPSED

CODES	DESCRIPTION	USE IN
A (3)	LINE DET – LIGHT	DS
B (6)	LINE DET – MEDIUM	DS
C (9)	LINE DET – HEAVY	DS
D (3)	OVAL < 5%	OS
E (6)	OVAL > 5% & < 10%	OS
F (9)	OVAL > 10%	OS
G (9)	COLLAPSED	CS
H (0)	PIPE DET – HEAVY	DS
L (0)	PIPE DET – LIGHT	DS
M (0)	PIPE DET – MEDIUM	DS
N (0)	PIPE DET – NONE	DS
O	LINE DET – NONE	DS
Z (0)	AT MANHOLE NUMBER	CS

END OF SECTION

SECTION 02762

SANITARY SEWER SERVICE STUBS OR RECONNECTIONS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of stacks and associated service pipe on new sanitary sewers serving areas where sanitary sewer service did not previously exist.

B. Reconnection of existing sanitary sewer service connections along parallel, replacement, or rehabilitated sanitary sewers.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 PERFORMANCE REQUIREMENTS

A. Accurately field locate all service connections, whether in service or not, along the rehabilitated sanitary sewer main.

B. Properly disconnect all existing connections from the existing sewer and reconnect to the rehabilitated liner, as described in this Section.

C. Accurately locate in the field existing service connections and proposed service stubs along the alignment of the new parallel or replacement sewer main.

D. Reconnect all service connections, including those that go to unoccupied or abandoned buildings or to vacant lots, unless directed otherwise by the Engineer.

E. Begin reconnection of service lines immediately after cured-in-place liner has cured.

F. Reconnection by the excavation method shall include the stack and 4-feet of service line, as necessary to the property line for which the connection is intended. The service lines shall be replaced to the right-of-way or easement line (short side and long side) and a cleanout installed at that location.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit product data for each pipe product, fitting, coupling and adapter.

C. Show reconnected services on record drawings. Give the exact distance from each service connection to the nearest downstream.

PART 2 P R O D U C T S

2.01 PVC SERVICE CONNECTION

A. As stubouts, use SDR 26 PVC sewer pipe, 6-inch diameter, conforming to ASTM D1784 and ASTM D3034 with a cell classification of 12454-B.

B. PVC pipe shall be gasket jointed with gasket conforming to ASTM D3212.

C. Provide service connection pipe in sizes shown on the Drawings (6-inch minimum). For reconnection of existing services, provide approved adapter coupling to match existing service line diameter at the right-of-way or easement line.

D. Connect service pipes to new parallel or replacement sewer mains with prefabricated, full-bodied tee or wye fittings conforming to specifications for the sewer main pipe material as specified in other Sections for all sewers up to 18 inches in diameter.

E. Where new sewers are installed using pipe augering or tunneling, or where the new sewer is greater than 18 inches in diameter, use Fowler "Inserta-Tee" to connect the sanitary sewer pipe to the new sewer main.

2.02 PIPE SADDLES

A. Use pipe saddles only on rehabilitated sanitary sewer mains. Comply with Paragraph 2.01D for new parallel and replacement sanitary sewer mains.

B. Supply one-piece prefabricated saddle, either polyethylene or PVC, with neoprene gasket to accomplish a complete seal. Use a saddle fabricated to fit the outside diameter of the pipe to which it will be attached. The protruding lip of the saddle must be at least 5/8-inch long with grooves or ridges to retain the stainless steel band clamps.

C. Use 1/2-inch stainless steel band clamps for securing saddles to liner pipe. The screws, bolts, and associated appurtenances shall be stainless steel.

2.03 COUPLINGS AND ADAPTERS

A. For connection between new PVC pipe stubout and existing service; 4-, 6-, or 8-inch diameter, use flexible adapter coupling consisting of a neoprene gasket and stainless steel shear ring, with 1/2-inch stainless steel band clamps:
   1. Fernco Pipe Connectors, Inc.;
   2. Band Seal by Mission Rubber Co., Inc.;
   3. Approved equal.

B. For connection between new PVC pipe stub out and new service, use rubber-gasketed adapter coupling:
   1. GPK Products, Inc.;
   2. IPS & Sewer Adapter;

3. Approved Equal.

2.04 STACKS

A. Provide stacks for service connections wherever the crown of the sewer is 8 feet or more below finished grade.

B. Construct stacks of the same material as the sanitary sewer unless shown otherwise on the Drawings.

C. Provide stacks of the same nominal diameter at the sanitary sewer line.

2.05 CLEANOUTS

A. Install cleanouts at property line (short side and long side) on each service connection, including concrete pad, as shown in detail on the Drawings.

2.06 PLUGS AND CAPS

A. Seal the upstream end of unconnected sewer service stubs with rubber gasketed plugs or caps of the same pipe type and size. Provide plugs or caps by GPK Products, Inc., or approved equal.

PART 3 E X E C U T I O N

3.01 PERFORMANCE REQUIREMENTS

A. Provide a minimum of 72 hours notice to customers whose sanitary sewer service will potentially be interrupted.

B. Accurately field locate service connections, whether in service or not, as pipe laying progresses from downstream to upstream.

C. Properly disconnect existing connections from the sewer and reconnect to the new sewer, as described in this Section.

D. Reconnect service connections, including those that go to unoccupied or abandoned buildings, unless directed otherwise by the Engineer. Plug the service connection at the right-of-way for vacant lots.

E. Complete reconnection of service lines within 24 hours after disconnection.

F. Reconnection shall include the stack and fittings, cleanout and required pipe length to reconnect service line.

G. Connect services 8 inches in diameter and larger to the sewer by construction of a manhole. Payment for the manhole will be made at the contract unit price for the appropriate manhole diameter and depth.

3.02 PROTECTION

A. Provide barricades and warning lights and signs for excavations created for service connections. Conform to requirements of Section 01570 - Traffic Control and Regulation.

B. Do not allow sand, debris or runoff to enter sewer system.

3.03 PREPARATION

A. Determine the exact location and number of existing service connections from television inspection tapes or from field survey. The Contractor shall accurately field locate all existing service connections, whether in service or not. Use existing service locations to reconnect service line to new liner. The locations may be changed by the Engineer.

B. For new parallel and replacement sanitary sewer mains, complete testing and acceptance of downstream sewers as applicable. Provide for compliance with requirements of Paragraph 3.01E.

C. Allow liner to normalize to ambient temperature and recover from imposed stretch. For cured-in-place liners, verify that liner is completely cured.

3.04 EXCAVATION AND BACKFILL

A. Excavate in accordance with Section 02227 - Excavation and Backfill for Utilities.

B. Provide barricades and warning lights and signs, for excavations created for service connections. Conform to requirements of the Texas Manual on Uniform Traffic Control Devices.

C. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 - Trench Safety System for excavations requiring trench safety.

D. Install and operate necessary ground water and surface water control measures in accordance with requirements of Section 01563 - Control of Ground Water and Surface Water.

3.05 SERVICE RECONNECTION BY EXCAVATION METHOD TO SANITARY SEWER PIPE REHABILITATED BY PIPE BURSTING, CURED-IN-PLACE LINER, AND SLIPLINING

A. Remove a portion of existing sanitary sewer main to expose the liner pipe. Provide sufficient working space for installing a prefabricated pipe saddle.

B. Carefully cut the liner pipe making a hole to accept the stubout protruding from the underside of the saddle. In the event the Contractor chooses to cut the liner pipe using a remote device prior to excavation, no additional payment shall be made for such efforts.

C. Strap on the saddle using a stainless steel band on each side of the saddle. Tighten the bands to produce a watertight seal of the saddle gasket to the liner pipe. Stainless steel bands shall be strapped 360 degrees around line and pipe with the existing pipe removed.

D. Use a saddle with a stubout that protrudes into the liner a depth equal to the liner pipe wall thickness.

E. Remove and replace service line to the street right-of-way line.

F. Make the connection between liner and existing service line using PVC sewer pipe and approved couplings and stainless steel bands to construct new stub outs and/or stacks.

G. Encase the entire service connection in cement stabilized sand. Place a minimum of 6-inches below and 12-inches above and on the sides of the pipe connections.

H. Test the service connections before backfilling.

3.06 SERVICE RECONNECTION ON POINT REPAIR, REMOVE AND REPLACE PIPE OR NEW PIPE

A. Install an in line Wye or Tee fitting at the appropriate location on the new pipe.

B. Remove and replace service line to the street right of way line.

C. Make the connection between the new line and the existing service line using PVC sewer pipe and approved couplings and stainless steel bands to construct new stubouts and or stubs.

D. Encase the entire service connection in cement stabilized sand. Place a minimum of 6-inches below and 12-inches above and on the sides of the pipe connections.

E. Test the service connections before backfilling.

F. Plug existing sewer connections on lines designated to be abandoned after connecting to the new line.

3.07 RECONNECTION ON CURED-IN-PLACE SEGMENTS (REMOTE METHOD) PRIOR TO RECONNECTION BY EXCAVATION

A. Service reconnections shall be made using remote operated cutting tools prior to reconnection by excavation on cured-in-place liners.

B. The method and equipment used shall restore the service connection capacity to not less than 90 percent of original capacity.

C. The Contractor shall immediately open any missed connections and repair any holes drilled in error, by a method approved by the Engineer.

D. Complete reconnection by excavation as per Item 3.05.

3.08 PROTRUDING TAPS:

A. Pipe Bursting and Sliplining:
1. Protruding taps or service connections which obstruct the passage of the television inspection camera during cleaning and during television inspection operations or the insertion of the liner while pulling or pushing shall be removed to allow the liner to pass through. Reconnection of this service to new carrier pipe shall be paid for as a service reconnection.
2. No payment shall be made at this location for any obstruction removal.
3. Abandoned taps/services which are protruding and which must be removed to allow the liner to be inserted into the sewer and the service abandoned, shall not be paid for as an obstruction removal. Payment shall be made for abandonment of service connection.

B. Cured-in-Place Method of Rehabilitation:
1. See Section 02769 - Obstruction Removal (by Remote) and Section 02763 - Point Repairs to Sanitary Sewers.

3.09 INSTALLATION OF NEW SERVICE STUBS

A. Install the new service connections on the new sanitary sewer main for each service connection. Provide the length of stub indicated on the Drawings. Install plug or cap on the upstream end of the service stub as needed.

B. Test service connections before backfilling.

C. Embed the service connection and service line as specified for the new sanitary sewer main at this location, and as shown on the Drawings. Place and compact trench zone backfill in compliance with Section 02227 - Excavation and Backfill for Utilities.

3.10 TESTING

A. Test service reconnections and service stubs. Follow applicable procedures given in Section 02732 - Acceptance Testing for Sanitary Sewers.

3.11 CLEANUP

A. Backfill the excavation as specified in Section 02227 - Excavation and Backfill for Utilities.

B. Replace pavement or sidewalks removed or damaged by excavation in accordance with Section 02571 - Pavement Repair for Utilities. In unpaved areas, bring surface to grade and slope surrounding the excavation. Replace a minimum of 4 inches of topsoil in accordance with Section 2920 - Topsoil and seed according to requirements of Section 02932 - Hydromulch Seeding.

C. Conform to Section 01564 - Waste Material Disposal.

END OF SECTION

SECTION 02763

POINT REPAIRS TO SANITARY SEWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Repairs to existing sewer lines by replacing short lengths of failed pipe.

1.02 UNIT PRICES

A. See Section 01025 - Measurement and Payment for Unit Prices.

1.03 PERFORMANCE REQUIREMENTS

A. Locate and replace small lengths of one or more pipe sections where isolated line failure has occurred due to settlement, corrosion, cracked pipe, crushing or separation of joints.

B. The Engineer may identify potential locations for point repair, but Contractor is responsible for verifying locations by televising the line and providing the videos to the Engineer.

C. The Engineer will authorize each point repair after review of the videos of the televised line. Do not make point repairs without prior approval of the Engineer.

D. Replace carrier pipe for all point repairs unless otherwise directed by the Engineer.

E. Minimum length of pipe to be replaced shall be determined by the depth of sewer line as given in the following table. Measure depth from natural ground to flow line.

Depth of Sewer Line	Minimum Length of Replacement Pipe
0 to 10-feet	6-feet
10 to 15-feet	10-feet
Greater than 15-feet	12-feet

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300.

PART 2 PRODUCTS

2.01 PIPE

A. PVC sewer pipe and joints: 4-inch through 24-inch pipe conforming to the requirements of Section 02620.

2.02 JOINTING MATERIALS

A. Use Fernco adapters secured with ½-inch stainless steel bands, or approved equal and, filter fabric; encase the joint with a reinforced concrete collar.

PART 3 EXECUTION

3.01 PROTECTION

A. Provide barricades and warning lights and signs, for excavations created by point repairs. Conform to requirements of the Texas Manual on Uniform Traffic Control Devices.

B. Do not allow sand, debris or runoff to enter sewer system.

3.02 EXCAVATION

A. Excavate trenches in accordance with Section 02227.

B. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 for excavations over 5-feet deep.

C. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01563.

3.03 BYPASS PUMPING

A. As per Section 02790.

B. Install and operate bypass pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for bypass pumping equipment and procedures from the Engineer.

C. Design all piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

D. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify the Engineer so that required reporting can be made to the Texas Commission on Environmental Quality and the Environmental Protection Agency.

3.04 TYPICAL SEQUENCE OF POINT REPAIR

A. Clean and televise entire line segment from manhole to manhole to verify the location of point repair and the method of rehabilitation. Submit TV inspection video and log data to the City and the Engineer for review prior to commencing point repair.

B. After the City or the Engineer reviews the video and from their recommendation, excavate to the minimum length of existing pipe to be replaced.

C. Prior to replacing pipe, determine condition of the existing line on both sides of point repair by lamping the line a minimum of 10-feet in each direction. Determine whether additional lengths of line beyond "minimum length" criteria, need replacement. Report need for additional replacement to the Engineer and obtain approval before proceeding.

D. Remove and replace failed pipe and connect to existing pipe using Fernco couplings. If joints cannot be made watertight using Fernco adapters, place waterstop gaskets on each joint and encase in a reinforced concrete collar as indicated on the Drawings. Reconnect affected service connections or stacks.

E. Establish proper grade for the pipe being replaced using methods acceptable to the Engineer.

F. After completion of point repair, but prior to backfill, perform a smoke test in the presence of the Engineer. Testing as specified in this section. Repair and retest sections that fail.

G. Encase exposed pipe in cement stabilized sand conforming to Section 02252 as indicated on Drawings.

H. Backfill the excavation as specified in Section 02227.

I. Replace pavement or sidewalks removed or damaged by excavation in accordance with Section 02571. In unpaved areas, bring surface to grade and slope surrounding the excavation. Replace a minimum of 4-inches of topsoil and sod area in accordance with Section 02920.

J. Perform cleaning and post-completion TV inspection as specified in Section 02733. Point repairs that have offset joints, non-uniform grade or alignment, or other unsatisfactory conditions, shall be rejected. Replace pipe and bedding as required when cleaning and television inspection work is rejected. No separate payment shall be made for rectifying defect.

3.05 SMOKE TESTING

A. Equipment Procedures
   1. Pneumatic Plugs

2. Smoke generator as supplied by Superior Signal Company or an approved equal.
3. Blowers producing 2,500 cfm minimum.

B. Application: Perform smoke test to:
1. Locate points of line failure for point repair.
2. Determine if point repairs are properly made.
3. Determine if service connections have been reconnected to the rehabilitated or newly installed sewer.
4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.

C. Limitations: Do not backfill service taps until completion of this test. Test only those taps in a single manhole section at any one time. Keep the number of open excavations to a minimum.

D. Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to City's Police and Fire Departments 24 hours prior to actual smoke testing.

E. Isolate Section: Isolate the manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal the annular space at manhole for sliplined sections.

F. Smoke Introduction:
1. Operate equipment according to manufacturer's recommendation and as approved by the Engineer.
2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for a minimum of 5 minutes.
3. Introduce liquid smoke into upstream and downstream manhole as appropriate. Monitor the tap/connection for smoke leaks. Note sources of leaks.

G. Repair and Retest: Repair and replace any taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at a time. If repair or replacement, testing or retesting, and backfilling of the excavation is not completed within one work day, properly barricade and cover each excavation as per Section 01570.

H. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to the newly installed pipe, perform a dye test to confirm reconnection. Introduce dye into the service line through a plumbing fixture inside the structure or a sewer clean out immediately outside the structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms a reconnection.

END OF SECTION

SECTION 02764

MANHOLE REHABILITATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Repair, rehabilitation, or replacement of deteriorated, leaking, or structurally unsound manholes.

1. Stopping Leaks by repair and sealing of the concrete and/or masonry bench, channel, invert, pipe inlets, walls, cone, chimney and frame of all manholes to include removal of unsound materials, preparation, chemical grouting, structural grouting, patching, plugging and sealing compounds.

2. Surface preparation, and installing of Structural Linings, Corrosion Protection Coating, and/or Flexible Corrosion Protection Lining, to include protection of surfaces not to be treated, touch-up, clean-up and appurtenant work all in accordance with the requirements of the Contract Documents and this Specification.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 PERFORMANCE REQUIREMENTS

A. Perform work needed to make manholes structurally sound, improve flow, prevent entrance of inflow or groundwater, prevent entrance of soil or debris, and provide protection against hydrogen sulfide gas attack.

B. Manufacturer's Product Support - When requested by the Engineer, provide a representative employed by the manufacturer having technical training in admixture and manhole wall liner available for consultation on site with 48 hours' notice. The manufacturer's representative shall submit a written report within one week of each site visit summarizing observations, recommendations with special notes about corrective actions, and photo(s).

1.04 QUALITY ASSURANCE

A. Obtain all chemical grouting materials from a single manufacturer.

B. Installation shall be completed by firms and individuals trained in methods of installation by the manufacturer with at least five years of experience.

C. Personnel shall have confined space entry certification.

D. Field verification shall be completed by the contractor prior to commencement of work.

E. Contractor shall verify the finished thickness of each rehabilitation method prior to starting the next layer and upon completion of the work. The Engineer may obtain core samples at his discretion.

1.05 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Product Data: Submit product data, including surface preparation instructions and application instructions, from manufacturer of wall repair materials, hydraulic cements, quickset mortars, specialized sealants, and grouts.

C. Installer Qualifications. Installers of liners and wall repair systems shall submit qualifications to Engineer at least 14 days prior to start of any material application. Submittal shall consist of:

1. Manufacturer's approved equipment list, by name and model number for application of product and contractor's equipment list showing approved equipment available for use in product application.
2. List of contractor's personnel who have satisfactorily completed manufacturer's training in product application within previous two years. Include date of certification for each person.

1.06 PROJECT CONDITIONS

A. Manholes Containing Mechanical or Electrical Equipment:

1. Drawings may not show locations of flow monitoring equipment. If a manhole contains any mechanical hardware or electrical flow monitoring equipment immediately notify Engineer.
2. Reschedule work in such manholes until equipment has been removed by Owner and further instructions are given.
3. Do not subject manholes with mechanical hardware or electrical equipment to diversion/bypass pumping.
4. Damage to installed equipment, due to negligence of Contractor, will be repaired by Owner and cost of repairs charged to Contractor.

B. Field Location of Manholes, Cleanouts, Inlets, and End of Lines:

1. Contractor is responsible for locating and uncovering all manholes, cleanouts, and end of lines. If difficulty is encountered in locating a manhole, cleanout, or end of line covered by ground or pavement, notify Engineer in writing and await instructions.

2. Manholes may be located within project limits which are not part of the system being rehabilitated. Properly identify manholes before starting cleaning and sealing operations.

1.07 SALVAGE

A. Manhole covers and frames, inlet grates and frames, and adjusting rings from abandoned manholes and inlets remain the property of the Owner. Deliver salvaged items to locations designated by Engineer.

1.08 MATERIAL HANDLING, DELIVERY AND STORAGE

A. Materials shall be delivered in the original unopened containers. Each container shall be clearly labeled with the following:

1) Product name
2) Manufacturers name
3) Component designation
4) Product mix ratio
5) Health and safety information

B. Provide equipment and personnel to handle the materials which prevent damage. The contractor shall promptly inspect delivered materials for damage.

C. Store materials in accordance with manufacturer’s recommendations.

PART 2 P R O D U C T S

2.01 WALL CLEANING MATERIAL

A. High Pressure Water: 3500-psi minimum force.

B. Cleaners: Detergent or muriatic acid capable of removing dirt, grease, oil and other matter which would prevent a good bond of sealing material to wall. Refer to sealing material manufacturer's recommendations.

2.02 WALL REPAIR MATERIALS

A. Hydraulic Cements: Use a blend of cement powders or hydraulic cement to stop active leaks in the manhole structure that meet the following:

1. Compressive strength of 5500 psi in 28-days
2. Tensile strength of 650 psi in 28-days
3. Bond strength of 880 psi in 28 days

B. Quickset Mortar: Use a quickset mortar to repair wide cracks, holes or disintegrated mortar.

2.03 CEMENTITIOUS LINER

A. This method consists of spray applying a cementitious mix to the manhole walls and benches on the existing manholes resulting in a monolithic liner having a minimum thickness of 1-inch. The mix(es) shall be batches in accordance with manufacturer's recommendations. Adding water to facilitate application at the nozzle will not be allowed.

B. Provide preapproved cementitious structural rehabilitation liner material for use as a liner for manhole and to repair and reform manhole benches and inverts. Use a pre-approved cementitious structural manhole rehabilitation material which developed a minimum compressive strength of 3000 psi at 14 days as, tested per the provisions of ASTM C1140. Follow manufacturer's recommended batching and mixing instructions.

C. Select manhole wall liner material from the following list of preapproved products:

1. Permacast CR-9000 (APM Permaform)
2. QM-1S (Quadex)
3. Strong Seal-MS-2C
4. Reliner MSP
5. Permacast-MS-10,000 (APM Permaform)
6. Emaco S88C

2.04 CORROSION RESISTANT MANHOLE MATERIALS

A. The materials to be utilized in the lining of manholes shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. Manufacturer of corrosion protection products shall have long proven experience in the production of the lining products utilized and shall have satisfactory installation record

B. The materials shall be applied by an approved certified applicator and must meet the manufacturer's recommendations. Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.

C. Acceptable 100% Solids Epoxy products are:

1. Raven 405 (RLS Solutions)
2. Mainstay DS-5 (Madewell Products Corporation)
3. Standard Epoxy 4553 (Standard Cement Materials, Inc.)

D. The Contractor shall have manufacturer's representative present on site during the installation of corrosion resistant barrier.

2.05 ALTERNATE STRUCTURAL REPAIR AND PROTECTIVE COATINGS

100% CALCIUM ALUMINATE LINER

1. This method consists of spray applying a 100% Fused Calcium Aluminate (mortar + aggregate) cementitious mix to the manhole walls and benches on the existing manholes resulting in a monolithic liner having a minimum thickness of 1-inch or to the thickness as designed on the bid proposal. The mix(es) shall be batched in accordance with manufacturer's recommendations. Adding water to facilitate application at the nozzle will not be allowed.

2. Provide pre-approved cementitious structural rehabilitation liner material for use as a liner for manhole and to repair and reform manhole benches and inverts. Use a pre-approved cementitious structural rehabilitation material which developed a minimum compressive strength of 5,500 psi at 24 hours as tested per the provisions of ASTM C109. Follow manufacturer's recommended batching and mixing instructions.

3. Select manhole wall liner material from the following list of preapproved products:
   a. SewperCoat PG by Kerneos, Inc. with a 10-year warranty from the manufacturer.

4. The materials to be utilized in the lining of manhole shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. Manufacturer of corrosion protection products shall have long proven experience in the production of the lining products utilized and shall have satisfactory installation record.

5. The materials shall be applied by an approved manufacturer's certified applicator and must have undergone training by the manufacturer. Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.

6. The Contractor shall have manufacturer's representative present on site during the installation of corrosion resistant barrier.

2.06 BENCH FORMING/REPAIR MATERIALS

A. Use corrosion resistant concrete containing microsilica admixtures to repair and reform manhole benches and inverts, as specified in Section 03305.

2.07 MANHOLE COVER, FRAME AND INSERTS

A. See Details on Plan Drawings.

B. Provide manhole inserts including new dish, gasket and relief valves. Select appropriate watertight inserts to fit walls and frames of manholes.

1. Supply inserts as manufactured by Southwestern Packing and Seals, or an approved equal.
2. Inserts shall be stamped with the words, "Property of (Owner's Name)".
3. Provide a frame-to-manhole seal as manufactured by Cretex, or approved equal.

PART 3 E X E C U T I O N

3.01 PROTECTION

A. Provide barricades and warning lights and signs for excavations created by manhole or cleanout removal.

B. Do not allow sand, debris or runoff to enter sewer system.

3.02 EXCAVATION

A. Excavate in accordance with Section 02227.

B. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 for excavations over 5 feet deep.

C. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01563.

3.03 BYPASS PUMPING

A. Install and operate diversion pumping equipment to maintain sewage flow and to prevent backup or overflow in accordance with requirements of the appropriate Section. Obtain approval for diversion pumping equipment and procedures from Engineer.

B. Design all piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify Engineer so that required reporting can be made to the TCEQ and Environmental Protection Agency.

3.04 ABANDONMENT OF CLEANOUTS AND MANHOLES

A. Abandon cleanouts or manholes designated on Drawing or as directed by the Engineer.

B. If a manhole is to be abandoned on a rehabilitated line, install a carrier pipe through the structure and fill manhole with cement stabilized sand, compacted to a level 2 feet above top of carrier pipe.

C. Fill remainder of manhole with selected backfill material to 2 feet below ground level.

D. Dismantle manhole including frame, to 2 feet below ground level. Fill void to existing ground level with select backfill material compacted to 95% Proctor Density.

E. If manhole to be abandoned is in a paved street, backfill manhole as described above with cement stabilized sand in lieu of select backfill material.

3.05 MANHOLE WALL CLEANING

A. The floor and interior walls of the manhole shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, oils, grease, sludge, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate.

1. High pressure water blasting with a minimum of 3500 psi shall be used to clean free all foreign material within the manhole.
2. When grease and oil are present within the manhole, an approved detergent or muriatic acid shall be used integrally with the high pressure cleaning water.
3. All materials resulting from the cleaning of the manhole shall be removed prior to application of the cement based coating.
4. All loose or defective brick, grout, ledges, steps and protruding ledges shall be removed to provide an even surface prior to application of coating.

B. Prevent any foreign material from entering the adjoining pipes. Remove droppings of foreign and wall sealant materials before they harden on the bottom of the manhole.

C. No separate pay shall be made for this item. Include cost for sealing in the unit price for manhole liner.

D. Manufacturer's representative shall be available at all times on site to answer questions and approve manhole preparation work prior to lining.

3.06 MANHOLE WALL SEALING

A. Seal active leaks in the manhole structure by using a blend of cement powder or hydraulic cement.

B. Remove loose or defective wall material. Wipe or brush surface clean prior to the application of hydraulic cements.

C. Drill weep holes at bottom of manhole walls to relieve hydrostatic pressure to stop leaks. Plug pressure relief holes after leaks are stopped using hydraulic cement materials. Lead wool may also be used to plug large leaks.

D. Repair wide cracks, holes, or disintegrated mortar with quickset mortars. Follow manufacturer's application procedures.

E. Reshape manhole inverts before wall sealing work. Apply concrete to cleaned manhole benches as specified in Section 03305.

F. After all active leaks have been stopped, clean and prepare walls for application of selected liner material.

G. Properly apply the sealing compound to provide the minimum required uniform coating to the wall surface.

H. Prevent any foreign material from entering the adjoining pipes. Remove droppings of foreign and wall sealant materials before they harden on the bottom of the manhole.

I. Strictly follow product manufacturer's published technical specifications and recommendations for surface preparation, application and proportioning.

3.07 CEMENTITIOUS LINER

A. Apply cementitious liner to a thickness of 1-inch using a steel trowel to provide a smooth, even surface. Finish and cure concrete as specified in Section 03305.

B. Cementitious liner material may be applied using spray application methods. Use steel trowel to provide a smooth, even surface before final set.

3.08 CORROSION RESISTANT LINER (100% EPOXY)

A. The corrosion resistant barrier shall be spray applied as per the manufacturer’s recommendation and shall have an average minimum finished thickness of 80 mils if applied in conjunction with cementitious liner.

B. Where corrosion resistant barrier is applied directly to manhole wall, upon cleaning and surface preparation, the average minimum finished thickness shall be as noted in the bid proposal.

C. The Contractor shall have manufacturer's representative present on site at all times during the installation of corrosion resistant barrier.

D. The Contractor shall make provisions in his unit price bid for each structure to maintain dry conditions for the corrosion resistant liner application and subsequent curing as per manufacturer's recommendations.

3.09 FIBERGLASS LINER

A. A manhole may be rehabilitated using a fiberglass liner if existing manhole has a minimum 45-inch inside diameter, a depth of at least 4-feet, and approved by the Engineer.

B. Clean manhole and remove corbel section until a 45-inch diameter opening is formed. Engineer may direct Contractor as to amount of corbel or wall to be removed. Do not allow debris to fall into sewer lines.

C. When calculating depth of a fiberglass manhole, allow for a minimum of 18-inches of adjustment rings to be placed between casting bottom and the manhole top. Set adjustment rings in approved grout or mortar.

D. Cut the bottom of rehabilitation manhole to fit evenly on benches or chip benches out to evenly support base.

E. Determine exact location of incoming and outgoing service lines in existing manhole and cut accurate openings for a close fit into manhole.

F. Place the fiberglass liner manhole concentrically into the existing manhole with the openings aligned with existing sewers. Use spacer guides in annular space between existing and rehabilitation manhole. Seal openings with Oakum soaked in sealing gel.

G. Use quick-set hydraulic cement around inside base of the fiberglass manhole and inside the annular space for a depth of 6-inches.

H. Fill the remaining annular space with grout after the hydraulic cement at the bottom has dried. Consolidate grout using a method approved by the Engineer.

I. After the grout has set, install adjustment rings, FRP liner, frame and cover.

J. Line rings using a one-piece fiberglass reinforced pipe (FRP). Seal pipe to casting and manhole with sealing compound. Grout annular space between the FRP and adjustment ring.

3.10 MANHOLE BENCHES/INVERTS

A. Remove obstructions and loose materials from benches prior to shaping the invert. Form a smooth, U-shaped invert having a minimum depth of one-half pipe

diameter and channel it across the floor of the manhole using a quickset mortar. Control flow to allow sufficient setting time for material used.

B. Make finished benches smooth and without defects which would allow for accumulation of debris.

3.11 MANHOLE COVERS AND FRAMES

A. Adjust manhole frames and covers found above or below grade and reset loose frames. Make adjustments with concrete rings or approved materials. Set frames in a full bed of non-shrink grout and adjust to surrounding grade as specified in the pertinent section. Protect bottoms of manhole from debris or soil during adjustment.

B. Install watertight manhole covers and frames at locations shown on the Drawings or as instructed by Engineer. Use new frames and covers.

C. For new sanitary sewer manholes subject to loading or differential movement at manhole frames, and for all rehabilitated manholes, install manhole chimney seals to prevent inflow between manhole frames and masonry chimneys. Refer to Section 02603.

3.12 RECONSTRUCTION OF EXISTING MANHOLE SECTIONS

A. Replace existing manhole cones or sections required that are offset or loose at the joints. Existing cones and manhole sections shall be removed and replaced with same size as removed. All manholes walls shall be aligned with existing walls and shall be set watertight with adjacent manhole sections or frame and cover.

B. All sanitary sewer connections in the manhole within the area designated for replacement shall be replaced at same location and made water tight.

C. All bedding and backfill necessary, as shown on the detail drawings, shall be placed to protect the manhole section from shifting once replaced.

3.13 FIELD QUALITY CONTROL

A. Inform Engineer immediately if materials being used are not producing required results or need modification. Engineer has the right to stop use of any material at any time.

3.14 INSPECTION

A. After manhole wall sealing or manhole rehabilitation has been completed, visually inspect the manhole in the presence of Engineer. Check for cleanliness and for elimination of active leaks.

B. At completion of manhole rehabilitation assist Engineer in verifying installation of minimum coating thickness of concrete liner. Test several points on the manhole wall. Repair verification points prior to final acceptance for payment.

C. During application of corrosion resistant liner, a wet film thickness gauge, meeting ASTM D4414, shall be used. Measurements shall be taken, documented and attested by the Contractor for submission to the Owner.

D. At completion of manhole rehabilitation, assist Engineer in inspection of installation, sealing and grouting of fiberglass liner.

3.15 TESTING

A. Refer to Section 02732 for manhole testing requirements.

B. A vacuum Manhole Tester, in lieu of infiltration test, may be used if criteria and equipment are approved by Engineer.

C. After the coating product(s) have set in accordance with manufacturer instructions, all surfaces shall be inspected for holidays with high-voltage holiday detection equipment. Reference NACE RPO 188-99 for performing holiday detection. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating can be hand applied to the repair area. All touch-up/repair procedures shall follow the coating manufacturer's recommendations. Documentation on areas tested, results and repairs made shall be provided to Owner by Contractor.

D. Visual inspection shall be made by the Project Engineer and/or Inspector. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by Contractor.

3.16 BACKFILL

A. Backfill and compact soil in area of excavation surrounding manholes in accordance with Section 02227.

B. In unpaved areas, grade surface at a uniform slop of 1 to 5 from the manhole frame to natural grade. Provide a minimum of 4 inches of topsoil conforming to requirements of Section 02920 and either seed according to Section 02932 or sod according to Section 02935, as required.

END OF SECTION

SECTION 02765

CURED-IN-PLACE-PIPE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Provision and installment of Cured-In-Place Pipe (CIPP) for the rehabilitation of sanitary sewer or storm sewer.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 PERFORMANCE REQUIREMENTS

A. Rehabilitate deteriorated sewers by forming a tight-fitting CIPP within the existing sewer.

B. The process generally consists of a flexible tube impregnated with an approved resin which is inserted into an existing sewer and cured with heat. Curing is accomplished by circulating heated water or steam to effect the desired cure throughout the length of the tube extending full length from manhole-to-manhole.

C. The CIPP, including flexible tube impregnated with a heat-cured resin, shall cure into a hard, impermeable pipe of the required thickness.

D. The system shall produce a structurally sound, uniformly smooth interior with hydraulic flow equal to or greater than the existing sewer when in new condition.

E. ASTM F1216 shall be the general guide for the materials and installation of the CIPP as modified by this specification. The Owner reserves the right to approve any material or installation practice which may differ from ASTM F1216.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit certified copies of test reports on physical and chemical properties of the resin and the flexible tube.

C. Relevant information from the resin manufacturer shall include specifications, characteristics, properties, and methods of application. A written certification that the resin material complies with the required application, along with curing temperature, and duration of the temperature depending upon the sewer size and CIPP thickness shall be submitted. A blanket letter shall not be sufficient in case of varying CIPP

thicknesses and lengths. This information shall be used during field inspection to verify that proper curing procedures are being followed.

D. Submit certified copies of test reports on CIPP coupons obtained during installation.

E. Submit results of additional product testing performed for quality control. Provide name, designation, and schedule for in-house testing of resin and liner material.

F. Submit an analysis of design criteria and calculations for CIPP thickness.

G. Submit a schedule for verification and inspection of the resin material at the "wet out" of the flexible tube. The inspection shall be at the discretion of the Engineer. Also submit the insertion and heating schedule/plan at least 24 hours in advance of installation.

H. Submit copies of curing temperature/time log sheets in an approved format immediately after curing is complete.

1.05 QUALITY ASSURANCE

A. ASTM F-1216 shall be the general guide for acceptable products and processes.

B. Though the process may be licensed, the Contractor shall not change any material, design values, or procedures during the course of the Contract without the prior written approval of Engineer.

C. The CIPP supplier shall maintain a filing/retrieval system to store certification statements from producers of resin and flexible tubes.

D. Resins shall be tested upon arrival from the manufacturer before being placed in stock.

PART 2 P R O D U C T S

2.01 SUPPLIERS

A. Suppliers of the cured-in-place pipe (CIPP) shall be preapproved by the Owner. Alternative suppliers shall not be considered by prequalification during bidding or substitution during construction.

B. Preapproved suppliers of CIPP are:
1. Inliner
2. Insituform
3. National Liner
4. Novapipe

2.02 MATERIALS

A. Flexible Tube

1. The flexible tube shall be manufactured and fabricated under quality-controlled conditions set by the process manufacturer. Tubes shall be sized so that, when installed, a tube will snugly fit the internal circumference of the existing sewer and produce the required thickness when the liquid thermosetting resin is cured.
2. The minimum length of the flexible tube shall be as necessary to effectively and fully span the actual field distance between manholes, with extra allowance as needed for proper stretching or shrinkage due to pressure or expansion. Include a sufficient amount of material to provide for lateral service cuttings.

B. Resin

1. The liquid thermosetting resin used to impregnate the tube shall produce a properly cured tube which shall be resistant to abrasion due to solids, grit, and sand. The cured tube shall also be resistant to corrosion due to acids and gases such as sulfuric acid, carbonic acid, hydrogen sulfide, methane, and carbon monoxide. The resin selected shall have proven resistance to municipal wastewater.
2. The resin system to be used shall be manufactured by approved company(ies) selected by the CIPP supplier. Only corrosion-resistant polyester and vinylester resins complying with the following requirements shall be used.
3. Polyester Resin. A resin created by reaction products between isophthalic/terathalic acid, maleic anhydride, and a glycol characterized by reactive unsaturation located along the molecular chain. This resin is compounded with a reactive styrene monomer and reacted together with initiators/promoters to produce crosslinked copolymer matrices.
4. Vinylester Resin. A resin crested by reaction products of epoxy resins with methacrylic acid and characterized by reactive unsaturation located in terminal positions of the molecular chain. This resin is compounded with a reactive styrene monomer and reacted together with initiators/promoters to produce crosslinked copolymer matrices.
5. The corrosion resistance of the resin system selected shall be tested by the resin manufacturer in accordance with ASTM C581. Exposure to the chemical solution listed below shall result in a loss of not more than twenty percent of the initial physical properties when tested in accordance with ASTM C581 for a period of not less than one year. For applications other than municipal wastewater, chemical resistance tests shall be conducted with actual samples of the fluid flowing in the pipe and in accordance with procedures approved by the Engineer.

CHEMICAL SOLUTION	CONCENTRATION, %
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	10
Gasoline	100
Vegetable Oil	100
Detergent	0.1
Soap	0.1

C. CIPP Properties

1. The installed CIPP after curing shall meet the minimum structural properties listed below:

PROPERTY	REFERENCE	MINIMUM VALUE
Flexural Strength	ASTM D790	4,500 psi
Flexural Modulus of Elasticity	ASTM D790	250,000 psi

D. CIPP Thickness

1. The installed CIPP after curing shall meet the minimum thickness specified in the following table. The minimum CIPP thickness has been rounded to the next highest multiple of 1.5 mm after adding an allowance of five percent for resin migration.

2.

MINIMUM CIPP THICKNESS				
NOMINAL SEWER DIAMETER (INCHES)	PIPE INVERT DEPTH			
	Up to 10-feet (mm)	10 - 15-feet (mm)	15 - 20-feet (mm)	20-25-feet (mm)
6	4.5	4.5	4.5	6.0
8	6.0	6.0	6.0	7.5
10	6.0	6.0	7.5	9.0
12	6.0	7.5	9.0	10.5
15	7.5	9.0	10.5	12.0
18	9.0	12.0	13.5	15.0
21	10.5	13.5	15.0	16.5
24	12.0	15.0	16.5	19.5
30	15.0	18.0	21.0	24.0
36	16.5	21.0	24.0	28.5
42	19.5	24.0	28.5	33.0
48	22.5	28.5	33.0	36.0
54	25.5	30.0	36.0	42.0
60	28.5	34.5	39	45

3. The minimum thickness for the installed CIPP after curing has been calculated based on the following design conditions:
   a. The existing sewer is considered fully deteriorated.
   b. The existing sewer is considered to have an ovality of 2 percent in circumference.
   c. The CIPP is subjected to a full soil load of 120 pounds per cubic foot.
   d. The CIPP is subjected to traffic line loads as calculated by AASHTO Standard Specifications for Highway Bridges, HS-20-44 Highway Loading.
   e. The modulus of soil reaction for pipe zone backfill material is 700 psi.
   f. The CIPP is subject to a groundwater elevation 5 feet below the ground surface.
   g. The long-term flexural strength and long-term flexural modulus of elasticity for CIPP is equivalent to 50 percent of the initial flexural

strength and initial flexural modulus of elasticity, respectively, as measured in accordance with ASTM D790.

h. The maximum deflection is 5 percent in the vertical axis.

i. The minimum overall factor of safety is 2.0.

4. Bidders shall review the table of CIPP thickness for correctness and, if disagreeing that the minimum CIPP thickness indicated is adequate to meet the design criteria, shall so advise the Engineer. If any modifications to increase CIPP thickness are required, the Engineer will issue such modifications by an addendum.

5. The thickness of the CIPP shall be within minus 5% and plus 10% of the minimum thickness. Thickness greater than required shall not be allowed if hydraulic capacity of the pipe is reduced. The required thickness shall be measured accurately using properly calibrated calipers.

E. FIELD TESTING

1. Flexible tube Thickness - Prior to wet-out; provide access to all flexible tubes intended for the use on the project. Clearly identify flexible tubes with their manufactured thickness. Do not use flexible tubes which fails to meet the specified thickness. Testing will be performed in accordance with ASTM D 5199.

2. Infrared Spectrum Analysis (Chemical Fingerprinting) - Provide access to the resin intended for the use on the project for sampling and chemical fingerprint testing. All testing will be performed in accordance with ASTM E 1252.

3. Physical Property Testing - Post installation physical property testing of the cured composite tube will be performed in accordance with ASTM D 790. Provide sufficient samples for conducting the testing required under ASTM D 790. If sample fails test, work is non-conforming.

4. Cured-in-Place Pipe Thickness - Caliper or other suitable measuring device shall be used to test liner thickness. The testing shall be performed on the samples prepared for physical property testing shall be tested for thickness. All calibration tubes or other non-structural linings and coatings shall be removed prior to testing for thickness. The sample shall be tested at three locations and the average thickness measured shall be taken as the actual thickness of the cured-in-place pipe for the impacted segment. If sample fails test, work is non-conforming.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Inform the Engineer of work schedules for CIPP installation.

B. Conduct operations in accordance with applicable OSHA standards, including those safety requirements involving work on an elevated platform and entry into a confined space. Make suitable precautions to eliminate hazards to personnel near construction activities when pressurized air is being used.

3.02 PRE-INSTALLATION CLEANING AND INSPECTION

A. Rewash and reclean existing sewer, as necessary, immediately before pre-installation television inspection.

B. Perform a television inspection immediately before installation of the resin impregnated flexible tube. Verify that sewer is clean and pipe conditions are as anticipated.

3.03 OBSTRUCTION REMOVAL AND POINT REPAIR

A. Complete point repairs and remove obstructions such as roots, rocks, or other debris prior to CIPP installation.

B. Refer to Section 02763 for point repairs.

C. Obstruction removal may be effected as a point repair or by use of a remote device. For removal by remote device, obtain prior approval of the Engineer.

D. To remove obstructions by remote device, use a solid steel mandrel or porcupine mandrels winched from one manhole to another. Use mandrels of adequate size to remove obstructions encountered. Use of bucket machines to break obstruction is acceptable if no damage to sewer pipe is caused.

3.04 DIVERSION PUMPING

A. Install and operate diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from the Engineer.

B. Design all piping, joints, and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify the Engineer so that required reporting can be made to the Texas Commission on Environmental Quality and Environmental Protection Agency.

3.05 ACCESS PITS

A. Use excavations at point repair locations as access pits when feasible.

B. Before excavating check with utility companies and determine the location of utilities in the vicinity of the work area. Arrange for temporary construction easements and rights-of-way. Damage done to utilities and the resulting repair, temporary service cost, etc., shall be borne by the Contractor.

C. Perform excavation and backfill in accordance with requirements of Section 02161 and Section 02227.

D. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 for excavations over 5 feet deep.

E. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01563.

3.06 INSTALLATION PROCEDURES

A. Wet Out: Designate a location where the flexible tube will be impregnated or wet out with resin. Thoroughly saturate flexible tube prior to installation. A catalyst system, or additive compatible with the resin and flexible tube, may be used as recommended by the manufacturer and with approval of the Engineer. Handle the resin impregnated flexible tube to retard or prevent resin setting until it is ready for insertion.

B. Insertion:
   1. Insert flexible tube through an existing manhole by means of an Inversion Procedure or Pulled-In Procedure. Connect tube ends by an attachment so that a leak-proof seal is created.
   2. Using the "Inversion Procedure", the flexible tube end shall initially be turned inside out and attached to a platform ring, standpipe, or as approved. The addition of water, air, or steam pressure will be adjusted to sufficient height or pressure to cause the impregnated flexible tube to invert from manhole to manhole and hold the tube tight against the existing sewer.
   3. Using the "Pulled-In Procedure", a calibration hose shall initially be turned inside out and attached to a platform ring, standpipe, or as approved. The addition of water, air, or steam pressure will be adjusted to sufficient height or pressure to cause the calibration hose to invert from manhole-to-manhole, and hold the tube tight against the existing sewer.

C. Curing
   1. After insertion is completed, apply a suitable heat source with a water or steam recirculation system capable of delivering hot water or steam uniformly throughout the section to achieve a consistent cure of the resin. Curing temperature shall be as recommended by the resin/catalyst system manufacturer.
   2. The heat source shall be fitted with suitable monitors to gauge the temperature of incoming and outgoing water or steam supply. Another such gauge shall be placed between impregnated tube and invert of the original pipe at the manholes to monitor outside liner temperatures during resin curing process.
   3. Heating shall continue uninterrupted until the desired temperature is achieved. Temperatures shall be measured at both ends by accurate measuring devices. The initials of the Engineer shall be obtained on curing logs if the Engineer is present at the site. Initial cure may be considered completed when exposed portions of the flexible tube pipe take a hard set and temperatures are adequate, as recommended by the resin/catalyst system manufacturer, and approved by the Engineer.

D. Cool Down: Cool the CIPP to a temperature below 110 degrees F before relieving water column or internal pressure. Cool water may be added to the water column while draining hot water from the opposite end of the CIPP, so that a constant water column height or constant internal pressure is maintained until cool-down is completed. Do not release water column or internal pressure in a way that creates a vacuum and damages the CIPP.

E. Copies of curing temperature/time log sheet in approved format shall be submitted to the Engineer immediately after curing is completed. Attach log sheets to daily construction report.

F. Finished Pipe: The finished CIPP shall be continuous and free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. Finished CIPP shall also meet leakage or pressure test requirements.

3.07 SEALING AT MANHOLES

A. The CIPP shall make a tight seal at the manhole opening with no annular gaps. Under all circumstances, a ½-inch-diameter activated Oakum band soaked in sealant shall be applied all around for an approved seal. Any annular spaces greater than 1/2-inch shall be sealed and then covered with a cementitious mortar. Complete the sealing procedure before proceeding to the next CIPP segment.

B. Reshape and smooth the manhole invert as specified in Section 02764.

C. Use cementitious grout to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of CIPP, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new CIPP.

3.08 SERVICE CONNECTIONS

A. For making service reconnections, conform to requirements of Section 02762.

B. Service reconnection may be made by remote-operated cutting tool or by excavation and mechanical connection.

3.09 FIELD QUALITY CONTROL

A. Exotherm tests shall be performed on the resins prior to wet out of the flexible tube.

B. A document shall be prepared during wet out of each CIPP segment showing information such as resin lot numbers, volumes of resin, and catalyst used. The document shall be arranged such that each critical step in the wet out process is checked off and initialized.

C. Charts and/or graphs of the CIPP temperatures at the upstream and downstream manholes shall be made during the curing process to document that proper temperatures and cure times have been achieved.

D. Low pressure air test before each CIPP segment has been sealed in place at the manholes and before any service reconnections have been made. Check integrity of joints that have been made and verify that the CIPP has not been damaged by inserting it into the sewer.

E. Service lateral connection test after all service laterals have been completed for a particular sewer section. Verify integrity of connections at points where they join the CIPP and existing service lines. Refer to Section 02732 for applicable test procedures.

F. Whenever required by the Engineer, a short section of pipe similar to the existing sewer shall be placed in the manhole to install the CIPP under restrained conditions. This pipe section will be used to obtain samples for testing. All samples shall be labeled before shipment for testing. Provide a duplicate sample to the Engineer for inspection and/or testing by an independent laboratory, if requested.

3.10 POST-TELEVISING OF COMPLETED WORK

A. Provide a quality color videos on DVD at standard play showing completed Work including condition of restored connections prior to requesting payment. Refer to Section 02732.

B. Correction of failed CIPP or CIPP deemed unacceptable, as a result of post-television inspection or test reports for structural values, thickness, etc., shall be repaired at no extra cost to the City. Method of repair, which may require field or workshop demonstration, shall be approved by the Engineer.

3.11 FINAL CLEANUP

A. Upon completion of installation work and testing, clean and restore project area affected by the Work, including removal and replacement of fences, damage to yards, lawns, sidewalks, and driveways due to movement of trucks and erection of equipment.

B. Replace pavement or sidewalks removed or damaged by operations in accordance with Section 02571.

C. In unpaved areas, bring surface to grade and slope of area surrounding disturbed portion. Sod the area in accordance with Section 02935, as required.

END OF SECTION

SECTION 02768

PIPE BURSTING/CRUSHING SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Pipe Bursting/Crushing existing sanitary sewers.

1.02 UNIT PRICES

A. See Section 01025 – Measurement and Payment for Unit Price procedures.

1.03 DEFINITIONS

A. Pipe Bursting/crushing: Reconstruction of existing sanitary sewers by the insertion of a liner pipe within the bore of the existing pipe, by breaking and expanding the old pipe.

1.04 SYSTEM DESCRIPTION

A. Pipe bursting/crushing involves rehabilitation of deteriorated gravity sewer pipe by installing new pipe material within the enlarged bore created by using a static, hydraulic, or pneumatic hammer moling device, suitably sized, to break the old pipe, or by using a modified boring knife with a flared plug that crushes the existing sewer pipe. Forward progress of the mole or the knife may be aided by hydraulic equipment or other apparatus. Replacement pipe is either pulled or pushed into the bore.

1.05 QUALITY ASSURANCE

A. Liner Acceptance: Provide liner material which is homogeneous without defects and manufactured to the standards and dimensions specified. Causes for rejection includes physical defects of the liner, such as concentrated ridges, discoloration, excessive spot roughness, pitting, visible cracks, foreign inclusions, and varying wall thickness.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prevent injury or abrasion to pipe during loading, transportation, and unloading. Do not drop pipe from vehicles, nor allow pipe to roll down skids without proper restraining ropes. Use suitable pads, strips, skids, or blocks for each pipe during transportation and while awaiting installation in the field.

B. Pipe with cuts, gashes, nicks, abrasions, or any such physical damage which may have occurred during shipping, storage, or handling, which are deeper than 10 percent of the wall thickness shall not be used and shall be removed from the construction site.

C. Use wide belly band slings for lifting and moving pipe. Do not use bare chains in contact with pipe.

1.07 PERFORMANCE REQUIREMENTS

A. Maintain sewage flow by diversion pumping or other method approved by the Engineer.

B. Clear existing sewers of debris, obstructions and other foreign material and make point repairs to existing sewers as specified in the pertinent section.

C. Perform pipe bursting/crushing according to this Section.

D. Shape manhole inverts as specified in Section 02768 - Manhole Rehabilitation.

E. Test lines as specified in Section 02732 - Acceptance Testing for Sanitary Sewers.

F. Inspect lines by video inspection as specified in Section 02733-Cleaning and Television Inspection.

1.08 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's product data with complete information on pipeline materials, physical properties, and dimensions pertinent to this job. Furnish a certificate of compliance with specifications for materials to be supplied.

C. Submit test reports prepared by an independent testing laboratory certifying that polyethylene pipe conforms to the requirements of ASTM D1248 and ASTM D3350 or that fiberglass reinforced pipe (FRP) conforms to requirements of ASTM D3262 and ASTM D3681, as applicable.

D. Submit manufacturer's product data on clamps.

E. Submit video as specified in Section 02733.

1.09 TESTING

A. The City may run tests on field samples following applicable ASTM specifications at an independent laboratory to verify the required properties and characteristics of supplied materials. Provide product samples as requested by the City Engineer.

B. The City will pay for tests on liner material which meets specifications requirements. Contractor shall pay for failed tests and retesting of failed materials.

PART 2 P R O D U C T S

2.01 PIPE BURSTING/CRUSHING SYSTEMS

A. The following manufactures/companies have been pre-approved as pipe bursting/crushing systems:

1. McConnell Pipe Crushing System
   Houston, Texas

2. Miller Pipeline Corporation (Xpandit System)
   Indianapolis, Indiana

3. PIM Corporation (PIM System)
   Piscataway, New Jersey

4. Trenchless Replacement Systems (TRS)
   Calgary, Canada

5. TT Technologies (Grundocrack Pipe Replacement System)
   Aurora, Illinois

2.02 MANUFACTURERS

A. Liner pipe systems shall be polyethylene or fiberglass reinforced plastic (FRP) products approved by the City.

B. Approved manufacturers for polyethylene liner are Chevron and Phillips.

C. Approved manufacturer for FRP liner is Hobas USA, Inc.

2.03 POLYETHYLENE LINER PIPE AND FITTINGS

A. Provide polyethylene liner pipe, manufactured of solid wall, high density, high molecular weight, polyethylene compound conforming to ASTM D1248, Type III, Class B, Grade P-34, Category 5, with a PPI rating of PE 3408. Use Polyethylene material with a minimum cell classification of 345434D or E (inner wall of Light color) under ASTM D3350. A higher numbered cell classification limit which gives a desirable higher primary property, according to ASTM D3350, is also acceptable. Dimensions and workmanship shall be in accordance with ASTM F714 and ASTM D2122.

B. The maximum Standard Dimension Ratio (SDR), the ratio of outside diameter of pipe to wall thickness, is specified below. Select the SDR for the deeper of two manholes in a particular pipeline segment.

Existing Nominal Diameter (Inches)	Minimum Outside Diameter (Inches)	Minimum Wall Thickness (Inches)		
		<15' Deep	> 15 <20' Deep	>20' Deep
		SDR 19	SDR 17	SDR 11
6-8	8.625	0.454	0.507	0.784
10	10.75	0.566	0.632	0.977
12	12.75	0.671	0.750	1.159
15	16.00	0.842	0.941	1.455
18	20.00	0.947	1.059	1.636

C. Before beginning work, the Contractor shall submit to the Engineer for approval, the vendor's specific technical data with complete physical properties of pipe and pipe dimensions pertinent to this job.

2.04 FRP LINER PIPE AND FITTINGS

A. Provide liner pipe manufactured in conformance to the requirements of ASTM D3262, Type 1, Liner 2, Grade 3. Liner pipe shall be reinforced plastic mortar pipe manufactured by the centrifugal casting process resulting in a dense, nonporous, corrosion resistant, consistent, composite structure. FRP pipe shall have a minimum stiffness of 72 psi measured in accordance with ASTM D2412. Pipes with a stiffness greater than 72 psi may be used with approval of the Engineer.

B. Resin systems shall be thermosetting polyester epoxy resin, with or without filler, producing a pipe conforming to requirements of ASTM D3262.

C. Reinforcing glass fibers shall be commercial grade, E-type glass filaments with binder and sizing compatible with impregnating resins.

D. Filler shall be sand with a minimum 98 percent silica content and a maximum moisture content of 0.2 percent.

E. Joints shall be low-profile FRP jacking bell-and-spigot joints with elastomeric sealing gaskets to produce watertight joint. Joints shall conform to the requirements of ASTM D4161.

F. Dimensions and Tolerances:

1. Pipe outside diameters and tolerances shall be in accordance with ASTM D3262, Cast Iron Pipe Equivalent Outside Diameters and the table below. Supply pipe in

nominal lengths of 20 feet, when possible. Where radius curves in existing pipe or limitations in entry pit dimensions restrict pipe length, shorter lengths may be used.

2. The FRP pipe minimum outside diameter and minimum wall thickness shall be as specified in the following table:

Existing Sewer Nominal Diameter (Inches)	Minimum Liner O.D. (Inches)	Minimum Wall Thickness 46 psi Stiffness (Inches)	Minimum Wall Thickness 72 psi Stiffness (Inches)
12	13.45	0.34	0.48
15-18	19.50	0.34	0.48

3. Fabricated pipe ends square to pipe axis or minus 0.25, inches, or plus or minus 0.5 percent of nominal diameter, whichever is greater.

G. Flanges and Fittings: Flanges, elbows, reducers, tees, wyes, and other fittings shall be capable of withstanding operating conditions. Fittings shall be contact-molded or manufactured from mitered sections of pipe jointed by glass fiber reinforced overlays.

2.05 LINER PIPE SEAL AT MANHOLE

A. The annular space between liner pipe and host sewer at manhole shall be sealed with oakum strips soaked in Scotchseal 5600 as manufactured by 3M Corporation, or approved equal.

B. Grout mix shall be non-shrink grout.

2.06 CLAMPS AND GASKETS

A. Clamps shall be stainless steel, including bolts and lugs as manufactured by JCM Industries, Type 108, or equal. Furnish full circle, universal clamp couplings with a minimum 3/16-inch thick neoprene, grid-type gasket. Select clamps to fit outside diameter of liner pipe. Use minimum clamp (length) as specified in the following table:

Liner Pipe O.D. (Inches)	Minimum *(Length)* of Clamp (Inches)
8.625	18
10.750 or greater	30

2.07 BEDDING MATERIAL

A. Provide bedding conforming to requirements of Section 02227 and Section 02252.

PART 3 E X E C U T I O N

3.01 PRE-INSTALLATION PREPARATIONS

A. Contractor shall submit a work plan to the Engineer for review and acceptance. The work plan shall address the following minimum preparation/steps, unless approved otherwise by the Engineer.

1. Safety - The Contractor shall carry out operations under this Section in strict accordance with all applicable OSHA Standards. Particular attention is drawn to those safety requirements involving work on an elevated platform and entry into a confined space. It shall be the Contractor's responsibility to comply with OSHA Standards and Regulations pertaining to all aspects of the work.

2. Pre-Installation Television Inspection - It shall be the responsibility of the Contractor to video (TV) inspect the sewer pipe immediately before the pipe bursting/crushing to assure that the existing pipe conditions are acceptable for pipe bursting/crushing. This inspection, as well as the Post-TV inspection after the installation, shall be incidental to the installation of the replacement pipe.

3. Bypassing Sewage - When required for acceptable completion of the pipe bursting/crushing process, the Contractor shall provide for continuous sewage flow around the section(s) of pipe designated for the installation of replacement pipe. The pump bypass lines shall be of adequate capacity and size to handle the flow in accordance with the applicable section.

4. Line Obstructions - If Pre-Installation video (TV) inspection reveals an obstruction in the existing sewer (heavy solids, dropped joints, protruding service taps or collapsed pipe) which will prevent completion of the pipe bursting/crushing process, and that cannot be removed by conventional sewer cleaning equipment, then an Obstruction Removal shall be made by the Contractor, with the approval of the Engineer.

5. Sags in Line - If Pre-Installation video (TV) inspection reveals a sag in the existing sewer that is greater than one-half the diameter of the existing pipe, it shall be the Contractor's responsibility to install the replacement pipe to result in an acceptable grade without the sag. The Contractor shall take the necessary measures to eliminate these sags by digging a sag elimination pit and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipe invert or by other measures that shall be acceptable to the Engineer. Elimination of sags in the line shall not be paid separately but shall be included in the unit price bid for pipe bursting/crushing.

3.02 BYPASS PUMPING

A. Refer to Section 02790 – Bypass Pumping.

3.03 INSERTION OR ACCESS PITS

A. Locate pits so that the total number is minimized and footage of liner pipe installed in a single pull is maximized. Use excavations at point repair locations for insertion pits, where possible.

B. Before excavating, check with local utility companies (electric, telephone, gas, cable, and city), and determine the location of utilities in the vicinity of the work area. For damage done to utilities, the resulting repair, temporary service, and other such costs shall be borne by Contractor.

C. Perform excavation and backfill in accordance with requirements of Section 02227.

D. Perform work in accordance with OSHA standards. Follow requirements specified in Section 01526 - Trench Safety System.

E. Install and operate necessary dewatering and surface water control measures in accordance with specifications.

3.04 REMOVAL OR CUTTING OF PLASTIC PIPE TO ALLOW FOR PIPE BURSTING/CRUSHING OF THE SEWER

A. If a pipe that is scheduled to receive rehabilitation is found to have received sliplining or pipe bursting on a previous occasion, the Contractor shall notify the Engineer immediately. The Engineer may direct the Contractor to clean and televise the line segment and/or cut or remove the existing liner in conjunction with the installation of a new pipe via pipe bursting/crushing. Removal or cutting of the existing liner shall be performed upon approval and notification from the Engineer.

B. The Contractor shall provide the means, method, equipment and labor to cut or remove the plastic pipe to allow for the successful pipe bursting/crushing of the sewer.

1. The means or methods utilized by the Contractor shall not disturb the surrounding soil or host pipe to the degree where it will affect the installation and operation of the new pipe to be installed.

2. Cutting of the liner or removal of the existing liner shall not interfere or damage the connections beyond the extent required to disconnect and reconnect the service laterals to the main line.

3. Removal of the existing liner will only be allowed if cutting is not possible.

4. Liner cutting or removal shall be considered complete when the existing pipe has been cut or removed and the new pipe has been successfully installed and accepted.

C. During the liner removal or cutting effort the Contractor may encounter conditions that inhibit pipe removal or the cutting of the pipe. These include, but are not limited to

obstructions, couplings, pipe clamps, or cement stabilized sand. When these conditions stop the advancement of the head, the Contractor shall request approval for an obstruction removal from the Engineer. Once approved, the Contractor shall perform all work necessary to remove the obstruction and allow for the resumption of progress of the liner removal or cutting effort.

D. Line segments with existing conditions that prevent the successful removal or cutting of the liner pipe by conventional methods shall be evaluated on a case by case basis.

3.05 PIPE INSTALLATION

A. The Contractor shall submit information, in detail, of the procedure and the steps to be followed for the installation of the pipe bursting/crushing system selected, even if the process is named in the specification. All such instructions and procedures submitted shall be carefully followed during installation. Any proposed changes in installation procedures shall require submittal of revised procedures and acceptance by the Engineer.

1. Finished Pipe - The installed replacement pipe shall be continuous over the entire length of each pipe segment from manhole to manhole and shall be free from visual defects such as foreign inclusions, concentrated ridges, discoloration, pitting, varying wall thickness, pipe separation and other deformities. Replacement pipe with gashes, nicks, abrasions, or any such physical damage which may have occurred during storage and/or handling, which are larger deeper than 10% of wall thickness shall not be used and shall be removed from the construction site. The replacement pipe passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by the Engineer. The invert and benches shall be streamlined and improved for smooth flow. The installed pipe shall meet the leakage requirements of the pressure test specified.

2. Process Limitations - Though the installation process may be licensed or proprietary in nature, the Contractor SHALL NOT change any material, thickness, design values or procedural matters stated or approved in the submittals, without the Engineer's prior knowledge and preapproval. The Contractor shall submit, in writing, full details about component materials, their properties and installation procedures and abide by them fully during the entire course of the project.

All sewer rehabilitation by pipe bursting/crushing systems are being considered structurally equal processes as far as end products required by the City. The minimum required performance criteria, and/or standards, physical/structural properties, chemicals resistance tests, and the replacement pipe thickness as given in this Specification shall be strictly complied. It shall be the responsibility of the Contractor to comply with the specifications in full without any request for any change after the award of the contract. The City reserves the right to accept, reject, or modify any later requests for change at no additional cost to the City or even to the extent of asking credit for the City.

B. Pipe Jointing

1. Polyethylene Pipe - Sections of polyethylene replacement pipe shall be assembled and jointed on the job site above the ground. Jointing shall be accomplished by the heating and butt-fusion system in strict conformance with the manufacturer's printed instructions.

   The butt-fusion system for pipe jointing shall be carried out in the field by operators with prior experience in fusing polyethylene pipe with similar equipment using proper jigs and tools per standard procedures outlined by the pipe manufacturer. These joints shall have a smooth, uniform, double rolled back head made while applying the proper melt, pressure and alignment. It shall be the sole responsibility of the Contractor to provide an acceptable butt-fusion joint. All joints shall be made available for inspection by the Engineer before insertion. The replacement pipe shall be joined on the site in appropriate working lengths near the insertion pit. The maximum length of continuous replacement pipe which shall be assembled above ground and pulled on the job site at any on time shall be 600 linear feet.

2. Centrifugally Cast Fiberglass Pipe - Sections of centrifugally cast fiberglass pipe shall be manufactured with an integral straight bell, gravity jacking bell-spigot joint. This joint shall be affixed to one end of the pipe by the manufacturer.

   An elastomeric gasket, supplied by the manufacturer, shall be placed on the groove of the spigot, just prior to installation. The gasket shall be properly seated, then lubricated per manufacturer's instruction. All joints shall be made available for inspection by the Engineer before insertion. The replacement pipe shall be jointed in or near the insertion pit.

C. Preparation: After completing insertion pit excavation, remove top of existing sanitary sewer line down to the spring line. Connect a Pipe Bursting/Crushing system to the end of liner by use of a suitable pulling head equal to or greater than the outside diameter of liner. Secure pulling head to liner and attach to Pipe Bursting/Crushing system so that liner can be satisfactorily fed and pulled through sanitary sewer main. Prevent ragged edges of existing pipe from scarring liner pipe. Refer to insertion procedures given in ASTM F585. Do not allow sand or other debris to enter the liner.

D. Pulling Liner:

1. The maximum length of continuous liner which may be assembled above ground and pulled at any one time is the length recommended by the manufacturer's printed instructions.

2. Limit the pulling force exerted on liner so that the forces do not exceed the values indicated below for the device connected to the winch or pulling mechanism.

Polyethylene Liner O.D. (Inches)	Maximum Pulling Force (Tons)
8.625	6.0
10.75	10.0
14.0	17.0
16.0	23.0
18.0	28.0

3.06 FRP LINER PIPE INSTALLATION

A. FRP liner pipes may be pulled into the existing sewer. Insert the pipes, spigot end first, with the bell end trailing. Apply pushing force to pipe wall end inside of bell in accordance with manufacturer's instruction. Do not apply a jacking load to end of bell. Maximum allowable joint angular deflection shall be 1.0 degree. Keep within safe jacking loads given in the following table:

Outside Diameter (Inches)	Maximum Jacking Load (Tons) For 72 psi Stiffness
13.45	22
17.40	30

B. Prior to pulling or pushing the liner, the Contractor shall enlarge the pipe opening at the wall and bench/invert of the manholes by chipping or sawing. If the Contractor fails to enlarge the opening of the manhole and the manhole is damaged, the Contractor shall replace the manhole at no cost to the project.

3.07 CLAMP INSTALLATION

A. Where excavation for liner pipe insertion are made between two manholes, cut ends of the liner pipe smooth, square to its axis. Join liner pipes with approximately sized stainless steel universal clamp couplings. Gap between ends of liner pipe shall be butted together with space between ends not exceeding 1 inch.

B. Bedding shall be stabilized cement sand conforming to requirements of Section 02252 - Cement Stabilized Sand. Bedding shall extend 12" above the clamp/liner pipe.

3.08 FRP COLLAR/CLOSURE

A. FRP collar closure pieces shall be installed in accordance with manufacturer's recommendations.

3.09 FIELD QUALITY CONTROL

A. All costs for testing the replacement pipe by a pressure method will be incidental to the installation. Two types of testing shall be required after the replacement pipe has been installed in the existing sanitary sewer main. The first is a low-pressure air test of the replacement pipe before it has been sealed in place at the manholes, and before any service reconnections have been made. The purpose of this test is to check the integrity of the joints that have been made and to verify that the replacement pipe has not been damaged by inserting it into the sanitary sewer. The second test is a service lateral connection test in accordance with the Section 02762 - Sanitary Sewer Service Reconnections. The test shall be done after all service laterals have been made for a particular pipe segment between adjacent manholes. This test shall verify the integrity of the connection at the point where it joins the replacement pipe and existing service line.

B. Low Pressure Air Test Procedure - Refer to Section 02732 - Acceptance Testing for Sanitary Sewers.

3.10 SEALING LINER IN MANHOLE

A. Allow liner pipe to normalize to ambient temperatures as well as recover from imposed stretch before cutting to fit between manholes, sealing at manholes, and manhole invert shaping. Normalization usually takes at least 12 hours for polyethylene.

B. Cut liner so that it extends 4 inches into manhole. Make a smooth, vertical cut and slope area over top of exposed liner using non-shrink grout.

C. Seal the annular space between liner and sanitary sewer main at each manhole with a chemical seal and nonshrink grout. Place strips of oakum soaked in sealer in a band to form an effective watertight gasket in the annular space between liner and existing opening in manhole. Make width of the sealing band a minimum of 8 inches or the thickness of the manhole wall, whichever is greater.

D. Finish seal with a non-shrink grout placed around annular space from inside manhole. Apply grout in a band not less than 6 inches wide.

E. Reshape and smooth the manhole invert as specified in Section 02764 - Manhole Rehabilitation. Use approved manhole rehabilitation material to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channels invert. Build up and smooth invert of manhole to match flow line of new liner.

F. The replacement pipe in the manhole shall be sealed as specified above before proceeding on to the next manhole section and all manholes shall be individually inspected for replacement pipe cut-offs, benches, and sealing work.

G. Payment for work described above shall be incidental to the unit price bid for pipe bursting/crushing.

3.11 POST INSTALLATION TELEVISING OF COMPLETED WORK

A. The Contractor shall provide the Engineer/City a color video DVD taken by a pan and tilt pipe inspection camera that pans 275 degrees and rotates 360 degrees for close up view showing the completed work, including the condition of the restored service connections.

B. Television inspections, videos and reports, etc., shall be in accordance with Section 02733 - Cleaning and Television Inspection. Upon completion of the installation work and testing, the Contractor shall restore/clean the project area affected by his operations. No trash, rubbish, etc., shall be stored at any site, whether the work is in progress or not.

3.12 FINAL CLEANUP

A. Upon completion of installation work and testing, clean and restore project area affected by the Work. Restoration shall be in accordance with the specifications.

END OF SECTION

SECTION 02769

OBSTRUCTION REMOVAL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

This section includes clearing the sewer main from obstructions by one for the following methods:

A. Obstruction removal by remote device

1. To remove protruding taps (service lines that protrude greater that 1-inch into the sewer)
2. To remove other obstructions

B. Obstruction removal by excavation

1.02 UNIT PRICES

A. See Section 01025 – Measurement and Payment for Unit Price procedures.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 OBSTRUCTION REMOVAL BY REMOTE DEVICE

A. This method of obstruction removal shall be performed prior to rehabilitation. When a video of televised sanitary line identifies an obstruction which could cause a non-uniform liner pipe or obstruction during installation of the liner, it shall be removed. The Contractor shall ask the Engineer for approval of obstruction removal with a remote device using one of the following:

1. To remove protruding taps prior to the rehabilitating with a liner, a power driven cutting device shall be utilized. The protruding tap shall be cut so that the protrusion is no greater than ¼-inch. In the event damage to the existing sewer line or service line occurs, a repair shall be done at the Contractor's expense and only a payment for the remote obstruction removal will be made. If the Contractor is unable to remove the protruding tap by this means, then a point repair may be performed at the Engineer's direction.
2. To remove other obstructions, such as hanging gaskets, fixed debris, stabilized sand, hardened mineral deposits (includes tuberculation in cast or ductile iron pipes), heavy roots, etc., a remote device shall be utilized. The device(s) shall be pulled or driven from manhole to manhole up to a

continuous length of 800-feet using a solid steel mandrel, porcupine, root saw, bucket, etc. to remove the obstruction. The device shall be adequately sized to remove the obstruction to the satisfaction of the Engineer. Damage to the existing sewer line, service line or tap must be repaired by the Contractor and only a payment for remote obstruction removal will be made. The mechanical cleaning method, as described in Section 02733, may be used to remove the obstruction when approved by the Engineer. No separate payment shall be made for utilizing mechanical cleaning method to remove the obstructions. The Contractor shall be paid at the bid unit price for performing obstruction removal (other) irrespective of the method utilized to remove obstruction. Damage to the existing sewer line, service line or tap must be repaired by the Contractor at his expense. The cleaning of the pipe in preparation for rehabilitation is not considered obstruction removal.

3.02 OBSTRUCTION REMOVAL BY EXCAVATION

A. This method of obstruction removal shall be performed while installing the liner in sanitary sewer. If during the liner insertion operation, a collapsed sewer, off-set joint, or other obstruction is encountered which prevents or blocks the passage or insertion of any liner involved in the rehabilitation process, the Contractor shall notify the Engineer for approval to make an excavation to uncover and remove the obstruction in the following manner:

1. Excavate at the point where there is an obstruction. A trench safety system shall be required for all excavations over 5-feet deep.
2. Break out the existing sanitary sewer pipe (carrier pipe), etc., as directed by the Engineer. Remove only that amount of material which is causing the obstruction. The amount of “carrier pipe” to be removed shall be minimized. The minimum length of pipe to be removed shall be six(6) feet for all depths.
3. When the liner is completely in place, it shall be encased with cement stabilized sand as per Class “AA” modified bedding.
4. When obstruction removal by excavation occurs under a paved area, then backfill shall be cement stabilized sand.

B. Under such conditions, replacement of the carrier pipe is not required. The existing sewer bedding should not be disturbed by the excavation work. However, if said bedding is disturbed during the obstruction removal procedure, the Contractor shall place cement stabilized sand beneath the liner; the minimum compacted thickness shall be 12-inches.

C. In the event during the performance of the pre-television inspection of the sanitary sewer line, a protruding or collapsed service prevents the forward progress of the camera, the Contractor shall complete the television inspection via a reverse set up. In the event the television inspection cannot be completed after attempting a reverse set up, the Contractor shall perform obstruction

removal (by excavation) and televise the remainder of the line and submit the television inspection videotape to the Engineer for review and evaluation. The Contractor shall await Engineer's review of the pre television inspection videotapes, and is responsible for providing adequate protection to the areas where obstruction removal (by excavation) was performed as per the specifications. In the event full length rehabilitation is performed, payment for obstruction removal (by excavation) will not be made for obstructions at service connections.

D. Payment for service reconnection (by excavation) shall be made if the obstruction removal performed is at a service connection and the line is rehabilitated full length (pipe bursting, cured-in-place, etc.). No separate payment for obstruction removal (by excavation) will be made for removing the obstruction at a service connection and subsequent full length rehabilitation is performed. If after a review of the pre-television inspection videotape, the sanitary sewer line is not designated for full length rehabilitation and point repairs are recommended, the Contractor shall repair the section of the pipe that was removed to facilitate completion of television inspection as per Section 02763. In those instances, payment for performing the point repair shall be made and no separate payment shall be made for obstruction removal (by excavation).

END OF SECTION

SECTION 02770

LIFT STATION REHABILITATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Repair and/or rehabilitation of deteriorated or structurally unsound lift station basins.

1. Lining and sealing of concrete and/or masonry walls, ceiling, floor, pipe inlets, to include removal of unsound materials, preparation, chemical grouting, structural grouting, patching, plugging and sealing compounds.

2. Surface preparation, and installing of Structural Linings, Corrosion Protection Coating, and/or Flexible Corrosion Protection Lining, to include protection of surfaces not to be treated, touch-up, clean-up and appurtenant work all in accordance with the requirements of the Contract Documents and this Specification.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 PERFORMANCE REQUIREMENTS

A. Perform work needed to make lift station basin structurally sound, prevent entrance of inflow or groundwater, prevent entrance of soil or debris, and provide protection against hydrogen sulfide gas attack.

B. Manufacturer's Product Support - When requested by the Engineer, provide a representative employed by the manufacturer having technical training in admixture and wall liner available for consultation on site with 48 hours notice. The manufacturer’s representative shall submit a written report within one week of each site visit summarizing observations, recommendations with special notes about corrective actions, and photo(s).

C. Obtain all chemical grouting materials from a single manufacturer.

D. Installation shall be completed by firms and individuals trained in methods of installation by the manufacturer with at least five years of experience.

E. Personnel shall have confined space entry certification.

F. Field verification shall be completed by the contractor prior to commencement of work.

G. Contractor shall verify the finished thickness of each rehabilitation method prior to starting the next layer and upon completion of the work. The Engineer may obtain core samples at his discretion.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Product Data: Submit product data, including surface preparation instructions and application instructions, from manufacturer of wall repair materials, hydraulic cements, quickset mortars, specialized sealants, and grouts.

C. Installer Qualifications. Installers of liners and wall repair systems shall submit qualifications to Engineer at least 14 days prior to start of any material application. Submittal shall consist of:

1. Manufacturer's approved equipment list, by name and model number for application of product and contractor's equipment list showing approved equipment available for use in product application.
2. List of contractor's personnel who have satisfactorily completed manufacturer's training in product application within previous two years. Include date of certification for each person.

D. Progress Photographs:

1. After cleaning and sealing each basin, submit color photographs of the basin's interior walls for review by Engineer. Engineer may inspect the basin before giving approval to begin lining.
2. After liner installation of each basin, submit a minimum of three additional color photographs to show final condition of rehabilitated lift station basin.
3. Provide photographs of sufficient quality and clarity so that interior condition can be readily determined by Engineer.
4. Provide with photos the date, lift station number, material used, and appropriate remarks.

1.05 SALVAGE

A. Covers and frames, inlet grates and frames, pipes, brackets, pumps, and all lift station equipment remain the property of the Owner. Deliver salvaged items to locations designated by Engineer.

1.06 MATERIAL HANDLING, DELIVERY AND STORAGE

A. Materials shall be delivered in the original unopened containers. Each container shall be clearly labeled with the following:

1) Product name
2) Manufacturer's name
3) Component designation
4) Product mix ratio
5) Health and safety information

B. Provide equipment and personnel to handle the materials which prevent damage. The contractor shall promptly inspect delivered materials for damage.

C. Store materials in accordance with manufacturer's recommendations.

PART 2 P R O D U C T S

2.01 WALL CLEANING MATERIAL

A. High Pressure Water: 5000-psi minimum force.

B. Cleaners: Detergent or muriatic acid capable of removing dirt, grease, oil and other matter which would prevent a good bond of sealing material to wall. Refer to sealing material manufacturer's recommendations.

2.02 WALL REPAIR MATERIALS

A. Hydraulic Cements: Use a blend of cement powders or hydraulic cement to stop active leaks in the structure that meet the following:

1) Compressive strength of 5500 psi in 28-days

2) Tensile strength of 650 psi in 28-days

3) Bond strength of 880 psi in 28 days

B. Quickset Mortar: Use a quickset mortar to repair wide cracks, holes or disintegrated mortar.

2.03 STRUCTURAL REPAIR AND PROTECTIVE COATINGS

A. CEMENTITIOUS LINER

1. This method consists of spray applying a cementitious mix to the basin walls, ceiling, and floor on the existing basin resulting in a monolithic liner having a minimum thickness as indicated on the drawings and/or the bid proposal. The mix(es) shall be batched in accordance with

manufacturer's recommendations. Adding water to facilitate application at the nozzle will not be allowed.

2. Provide preapproved cementitious structural rehabilitation liner material for use as a liner for basin. Use a pre-approved cementitious structural rehabilitation material which developed a minimum compressive strength of 3,500 psi at 24 hours as tested per the provisions of ASTM C109. Follow manufacturer's recommended batching and mixing instructions.

3. Select wall liner material from the following list of preapproved products:
   a. Permacast CR-9000 (APM Permaform)
   b. QM-1S (Quadex)
   c. Strong Seal-MS-2C
   d. Reliner MSP
   e. Permacast-MS-10,000 (APM Permaform)
   f. Emaco S88C

B. CORROSION RESISTANT BASIN LINER MATERIALS

1. The materials to be utilized in the lining of lift station basins shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. Manufacturer of corrosion protection products shall have long proven experience in the production of the lining products utilized and shall have satisfactory installation record.

2. The materials shall be applied by an approved certified applicator and must meet the manufacturer's recommendations. Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.

3. Acceptable 100% Solids Epoxy products are:
   a. Raven 405 (RLS Solutions)
   b. Mainstay DS-5 (Madewell Products Corporation)
   c. Standard Epoxy 4553 (Standard Cement Materials, Inc.)

4. The Contractor shall have manufacturer's representative present on site during the installation of corrosion resistant barrier.

2.04 ALTERNATE STRUCTURAL REPAIR AND PROTECTIVE COATINGS

A. 100% CALCIUM ALUMINATE BASIN LINER

1. This method consists of spray applying a 100% Calcium Aluminate (mortar + aggregate) cementitious mix to the basin walls, ceiling, and floor on the existing basin resulting in a monolithic liner to the thickness as designed on the bid proposal and on the drawings. The mix(es) shall be

batched in accordance with manufacturer's recommendations. Adding water to facilitate application at the nozzle will not be allowed.

2. Provide preapproved cementitious structural rehabilitation liner material for use as a liner for basin. Use a pre-approved cementitious structural rehabilitation material which developed a minimum compressive strength of 5,500 psi at 24 hours as tested per the provisions of ASTM C109. Follow manufacturer's recommended batching and mixing instructions.

3. Select wall liner material from the following list of preapproved products:
   a. Sewpercoat PG by Kerneos, Inc.

4. The materials to be utilized in the lining of lift station basins shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. Manufacturer of corrosion protection products shall have long proven experience in the production of the lining products utilized and shall have satisfactory installation record.

5. The materials shall be applied by an approved certified applicator and must meet the manufacturer's recommendations. Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.

6. The Contractor shall have manufacturer's representative present on site during the installation of corrosion resistant barrier.

PART 3 E X E C U T I O N

3.01 BYPASS PUMPING

A. Install and operate diversion pumping equipment to maintain sewage flow and to prevent backup or overflow in accordance with requirements of the appropriate Section. Obtain approval for diversion pumping equipment and procedures from Engineer.

B. Design all piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify Engineer so that required reporting can be made to the TCEQ and Environmental Protection Agency.

3.02 LIFT STATION BASIN WALL CLEANING

A. The floor, ceiling, piping, pumps, brackets, anchors, and interior walls of the basin shall be thoroughly cleaned and made free of all foreign materials

including dirt, grit, roots, oils, grease, sludge, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate.

1. High pressure water blasting with a minimum of 3500 psi shall be used to clean free all foreign material within the basin.
2. An approved detergent or muriatic acid shall be used integrally with the high pressure cleaning water.
3. All materials resulting from the cleaning of the basin shall be removed prior to application of the cement based coating.
4. All loose or defective concrete aggregate, cement, brick, grout, ledges, steps and protruding ledges shall be removed to provide an even surface prior to application of coating.

B. Prevent any foreign material from entering the adjoining pipes. Remove droppings of foreign and wall sealant materials before they harden on the bottom of the basin.

C. Manufacturer's representative shall be available at all times on site to answer questions and approve preparation work prior to lining.

3.03 LIFT STATION BASIN WALL SEALING

A. Seal active leaks in the basin structure by using a blend of cement powder or hydraulic cement.

B. Remove loose or defective wall material. Wipe or brush surface clean prior to the application of hydraulic cements.

C. Drill weep holes at bottom of manhole walls to relieve hydrostatic pressure to stop leaks. Plug pressure relief holes after leaks are stopped using hydraulic cement materials. Lead wool may also be used to plug large leaks.

D. Repair wide cracks, holes, or disintegrated mortar with quickset mortars. Follow manufacturer's application procedures.

E. After all active leaks have been stopped, clean and prepare walls and ceiling for application of selected liner material.

F. Properly apply the sealing compound to provide the minimum required uniform coating to the wall surface.

G. Prevent any foreign material from entering the adjoining pipes. Remove droppings of foreign and wall sealant materials before they harden on the bottom of the basin.

H. Strictly follow product manufacturer's published technical specifications and recommendations for surface preparation, application and proportioning.

3.04 CEMENTITIOUS LINER

A. Apply cementitious liner to a thickness as indicated on the drawings and bid proposal using a steel trowel to provide a smooth, even surface. Finish and cure concrete as specified in Section 03305.

B. Cementitious liner material may be applied using spray application methods. Use steel trowel to provide a smooth, even surface before final set.

3.05 CORROSION RESISTANT LINER (100% EPOXY)

A. The corrosion resistant barrier shall be spray applied as per the manufacturer's recommendation and shall have an average minimum finished thickness as indicated in the drawings and bid proposal.

B. Where corrosion resistant barrier is applied directly to manhole wall, upon cleaning and surface preparation, the average minimum finished thickness shall be as noted in the bid proposal.

C. The Contractor shall have manufacturer's representative present on site at all times during the installation of corrosion resistant barrier.

D. The Contractor shall make provisions in his unit price bid for each structure to maintain dry conditions for the corrosion resistant liner application and subsequent curing as per manufacturer's recommendations.

3.06 100% CALCIUM ALUMINATE LINER

A. The structural liner/corrosion resistant barrier shall be spray applied as per the manufacturer's recommendation and shall have an average minimum finished thickness as indicated in the drawings and bid proposal.

B. The Contractor shall have manufacturer's representative present on site at all times during the installation of structural liner/corrosion resistant barrier.

C. The Contractor shall make provisions in his unit price bid for each structure to maintain dry conditions for the corrosion resistant liner application and subsequent curing as per manufacturer's recommendations.

D. Minimum moist curing time is 18 hours or per manufacturer's requirements, whichever is longer.

3.07 FIELD QUALITY CONTROL

A. Inform Engineer immediately if materials being used are not producing required results or need modification. Engineer has the right to stop use of any material at any time.

3.08 INSPECTION

A. After basin wall sealing has been completed, visually inspect the basin in the presence of Engineer. Check for cleanliness and for elimination of active leaks.

B. At completion of lift station rehabilitation assist Engineer in verifying installation of minimum coating thickness of concrete liner. Test several points on the basin wall and ceiling. Repair verification points prior to final acceptance for payment.

C. During application of corrosion resistant liner, a wet film thickness gauge, meeting ASTM D4414, shall be used. Measurements shall be taken, documented and attested by the Contractor for submission to the Owner.

D. At completion of lift station rehabilitation assist Engineer in verifying installation of minimum coating thickness of structural/corrosion resistant 100% calcium aluminate liner. Test several points on the basin wall and ceiling. Repair verification points prior to final acceptance for payment.

3.09 TESTING

A. After the coating product(s) have set in accordance with manufacturer instructions, all surfaces shall be inspected for holidays with high-voltage holiday detection equipment. Reference NACE RPO 188-99 for performing holiday detection. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating can be hand applied to the repair area. All touch-up/repair procedures shall follow the coating manufacturer's recommendations. Documentation on areas tested, results and repairs made shall be provided to Owner by Contractor.

B. Any deficiencies in the finished coating shall be marked and repaired by the Contractor according to the procedures set forth herein.

END OF SECTION

SECTION 02790

BYPASS PUMPING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Use of by-pass pumping to prevent surcharging and maintain un-interrupted flow through sewage collection system while allowing Contractor to provide reliable sewer service to the sanitary sewer users at all times and to isolate sewer line manholes and/or sewer line segments designated for cleaning, rehabilitation, and television inspection operations. Includes installation and operation of bulkheads, plugs, hoses, piping and pumps to maintain sewage flow and prevent backup and overflow.

1.02 UNIT PRICES

A. No separate payment for work performed under this item, unless stated in the bid proposal. Include cost of same in contract price bid for items of work which it is a component.

B. Bypass pumping shall be shall be utilized and shall include but not limited to the following instances.

1. Maintaining flow in the existing sanitary sewer during the duration of the cleaning television inspection (pre and post) and rehabilitation operations.
2. Maintaining rehabilitation/compaction service to all residential and commercial areas during the duration of construction operations.
3. Construction/rehabilitation of proposed manholes.
4. Cleaning and television inspection of the newly constructed or rehabilitated main.
5. Facilitate connections to existing lines or structures.
6. Cleaning and television inspection to verify service connections.
7. Bypass pumping to remove manholes and/or structures.
8. Bypass pumping to facilitate testing.
9. Any bypass pumping required to accomplish the work as necessary regardless of the sequencing and phasing.

C. Measurement and payment for the installation and operation of bypass pumping system to facilitate the construction of the proposed improvements and accomplish various tasks including but not limited to items stated above (See Item ‘A’) shall be incidental to the project cost and shall include all equipment, materials and labor necessary to prevent backup or overflow. It shall include the pumping systems, all pipe, hoses, stand by pumps, connections and any other

appurtenances necessary to operate the system 24 hours a day during the duration of the proposed improvements.

D. The Contractor shall submit a by-pass pumping plan to the Engineer for review and concurrence prior to commencing rehabilitation operations in any given area.

PART 2 M A T E R I A L S

2.01 PUMPS

A. Use electrical powered pumps having a minimum pumping capacity as required.

2.02 PIPING, JOINTS AND ACCESSORIES

A. All piping, joints and accessories shall be designed to withstand at least twice the maximum system pressure or a minimum of 50 psi which ever is greater and be leak free.

PART 3 E X E C U T I O N

3.01 PROCEDURES AND METHODS

A. Prior to beginning sewer cleaning, rehabilitation and television inspection operations demonstrate pumping system is in good working order.

B. Prior to isolating sewer manhole and/or line segment for beginning work have all materials, equipment and labor necessary to complete sewer on job site.

C. Locate pumping suction and discharge lines so as not to cause undue interference with the use of streets, private driveways entrances or residences.

D. All piping, joints and accessories shall be designed to withstand at least twice the maximum system pressure or a minimum of 50 psi whichever is greater.

E. Plug off and pump down sewer manhole or line segment in designated area. Maintain sanitary sewer system so that surcharging does not occur.

F. Complete sewer cleaning, rehabilitation and television inspection operations as quickly as possible.

G. An experienced operator shall be on site at all times to monitor the operation, adjust pump speed, valves, etc.

H. Furnish all labor, materials, supervision and equipment necessary for maintaining the pumping system in continuous proper working order for the duration of cleaning, rehabilitation and television inspection operations. Obtain approval of discharge location for diversion pumping system prior to commencing work. Under no condition will raw sewage be allowed to discharge

in open ditches, streets or storm sewer systems nor in any way that would create unsanitary conditions or interfere unduly with the use of streets, private driveways entrances or residences. Whenever flows in a sewer line are blocked, plugged or bypassed, sufficient precautions must be taken to protect the sewer lines from damage. Ensure that sewer line cleaning, rehabilitation and television inspection and/or by-pass operations do not cause flooding or damage to public or private property being served by the sewer lines involved in the repair. The Contractor is responsible for having additional stand by pumps in the event of failure of any pumps.

I. In the event sewage accidentally drains into the drainage system or street, the Contractor shall immediately stop the overflow, notify the Engineer and cleanup and disinfect the spillage to the satisfaction of the Engineer.

1. In the event the sewage is spilled onto public or private property, the Contractor shall wash down, clean up and disinfect the spillage to the private owner's/Engineer's satisfaction.
2. Overflow/spillage shall be reported to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA) by the Contractor within 24 hours.

J. When diversion pumping operations are complete, piping shall be drained into the sanitary sewer prior to disassembly.

END OF SECTION

SECTION 02920

TOPSOIL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Furnishing and placing topsoil for finish grading and for seeding, sodding and planting.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this section. Include the cost of such work for restoration of the existing vegetation in unit cost for utility and paving items in the Bid Proposal.

PART 2 P R O D U C T S

2.01 TOPSOIL

A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having the following characteristics:

1. pH value of between 5.5 and 6.5.
2. Liquid limit: topsoil not exceed 50
3. Plasticity index: 10 or less.
4. Gradation: maximum of 40 percent with a passing the #280 sieve.

B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.

C. Obtain topsoil from naturally well-drained areas where topsoil occurs at a minimum depth of 4 inches and has similar characteristics to that found at the placement site. Do not obtain topsoil from areas infected with a growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify that excavation and embankment operations have been completed to correct lines and grades.

3.02 TOPSOIL EXCAVATION

A. Conform to excavation and stockpiling requirements of section 02227 – Excavation and Backfill for Utilities.

3.03 PLACEMENT

A. For areas to be seeded or sodded, scarify or plow existing material to a minimum depth of 4 inches. Remove any vegetation and foreign inorganic material. Place 4 inches of topsoil on the loosened material and roll lightly with an appropriate lawn roller to consolidate the topsoil.

B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Section 02229 - Utility Backfill Materials.

C. For areas to receive bushes or trees, excavate existing material and place topsoil to the depth and dimensions as specified in Section 01535 – Tree and Plant Protection.

D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Section 01564 - Waste Material Disposal.

3.04 PROTECTION

A. Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION

SECTION 02932

HYDROMULCH SEEDING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Seeding, fertilizing, mulching, and maintenance of areas.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this section. Include the cost of such work for restoration of the existing vegetation in unit cost for utility and paving items in the Bid Proposal.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit certification from supplier that each type of seed conforms to these specification requirements and the requirements of the Texas Seed Law. Certification shall accompany seed delivery.

C. Submit a certificate stating that fertilizer complies with these specification requirements and the requirements of the Texas Fertilizer Law.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Topsoil: Conform to material requirements of Section 02920 - Topsoil.

B. Seed: Conform to U.S. Department of Agriculture rules and regulations of the Federal Seed Act and the Texas Seed Law. Seed shall be certified 90 percent pure and furnish 80 percent germination and meet the following requirements:

1. Rye: Fresh, clean, Italian rye grass seed (lollium multi-florum), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.

2. Bermuda: Extra-fancy, treated, lawn type common bermuda (Cynodon dactylon). Deliver in original, unopened container showing weight, analysis, name of vender, and germination test results.

3. Wet, moldy, or otherwise damaged seed will not be accepted.

4. Seed requirements, application rates and planting dates are:

Type	Application Rate Pounds/A	Planting Date
Hulled Common Bermuda Grass 98/88 Unhulled Common Bermuda Grass 98/88	40 40	Jan 1 to Mar 31
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88 Unhulled Common Bermuda Grass 98/88 Annual Rye Grass (Gulf)	40 40 30	Oct 1 to Dec 31

C. Fertilizer: Dry and free flowing, inorganic, water-soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear the manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of the following elements:

Nitrogen	10 Percent
Phosphoric Acid	20 Percent
Potash	10 Percent

D. Mulch: Virgin wood cellulose fibers from whole wood chips having a minimum of 20 percent fibers 0.42 inches (10.7 mm) in length and 0.01 inches (0.27 mm) in diameter. Mulch shall be dyed green for coverage verification purposes.

E. Soil Stabilizer: "Terra Tack" 1 or approved equal.

F. Weed control agent: Pre-emergent herbicide for grass areas, "Benefin" or approved equal.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Place and compact topsoil in accordance with requirements of Section 02920 - Topsoil.

3.02 APPLICATION

A. Seed: Apply uniformly at rates given in Paragraph 2.01 B for type of seed and planting date.

B. Fertilizer: Apply uniformly at a rate of 500 pounds per acre.

C. Mulch: Apply uniformly at a rate of 50 pounds per 1000 square feet.

D. Soil stabilizer: Apply uniformly at a rate of 40 pounds per acre.

E. Weed control agent: Apply at manufacturer's recommended rate prior to hydromulching.

F. Suspend all operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold. Obtain the Engineer's approval before resuming operations.

3.03 MAINTENANCE

A. Maintain grassed areas a minimum of 90 days, or as required to establish an acceptable lawn. For areas seeded in the fall, continue maintenance the following spring until an acceptable lawn is established.

B. Maintain grassed areas by watering, fertilizing, weeding, and trimming.

C. Repair areas damaged by erosion by regrading, rolling and replanting.

END OF SECTION

SECTION 02935

SODDING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Restoration of existing lawn areas disturbed by construction shall be by installation of new sod.

B. Sod is defined as blocks, squares, strips of turf grass, and adhering soil used for vegetative planting. To be placed edge to edge for complete coverage.

C. Lawn is defined as ground covered with fine textured grass kept neatly mowed.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this section unless included as a bid item on the Bid Form. Include the cost of such work for restoration of the existing sod or lawn areas in unit cost for utility and paving items in the Bid Proposal.

1.03 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01300 - Submittals.

1.04 QUALITY ASSURANCE

A. Perform sodding only when weather and soil conditions are deemed by Project Engineer to be suitable for proper placement.

B. Water and fertilize new sod.

C. Guarantee sod to be growing 30 days after completion.

D. Maintenance Period:

1. Begin maintenance immediately after each section of grass sod is installed and continue for a 30-day period from date of substantial completion.

2. Resod unacceptable areas.

3. Water, fertilize, control disease and insect pests, mow, edge, replace unacceptable materials, and perform other procedures consistent with good horticultural practice to ensure normal, vigorous and healthy growth. All disease control shall be installed within guidelines set forth by the Structural Pest Control Board of the State of Texas.

E. Notify Engineer 10 days before end of maintenance period for inspection.

PART 2 P R O D U C T S

2.01 SOD

A. Species: Bermuda (Cynodon Dactylon), Buffalo (Buchloe Dactyloides), or St. Augustine.

B. Contents: 95 percent permanent grass suitable to climate in which it is to be placed; not more than 5 percent weeds and undesirable grasses; good texture, free from obnoxious grasses, roots, stones and foreign materials. Block sod is usually a 16” x 16” square.

C. Size: 16 inch wide strips, uniformly 2 inches thick with clean-cut edges.

D. Sod is to be supplied and maintained in a healthy condition as evidenced by the grass being a normal green color.

2.02 FERTILIZER

A. Available nutrient percentage by weight: 12 percent nitrogen, 4 percent phosphoric acid, and 8 percent potash; or 15 percent nitrogen, 5 percent phosphoric acid, and 10 percent potash.

2.03 WEED AND INSECT TREATMENT

A. Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to the Engineer for approval. All insect and disease control shall be installed within guidelines set forth by the Structural Pest Control Board of the State of Texas.

2.04 WATER

A. Potable, available on-site through Contractor's water trucks. Do not use private resident's water.

2.05 BANK SAND

A. Free of clay lumps, roots, grass, salt or other foreign material.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify that top soil placement and compaction has been satisfactorily completed. Verify that soil is within allowable range of moisture content.

B. Topsoil shall be free of weeds and foreign material immediately before sodding.

C. Do not start work until conditions are satisfactory. Do not start work during inclement or impending inclement weather.

D. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions.

E. Spread 2-inch layer of bank sand over areas to be sodded prior to planting of sod.

F. Apply fertilizer at a rate of 25 lbs/1000 SF. Apply after raking soil surface and not more than 48 hours prior to laying sod. Mix thoroughly into upper 2 inches of soil. Lightly water to aid in dissipation of fertilizer.

3.02 APPLICATION

A. Lay sod with closely fitted joints leaving no voids and with ends of sod strips staggered. Sod shall be laid within 24 hours of harvesting.

B. After sod is laid, irrigate thoroughly to secure 6-inch minimum penetration into soil below sod.

C. Tamp and roll sod with approved equipment to eliminate minor irregularities and to form close contact with soil bed immediately after planting and watering. Submit type of tamping and rolling equipment to be used to the Engineer for approval, prior to construction.

3.03 MAINTENANCE

A. Watering:

1. Water lawn areas once a day with minimum 1/2 inch water for the first 3 weeks after area is sodded.

2. After 3-week period, water twice a week with 3/4 inch of water each time unless comparable amount has been provided by rain.

3. Make weekly inspections to determine moisture content of soil unless soil is in frozen condition.

4. Water in the morning to enable soil to absorb maximum amount of water with minimum evaporation.

B. Mowing:

1. Mow sod at intervals which will keep grass height from exceeding 3-1/2 inches.

2. Set mower blades at 2-1/2 inches.

3. Not remove more than one-half of grass leaf surface.

4. Sodded areas requiring mowing within 1 month after installation, shall be mowed with a light-weight rotary type mower. The sod shall be mowed only when dry and not in a saturated or soft condition.

5. Remove grass clippings during or immediately after mowing.

C. Fertilizer and Pest Control:

1. Evenly spread fertilizer composite at a rate of 40 pounds per 5,000 square feet or as recommended by manufacturer. Fertilizer shall not be placed until 2 weeks after placement of sod.

2. Restore bare or thin areas by topdressing with a mix of 50 percent sharp sand and 50 percent sphagnum peat moss.

3. Apply mixture 1/4 to 1/2 inch thick.

4. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.

3.04 CLEANUP

A. During course of planting, remove excess and waste materials; keep lawn areas clean and take precautions to avoid damage to existing structures, plants, grass and streets.

B. Remove barriers, signs and all other Contractor material and equipment from project site at termination of establishment period.

END OF SECTION

SECTION 02999

REMOVE AND RELOCATE ROADWAY TRAFFIC SIGNS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This item provides for the removal and relocation of traffic signs, roadway signs, mail boxes, light and traffic signal poles. Traffic signs shall be relocated in accordance with the "Texas Manual on Uniform Traffic control Devices" (TxMUTCD).

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

PART 2 E X E C U T I O N

2.01 CONSTRUCTION METHODS

A. The contractor shall relocate those traffic signs, etc., that are indicated on the plans to be relocated. They shall be reinstalled with standard break-away type bases.

B. All concrete for footings shall be Class "C" Concrete in accordance with Section 03310 - Structural Concrete, with f'c = 3600 psi.

C. For any location on the job site that is to remain open to traffic, the Contractor is required to furnish and install temporary poles, fittings, fixtures, signals, signs or other incidentals necessary to construct permanent traffic control systems. Such temporary installation shall remain in place until such time as the relocated systems are operational, or until required by the Engineer.

END OF SECTION

SECTION 03305

CONCRETE FOR UTILITY CONSTRUCTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, cast-in-place manholes, inlets, headwalls and miscellaneous small structures.

1.02 UNIT PRICES

A. No payment will be made for concrete for utility construction under this Section unless specifically noted in bid documents. Include payment in applicable utility structure section.

B. Obtain the services of and pay for a certified testing laboratory to prepare design mixes.

1.03 SUBMITTALS

A. Conform to Section 01300 - Submittals.

B. Submit proposed mix design and test data for each type and strength of concrete in the Work.

C. Submit laboratory reports prepared by an independent testing laboratory stating that materials used comply with the requirements of this Section.

D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by the Engineer.

E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.

F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details and other pertinent information.

G. For waterstops, submit product information sufficient to indicate compliance with specifications, including manufacturer's descriptive literature and specifications, when required on Drawings.

1.04 HANDLING AND STORAGE

A. Cement: Store cement off of the ground in a well-ventilated weatherproof building.

B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.

C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to the coating.

PART 2 P R O D U C T S

2.01 CONCRETE MATERIALS

A. Cementitious Material:

1. Portland Cement: ASTM C150, Type II, unless the use of Type III is authorized by the Engineer; or ASTM C595, Type IP. For concrete in contact with sewage use Type II cement.

2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in the form of $Na_2O + 0.658K_20$.

B. Water: Clean, free from harmful amounts of oils, acids, alkalis or other deleterious substances, and meeting requirements of ASTM C94.

C. Aggregate:

1. Coarse Aggregate: ASTM C33. Unless otherwise indicated, use the following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of the narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.

2. Fine Aggregate: ASTM C33.

3. Determine the potential reactivity of fine and coarse aggregate in accordance with the Appendix to ASTM C33.

D. Air Entraining Admixtures: ASTM C260.

E. Chemical Admixtures:

1. Water Reducers: ASTM C494, Type A.

2. Water Reducing Retarders: ASTM 494, Type D.

3. High Range Water Reducers (Superplasticizers): ASTM C494, Types F and G.

F. Prohibited Admixtures: Admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of 0.1 percent by weight of cement.

G. Reinforcing Steel:

1. Use new billet steel bars conforming to ASTM A615, ASTM A767, or ASTM A775, grade 40 or grade 60, as shown on Drawings. Use deformed bars except where smooth bars are specified. When placed in work, keep steel free of dirt, scale, loose or flaky rust, paint, oil or other harmful materials.

2. Where shown, use welded wire fabric with wire conforming to ASTM A185 or ASTM A884. Supply the gage and spacing shown, with longitudinal and transverse wires electrically welded together at points of intersection with welds strong enough not to be broken during handling or placing.

3. Wire: ASTM A82. Use 16-1/2 gage minimum for tie wire, unless otherwise indicated.

H. Fiber:

1. 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: 0.9l.

(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.

1. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A820.

   d. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.

   e. 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. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C309.

2.02 FORMWORK MATERIALS

A. 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. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2-inch (nominal) lumber, or 3/4-inch form plywood backed adequately to prevent misalignment. General use: Provide lumber of 1-inch nominal thickness or form plywood of approved thickness.

B. Formwork for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4-inch minimum thickness, preferably oiled at the mill.

C. 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.

D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.

E. 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.

2.03 PRODUCTION METHODS

A. 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.

2.04 MEASUREMENT OF MATERIALS

A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C685.

B. Measure water and liquid admixtures by volume.

2.05 DESIGN MIX

A. Use design mixes prepared by a certified testing laboratory in accordance with ASTM C1077 and conforming to requirements of this section.

B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to the Engineer for review.

C. Proportioning on the basis of field experience or trial mixtures in accordance with the requirements at Section 5.3 of ACI 318 may be used, if approved by the Engineer.

D. Classification:

Class	Type	Minimum Compressive Strength (Lbs/sq. in.) 7-Day	28-Day	Maximum W/C Ratio	Air Content (Percent)	Range in Slump (Inches)
A	Structural	3200	4000	0.45	4□1	2 to 4*
B	Pipe Block Fill, Thrust Block	----	2500	----	4□1	5 to 7

* When ASTM C494, Type F or type G admixture is used to increase workability, this range may be 6 to 9.

E. Add steel or polypropylene fibers only when called for on the Drawings or in another section of these Specifications.

F. Determine air content in accordance with ASTM C138, ASTM C173 or ASTM C231.

G. Use of Concrete Classes: Use classes of concrete as indicated on the drawings and other specifications. Use Class B for un-reinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, and concrete fill unless indicated otherwise. Use Class A for all other applications.

2.06 PVC WATERSTOPS

A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that the material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.

B. Flat Strip and Center-Bulb Waterstops: As detailed, and as manufactured by: Kirkhill Rubber Co., Brea, California; Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal acceptable to the Engineer, provided that at no place shall waterstop thickness be less than 3/8 inch.

2.07 RESILIENT WATERSTOP

A. Resilient waterstop, where called for on the Drawings, shall be either a bentonite or adhesive type material.

B. Bentonite Waterstop:

1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.

2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.

3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch.

4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.

C. Adhesive Waterstop:

1. Adhesive waterstop shall be at least 2 inches in diameter and shall be Synko-Flex preformed plastic adhesive waterstop by Synko-Flex Products, Inc., or equal. The waterstop shall meet or exceed requirements of Federal Specification SS-S-210A.

2. The adhesive waterstop shall be supplied wrapped completely by a two part protective paper.

3. The adhesive waterstop material shall have independent laboratory tests verifying that the material seals joints in concrete against leakage when subjected to a minimum of 30 psi water pressure for at least 72 hours.

4. Primer, to be used on hardened concrete surfaces, shall be provided by the same manufacturer as the waterstop material.

PART 3 E X E C U T I O N

3.01 FORMS AND SHORING

A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within the tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate cleanout openings. Before placing concrete, remove extraneous matter from within forms.

B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.

C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.

D. Back formwork with a sufficient number of studs and wales to prevent deflection.

E. Re-oil or lacquer the liner on the job before using. Facing may be constructed of 3/4-inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.

F. Unless otherwise indicated, form outside corners and edges with triangular 3/4-inch chamfer strips (measured on sides).

G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.

H. Treat facing of forms with approved form coating before concrete is placed. When directed by the Engineer, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before the concrete is placed, wet surface of forms which will come in contact with concrete.

3.02 PLACING REINFORCEMENT

A. Place reinforcing steel accurately in accordance with approved Drawings. Secure steel adequately in position in forms to prevent misalignment. Maintain reinforcing steel in

place using approved concrete and hot-dip galvanized metal chairs and spacers. Place reinforcing steel in accordance with CRSI Publication "Placing Reinforcing Bars." Request inspection of reinforcing steel by the Engineer and obtain acceptance before concrete is placed.

B. Minimum spacing center-to-center of parallel bars: 2-1/2 times nominal bar diameter. Minimum cover measured from surface of concrete to face of reinforcing bar unless shown otherwise on the Drawings: 3 inches for surfaces cast against soil or subgrade, 2 inches for other surfaces.

C. Detail bars in accordance with ACI 315. Fabricate reinforcing steel in accordance with CRSI Publication MSP-1, "Manual of Standard Practice." Bend reinforcing steel to required shape while steel is cold. Excessive irregularities in bending will be cause for rejection.

D. Do not splice bars without written approval of the Engineer. Approved bar bending schedules or placing drawings constitute written approval. Splice and development length of bars shall conform to ACI 318, Chapters 7 and 12, and as shown on Drawings. Stagger splices or locate at points of low tensile stress.

3.03 EMBEDDED ITEMS

A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping and other embedded items in forms.

B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints unless otherwise indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

3.04 BATCHING, MIXING AND DELIVERY OF CONCRETE

A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C94, Sections 8 through 11. Produce ready-mixed concrete using an automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.

B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C685, Sections 6 though 8.

C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of the Engineer before adjustment and change of mix proportions.

D. Ready-mixed concrete delivered to the site shall be accompanied by batch tickets providing the information required by ASTM C94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing the information required by ASTM C685, Section 14.

E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when the air temperature is at or below 40 degrees F and falling. Concrete may be mixed when temperature is 35 degrees F and rising. Take temperature readings in the shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until the concrete has cured for a minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.

When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.

F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.

G. Hand-mix only when approved by the Engineer.

3.05 PLACING CONCRETE

A. Give sufficient advance notice to the Engineer (at least 24 hours prior to commencement of Operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to the Engineer's approval.

B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, if necessary to continue after daylight hours, light the site as required. If rainfall occurs after placing operations are started, provide covering to protect the Work.

C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.

D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken on initial set; do not place any strain on projecting reinforcement or anchor bolts.

E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.

F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.

G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for the size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move the vibrator vertically through the layer of concrete

just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.

H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.06 WATERSTOPS

A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for the extent of the joint; make splices necessary to provide such continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.

B. Install waterstops in concrete on one side of joints, leaving other side exposed until the next pour. When a waterstop will remain exposed for 2 days or more, shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

C. Splicing PVC Waterstops:

1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.

2. Butt end-to-end joints of 2 identical waterstop sections may be made in the forms during placement of waterstop material.

3. Prior to placement in formwork, prefabricate all waterstop joints involving more than two ends to be joined together, an angle cut, an alignment change, or the joining of two dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the Engineer, install prefabricated waterstop joint assemblies in formwork, and butt-weld ends of the 24-inch strips to the straight-run portions of waterstop in the forms.

D. Setting PVC Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete and to prevent folding over of the waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.

2. Where a waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to a waterstop in a future concrete placement, terminate the waterstop 6 inches below the top of the wall.

E. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying the Contract Documents.

F. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations except as otherwise indicated and specified.

2. When requested by the Engineer, provide technical assistance by manufacturer's representative in the field at no additional cost to the Owner.

3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.

4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop a minimum of 6 inches and place in contact with the PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form a smooth joining surface.

5. At the free top of walls without connecting slabs, stop the resilient waterstop and grooves (where used) 6 inches from the top in vertical wall joints.

6. Bentonite Waterstop:

a. Locate bentonite waterstop as near as possible to the center of the joint and extend continuous around the entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.

b. Where thickness of the concrete member to be placed on the bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1-1/4 inches wide formed or ground into the concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.

c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm the material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.

d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth if necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using an epoxy grout which completely fills voids and irregularities beneath the waterstop material. Prior to installation, wire brush the concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.

e. In addition to the adhesive backing provided with the waterstop, secure bentonite waterstop in place with concrete nails and washers at 12-inch maximum spacing.

1. Adhesive Waterstop:

f. Thoroughly clean the concrete surface on which the waterstop is to be placed with a wire brush and coat with primer.

g. If the surface is too rough to allow the waterstop to form a complete contact, grind to form an adequately smooth surface.

h. Install the waterstop with the top protective paper left in place. Overlap joints between strips a minimum of 1 inch and cover back over with the protective paper.

i. Do not remove protective paper until just before final formwork completion. Concrete shall be placed immediately. The time that the waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

3.07 CONSTRUCTION JOINTS

A. Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.

2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of the Engineer. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.

B. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

3.08 CURING

A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for a period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from the concrete surface after placing and finishing. A curing day is any calendar day in which the temperature is above 50 degrees F for at least 19 hours. Colder days may be counted if air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not

provided, removal of forms and shoring may be permitted at the end of calendar days equal to twice the required number of curing days. However, leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Engineer.

B. Cure formed surfaces not requiring rub-finished surface by leaving forms in place for the full curing period. Keep wood forms wet during the curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.

C. Rubbed Finish:

1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging the surface.

2. After rub-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.

D. Unformed Surfaces: Cure by membrane curing compound method.

1. After concrete has received a final finish and surplus water sheen has disappeared, immediately seal surface with a uniform coating of approved curing compound, applied at the rate of coverage recommended by manufacturer or as directed by the Engineer. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of the compound.

2. Thoroughly agitate the compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.

3. Do not apply compound to a dry surface. If concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or if rain falls on a newly coated surface before film has dried sufficiently to resist damage, apply an additional coat of compound at the specified rate of coverage.

3.09 REMOVAL OF FORMS AND SHORING

A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rub-finish when concrete has aged for the required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement,

B. Leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Engineer.

3.10 DEFECTIVE WORK

A. Immediately repair any defective work discovered after forms have been removed. If concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace the entire section.

3.11 FINISHING

A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use a stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with the surface.

B. Apply a rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet the surface with a brush and perform first surface rubbing with No. 16 carborundum stone or equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce a smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or equal. After rubbing, allow paste on the surface to reset; then wash surface with clean water. Leave structure with a clean, neat and uniform-appearing finish.

C. Apply a wood float finish to concrete slabs.

3.12 FIELD QUALITY CONTROL

A. Testing shall be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Unless otherwise directed by the Engineer, the following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by an approved independent testing agency, and conform to the requirements of ASTM C1077.

1. Take concrete samples in accordance with ASTM C172.

2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test the specimens in accordance with ASTM C31 and ASTM C39.

3. When taking compression test specimens, test each sample for slump according to ASTM C143, for temperature according to ASTM C1064, for air content according to ASTM C231, and for unit weight according to ASTM C138.

4. Inspect, sample and test concrete in accordance with ASTM C94, Section 13, 14 and 15, and ACI 311-5R.

C. Test Cores: Conform to ASTM C42.

D. Testing High Early Strength Concrete: When Type III cement is used in concrete, the specified 7-day and 28-day compressive strengths shall be applicable at 3 and 7 days, respectively.

E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. If additional curing fails to produce the required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by the Engineer, at no additional cost to the Owner.

3.13 PROTECTION

A. Protect concrete against damage until final acceptance by the Owner.

B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide such protection while the concrete is still plastic, and whenever such precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until all components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the Engineer.

END OF SECTION

SECTION 03310

STRUCTURAL CONCRETE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cast-in-place normal-weight structural concrete and mass concrete.

1.02 UNIT PRICES

A. Measurement for structural concrete is on lump-sum basis for each structure as bid. Payment includes related work performed on these structures in accordance with related sections of these Specifications.

B. Measurement for extra structural concrete is on cubic-yard basis. Payment includes related work performed in accordance with related sections.

1.03 DEFINITIONS

A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

B. Hot Weather: Any combination of high air temperature, low relative humidity and wind velocity tending to impair quality of fresh or hardened concrete or otherwise resulting in abnormal properties.

C. Cold Weather: Period when, for more than 2 successive days, mean daily temperature is below 40 degrees F.

1.04 SUBMITTALS

A. Conform to all provisions and sections of these specifications.

B. Mill Certificates: Required for bulk cement.

C. Design Mixes:

1. Submit test data on proposed design mixes for each type of concrete in the Work, including each class, and variations in type, source or quantity of material. Include type, brand and amount of cementitious materials; type, brand and amount of each admixture; slump; air content; aggregate sources, gradations, specific gravity and absorption; total water (including moisture in aggregate); water/cement ratio; compressive strength test results for 7 and 28 days; and shrinkage tests for Class C and D concrete at 21 or 28 days of drying.

2. Submit abrasion loss and soundness test results for limestone aggregate.

3. Testing of aggregates, including sieve analysis, shall be performed by a certified independent testing laboratory. Tests shall have been performed no earlier than 3 months before Notice to Proceed.

4. Provide standard deviation data for plant producing concrete. Data shall include copies of laboratory test results and standard deviation calculated in accordance with ACI 318, Item 5.3.1. Laboratory tests shall have been performed within past 12 months. When standard deviation data is not available, comply with ACI 318, Table 5.3.2.2.

5. Review and acceptance of mix design does not relieve Contractor of responsibility to provide concrete of quality and strength required by these Specifications.

D. Admixtures: Submit manufacturer's technical information, including following:

1. Air-Entraining Admixture: Give requirements to control air content under all conditions, including temperature variations and presence of other admixtures.

2. Chemical Admixtures: Give requirements for quantities and types to be used under various temperatures and job conditions to produce uniform, workable concrete mix. Submit evidence of compatibility with other admixtures and cementitious materials proposed for use in design mix.

E. High-Range Water Reducer (Superplasticizer): When proposed for use, submit manufacturer's technical information and instructions for use of superplasticizer. State whether superplasticizer will be added at ready-mix plant or job site. When superplasticizer will be added at job site, submit proposed plan for measuring and adding superplasticizer to concrete mix at job site, and establish dosing area on site with holding tanks and metering devices. When superplasticizer is to be added at ready-mix plant, submit contingency plans for adding additional superplasticizer at job site when required due to delay in placing concrete. Identify portions of Work on which superplasticizer is proposed for use.

F. Hot and Cold Weather Concreting: Submit, when applicable, proposed plans for hot and cold weather concreting. Review and acceptance of proposed procedure will not relieve Contractor of responsibility for quality of finished product.

G. Project Record Drawings: Accurately record actual locations of embedded utilities and components which are concealed from view.

1.05 QUALITY ASSURANCE

A. Provide necessary controls during evaluation of materials, mix designs, production and delivery of concrete, placement and compaction to assure that the Work will be accomplished in accordance with Contract Documents. Maintain records of concrete placement. Record dates, locations, quantities, air temperatures, and test samples taken.

B. Code Requirements: Concrete construction for buildings shall conform to ACI 318. Concrete construction for water and wastewater treatment and conveying structures shall conform to ACI 318 with modifications by ACI 350R, Item 2.6. Where this Specification conflicts with ACI 318 or ACI 350R, this Specification governs.

C. Testing and Other Quality Control Services:

1. Concrete testing required in this section, except concrete mix design, limestone aggregate test data, and testing of deficient concrete, will be performed by an independent commercial testing laboratory employed and paid by the Owner in accordance with Section 01410 - Testing Laboratory Services.

2. Provide material for and cooperate fully with Owner's testing laboratory technician in obtaining samples for required tests.

3. Standard Services: The following testing and quality control services will be provided by Owner in accordance with Section 01410, Testing Laboratory Services:

a. Verification that plant equipment and facilities conform to NRMCA "Certification of Ready-Mix Concrete Production Facilities".

b. Testing of proposed materials for compliance with this Specification.

c. Review of proposed mix design submitted by Contractor.

d. Obtaining production samples of materials at plants or stockpiles during work progress and testing for compliance with this Specification.

e. Strength testing of concrete according to following procedures:

(1). Obtaining samples for field test cylinders from every 100 cubic yards and any portion less than 100 cubic yards for each mix design placed each day, according to ASTM C172, with each sample obtained from a different batch of concrete on a representative, random basis. Selecting test batches by any means other than random numbers chosen before concrete placement begins is not allowed.

(2). Molding four specimens from each sample according to ASTM C31, and curing under standard moisture and temperature conditions as specified in Sections 7(a) and (b) of ASTM C31.

(3). Testing two specimens at 7 days and two specimens at 28 days according to ASTM C39, reporting test results averaging strengths of two specimens. However, when one specimen evidences improper sampling, molding or testing, it will be

discarded and remaining cylinder considered test result. When high-early-strength concrete is used, specimens will be tested at 3 and 7 days.

f. Air content: For each strength test, determination of air content of normal weight concrete according to ASTM C231.

g. Slump: For each strength test, and whenever consistency of concrete appears to vary, conducting slump test in accordance with ASTM C143.

h. Temperature: For each strength test, checking concrete temperature in accordance with ASTM C1064.

i. Lightweight concrete: For each strength test, or more frequently when requested by the Owner's Representative, determination of air content by ASTM C567 and unit weight by ASTM C567.

j. Monitoring of current and forecasted climatic conditions to determine when rate of evaporation, as determined by Figure 2.1.5 of ACI 305R, will produce loss of 0.2 pounds of water, or more, per square foot per hour. Testing lab representative will advise Contractor to use hot weather precautions when such conditions will exist during concrete placement, and note on concrete test reports when Contractor has been advised that hot weather conditions will exist.

k. Class A and D Concrete Shrinkage Tests: Performance of drying shrinkage tests for trial batches as follows:

(1). Preparation and Testing of Specimens: Compression and drying shrinkage test specimens will be taken in each case from the same concrete sample; shrinkage tests will be considered a part of the normal compression tests for the project. 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C157, modified as follows:

(2). Wet curing: Remove specimens from molds at an age of 23 hours 1 hour after trial batching and immediately immerse in water at 70 degrees F 3 degrees F for at least 30 minutes;

(a). Measure within 30 minutes after first 30 minutes of immersion to determine original length (not to be confused with "base length");

(b). Then submerge in saturated limewater, at 73 degrees F 3 degrees F, for 7 days;

(c). Then measure at age 7 days to establish "base length" for drying shrinkage calculations ("zero" days drying age);

(d). Calculate expansion (base length expressed as a percentage of original length);

(e). Immediately store specimens in a temperature- and humidity-controlled room maintained at 73 degrees F, +3 degrees F and 50 percent +4 percent relative humidity, for the remainder of the test.

(f). Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (initial length of specimen when created) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage.

(g). Report shrinkage separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

4. Additional Testing and Quality Control Services: The following will be performed by an independent commercial testing laboratory employed and paid by the Owner in accordance with Section 01410, Testing Laboratory Services, when requested by the Owner's Representative.

a. Checking of batching and mixing operations.

b. Review of manufacturer's report of each cement shipment and conducting laboratory tests of cement.

c. Molding and testing reserve 7-day cylinders or field cylinders.

d. Conducting additional field tests for slump, concrete temperature and ambient temperature.

e. Alkalinity Tests: For concrete used in sanitary structures, one test for each structure. Perform alkalinity tests on concrete covering reinforcing steel on the inside of the pipe or structure in accordance with "Encyclopedia of Industrial Chemical Analysis," Vol. 15, page 230.

5. Contractor shall provide the following testing and quality control services:

   a. Employ an independent commercial testing laboratory, acceptable to Owner, to prepare and test design mix for each class of concrete for which material source has been changed.

   b. Notify commercial testing laboratory employed by Owner 24 hours prior to placing concrete.

6. Testing of deficient concrete in place:

   a. When averages of three consecutive strength test results fail to equal or exceed specified strength, or when any individual strength test result falls below specified strength by more than 500 psi, strength of concrete shall be considered potentially deficient and core testing, structural analysis or load testing may be required by the Owner's Representative.

   b. When concrete in place proves to be deficient, Contractor shall pay costs, including costs due to delays, incurred in providing additional testing and analysis services provided by the Owner's Representative, or the independent commercial testing laboratory selected by the Owner.

   c. Replace concrete work judged inadequate by core tests, structural analysis or load tests at no additional cost to the Owner.

   d. Core Tests:

      (1). Obtain and test cores in accordance with ASTM C42. Where concrete in structure will be dry under service conditions, air-dry cores (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for 7 days before test; test dry. Where concrete in structure will be more than superficially wet under service conditions, test cores after moisture conditioning in accordance with ASTM C42.

      (2). Take at least three representative cores from each member or area of concrete in place that is considered potentially deficient. Location of cores shall be determined by the Owner's Representative so as to least impair strength of structure. When, before testing, one or more cores shows evidence of having been damaged during or after removal from structure, replace the damaged cores.

      (3). Concrete in area represented by core test will be considered adequate when average strength of cores is equal to at least 85 percent of specified strength, and when no single core is less than 75 percent of specified strength.

(4). Patch core holes in accordance with Section 03345 - Concrete Finishing.

e. Structural Analysis: When core tests are inconclusive or impractical to obtain, the Owner's Representative may perform additional structural analysis at Contractor's expense to confirm safety of structure.

f. Load Tests: When core tests and structural analysis do not confirm safety of structure, load tests may be required, and their results evaluated, in accordance with ACI 318.

g. Testing by impact hammer, sonoscope, probe penetration tests (Windsor probe), or other nondestructive device may be permitted by the Owner's Representative to determine relative strengths at various locations in structure, to evaluate concrete strength in place, or for selecting areas to be cored. However, such tests, unless properly calibrated and correlated with other test data, shall not be used as basis for acceptance or rejection of structure's safety.

1.06 STORAGE AND HANDLING OF MATERIALS

A. Cement: Store cement in weathertight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set. When there is any doubt as to expansive potential of shrinkage-compensating cements because of method or length of storage and exposure, laboratory test cement before use.

B. Aggregate: Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3 feet in thickness. Complete each layer before next is started.

C. Fine Aggregate: Before using, allow fine aggregate to drain until uniform moisture content is reached.

D. Admixtures: Store admixtures to avoid contamination, evaporation or damage. For those used in form of suspensions or unstable solutions, provide suitable agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and other temperature changes which would adversely affect their characteristics.

E. Lightweight Aggregates: Uniformly predampen lightweight aggregates as necessary to prevent excessive variations in moisture content. Allow predampened aggregates to remain in stockpiles, under continuous fog spray, for minimum of 24 hours before use. Provide adequate drainage in stockpile areas to eliminate excess water and accumulation of contaminated fines.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Cement:

1. Use same brand of cement used in concrete mix design. Use only one brand of each type in each structure, unless otherwise indicated on Drawings.

2. Portland Cement: ASTM C150, Type I or Type II, gray in color. Use Type III only when specifically authorized by the Owner's Representative in writing. Use Type II, including the requirements of Table 2, in construction of liquid-containing structures and cooling towers, unless shown otherwise on Drawings.

B. Admixtures:

1. Do not use calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions.

2. Air-Entraining Admixtures: ASTM C260, compatible with other admixtures used.

3. Chemical Admixtures: Polymer type, nonstaining, chloride-free admixtures conforming to ASTM C494, Type A, C, D or E.

4. High-Range Water Reducer (Superplasticizer): ASTM C494, Type F or G, compatible with and by the same manufacturer as other admixtures.

C. Mixing Water: Use clean, potable water, free from harmful amounts of oils, acids, alkalis or other deleterious substances, meeting requirements of ASTM C94.

D. Aggregates: Use coarse aggregate from only one source, and fine aggregate from only one source, for exposed concrete in any single structure.

1. Coarse Aggregate: Gravel, crushed gravel or crushed limestone conforming to ASTM C33.

2. Fine Aggregate: Natural sand complying with ASTM C33.

3. Limestone aggregate shall conform to ASTM C33 and the following additional requirements: Clean, hard, strong and durable particles free of chemicals and coatings of silt, clay, or other fine materials that may affect hydration and bond of cement paste. Select crushed limestone: High-calcium limestone (minimum 95 percent $CaCO_3$ and maximum 3.5 percent $MgCO_3$) with maximum Los Angeles Abrasion loss of 38 percent, when tested in accordance with ASTM C131 or ASTM C535. Test aggregate for soundness in accordance with ASTM C88; maximum loss shall not exceed 18 percent after 5 cycles of magnesium sulfate test

4. Maximum size of coarse aggregate:

a. Normal weight concrete, except as noted below: 1-1/2 inches.

b. Formed members 6 inches or less in least dimension: 1/5 least dimension.

c. Slabs: 1/3 depth of slab.

d. Drilled shafts: 1/3 clearance between reinforcing steel, but not greater than 3/4 inch.

e. Concrete fill, seal slabs and bonded concrete topping in clarifiers: 3/8 inch.

5. Coarse aggregate for lightweight concrete: ASTM C330. Grading limits: 3/4 inch to No. 4.

6. Abrasive Aggregate: Conform to requirements of Section 03345 - Concrete Finishing.

E. Calcium Chloride: Not permitted.

F. Evaporation Retardant: Masterbuilders "Confilm", Euclid "Eucobar", or equal.

G. Miscellaneous Materials:

1. Bonding Agent: Two-component modified epoxy resin.

2. Vapor barrier: 6 mil clear polyethylene film of type recommended for below-grade application.

3. Non-shrink grout: premixed compound consisting of non-metallic aggregate, cement and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.02 CONCRETE MIX

A. Objective: Select proportions of ingredients to produce concrete having proper placability, durability, strength, appearance and other specified properties.

B. Mix Design: Employ and pay an independent commercial testing laboratory, acceptable to Owner, to prepare and test mix designs for each type of concrete specified. Proportion mix design ingredients by weight. Submit mix designs and test results for approval.

1. During the trial batches, aggregate proportions may be adjusted by the testing laboratory using two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. Concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or

whether the proportions have been adjusted during the trial batch process. Prepare trial batches using the aggregates, cement and admixtures proposed for the project. Make trial batches large enough to obtain 3 drying shrinkage test specimens and 6 compression test specimens from each batch. Shrinkage testing is required only for Class A and D concrete.

2. Determine compressive strength by testing 6-inch diameter by 12-inch high cylinders, made, cured and tested in accordance with ASTM C192 and ASTM C39. Test 3 compression test cylinders at 7 days and 3 at 28 days. Average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall be not less than 125 percent of the specified compressive strength.

3. Perform sieve analysis of the combined aggregate for each trial batch according to of ASTM C136. Report percentage passing each sieve.

4. In mix designs for Class A and D concrete, fine aggregate shall not exceed 41 percent of total aggregate by weight.

C. Shrinkage Limitations, Class A and D Concrete

1. Maximum concrete shrinkage for specimens cast in the laboratory from the trial batch: 0.036 percent as measured at 21-day drying age, or 0.042 percent at 28-day drying age. Use for construction only mix designs that meet trial batch shrinkage requirements. Shrinkage limitations apply only to Class A and D concrete.

2. Maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

3. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the Owner, for securing the specified shrinkage requirements: Changing the source or aggregates, cement or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or its effects.

D. Selecting Ingredient Proportions for Concrete:

1. Proportion concrete mix according to ACI 301, Chapter 3.

2. Establish concrete mix design by laboratory trial batches prepared by independent testing laboratory, or on basis of previous field experience in accordance with provisions of ACI 318, Item 5.3; however, minimum cement content for each class of concrete shall not be less than specified.

3. Concrete mix design data submitted for review shall have average 28-day compressive strength calculated in accordance with ACI 318, Item 5.3.2.1. When data is not available to determine standard deviation in accordance with

ACI 318, Item 5.3.1, average 28-day strength of mix design shall conform to ACI 318, Table 5.3.2.2.

E. Water-Cement Ratios:

1. Maximum allowable water-cement ratios shall be as follows:

a. Concrete for liquid-containing structures: 0.45.

b. Concrete subjected to brackish water, salt spray or deicers: 0.40.

c. All other concrete: 0.55.

2. Superplasticizer may be added to maintain specified maximum water-cement ratios. Include free water in aggregate in water-cement ratio computations.

F. Adjustment of Mix Proportions: After sufficient data becomes available during construction, mix may be adjusted upon approval of the Owner's Representative, in accordance with ACI 318, Item 5.5; however, minimum cement content for each class of concrete shall not be less than specified.

G. Entrained Air: Air-entrain all concrete except drilled shafts. Total air content in accordance with ASTM C173: 4 to 6 percent.

H. Consistency, Workability, and Slump:

1. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce concrete which can be worked properly into place without segregation, and which can be compacted by vibratory methods as specified, to give the desired strength, density, impermeability and smoothness of surface. Change the quantity of water as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. Determine the consistency of the concrete in successive batches by slump tests in accordance with ASTM C 143. Slumps shall be as follows:

Concrete Type	Minimum Slump	Maximum Slump
Portland Cement Concrete:	2"	4"
Concrete to be dosed with superplasticizer:	1"	3"
Normal Weight Concrete after dosing with superplasticizer:	4"	9"
Lightweight Concrete after dosing with superplasticizer:	4"	7"
Drilled Shaft Concrete:	4"*	8"

* Minimum slump where drilled shafts are cast in temporary casings: 5 inches.

2. Specified slump shall apply at time when concrete is discharged at job site. Perform slump tests to monitor uniformity and consistency of concrete delivered to job site; however, do not use as basis for mix design. Do not exceed water-cement ratios specified.

I. Admixtures: Proportion admixtures according to manufacturer's recommendations. Use of accelerator is permitted when air temperature is less than 40 degrees F. Use of retarder is permitted when temperature of placed concrete exceeds 65 degrees F.

J. High-Range Water Reducers (Superplasticizers): Use superplasticizer to improve workability of concrete or delay hydration of cement, in accordance with requirements and recommendations of product manufacturer and approved submittals.

K. Concrete Classification and Strength:

1. Strength: Conform to values for class of concrete indicated on Drawings for each portion of Work. Requirements are based on 28-day compressive strength. If high early-strength concrete is allowed, requirements are based on 7-day compressive strength.

2. Classification:

Class (Normal-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per CubicYard
Concrete for Structures Containing Water or Wastewater		
A	4000	564 (6 Sacks)
B	1500	329 (3-1/2 Sacks)
C	3600	517 (5-1/2 Sacks)
D	5000	658 (7 Sacks)
H	3000	611 (6-1/2 Sacks)

Class (Normal-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per CubicYard
Concrete for Buildings, Slabs on Grade and Miscellaneous Structures		
AB	4000	Not Applicable
BB	1500	Not Applicable
CB	3000	Not Applicable
DB	5000	Not Applicable

Class (Light-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per Cubic Yard
E	3000	Not Applicable
F	4000	Not Applicable
G	5000	Not Applicable

3. Maximum size aggregate for Class H concrete: 3/8 inch. Maximum size aggregate for all other normal-weight concrete: 1-1/2 inches, except as specified in Paragraph 2.01D.4.

4. When required strength is not obtained with minimum cement content as specified, add cement, lower water-cement ratio or provide other aggregates as necessary.

5. In addition to conforming to specified strength, lightweight concrete must be within specified unit weight limits. Maximum air-dry unit weight is 118 pounds per cubic foot; minimum is 110 pounds per cubic foot unless shown otherwise on Drawings. Determine air-dry unit weight in accordance with ASTM C567. Correlate air-dry unit weight with fresh unit weight of the same concrete as a basis for acceptance during construction.

L. Use of Classes of Concrete:

1. Use classes of concrete as indicated on the Drawings and in other specifications.

2. Liquid-containing structures: If not otherwise indicated, use the following classes for structures containing water or wastewater and for utility applications in the locations described:

   a. Class A: All reinforced concrete and where not otherwise defined.

   b. Class B: Un-reinforced concrete used for plugging pipes, seal slabs, thrust blocks and trench dams, unless indicated otherwise.

   c. Class H: Fill and topping. Where concrete fill thickness exceeds 3 inches in the majority of a placement and is not less than 1.5 inches thick, Class A concrete may be used.

3. All other structures: If not otherwise indicated, use the following classes in the locations described:

   a. Class AB: All reinforced concrete and where not otherwise defined.

   b. Class CB: Duct banks; see section 16402 - Underground Duct Banks for additional requirements.

c. Class BB: Un-reinforced concrete fill under structures.

2.03 MIXING NORMAL WEIGHT CONCRETE

A. Conform to ACI 301, Chapter 7.

B. Ready-Mixed Concrete:

1. Measure, batch, mix and transport ready-mixed concrete according to ASTM C94. Plant equipment and facilities shall conform to NRMCA "Certification of Ready Mixed Concrete Production Facilities".

2. Provide batch tickets with information specified in ASTM C94. Deliver batch ticket with concrete and give to Owner's on-site testing laboratory representative.

C. Admixtures:

1. Charge air-entraining and chemical admixtures into mixer as solution using automatic dispenser or similar metering device. Measure admixture to accuracy within + 3 percent. Do not use admixtures in powdered form.

2. Two or more admixtures may be used in same concrete, provided that admixtures in combination retain full efficiency and have no deleterious effect on concrete or on properties of each other. Inject admixtures separately during batching sequence.

3. Add retarding admixtures as soon as practicable after addition of cement.

D. Temperature Control:

1. When ambient temperature falls below 40 degrees F, keep as-mixed temperature above 55 degrees F to maintain concrete above minimum placing temperature.

2. When water or aggregate has been heated, combine water with aggregate in mixer before cement is added. Do not add cement to mixtures of water and aggregate when temperature of mixture is greater than 100 degrees F.

3. In hot weather, maintain temperature of concrete below maximum placing temperature. When necessary, temperature may be lowered by cooling ingredients, cooling mixer drum by fog spray, using chilled water or well-crushed ice in whole or part for added water, or arranging delivery sequence so that time of transport and placement does not generate unacceptable temperatures.

4. Submit hot weather and cold weather concreting plans for approval.

2.04 MIXING LIGHTWEIGHT CONCRETE

A. Determining Absorption of Aggregates: Mixing procedures vary according to total absorption by weight of lightweight aggregates. Determine total absorption by weight before predamping in accordance with ASTM C127.

B. Ten Percent or Less Absorption: Follow same requirements as for mixing normal-weight concrete when preparing concrete made with low-absorptive lightweight aggregates having 10 percent or less total absorption by weight. To be low absorptive, aggregates must absorb less than 2 percent additional water in first hour after mixing.

C. More Than 10 Percent Absorption: Batch and mix concrete made with lightweight aggregates having more than 10 percent total absorption by weight, as follows:

1. Place approximately 80 percent of mixing water in mixer.

2. If aggregates are pre-dampened, add air-entraining admixture and all aggregates. Mix for minimum of 30 seconds, or 5 to 10 revolutions of truck mixer.

3. When aggregates have not been predampened, mix aggregates and water for minimum of 1 minute and 30 seconds, or 15 to 30 revolutions of truck mixer. Then add air-entraining admixture and mix for additional 30 seconds.

4. Then, in the following sequence, add specified or permitted admixtures (other than air-entraining agent), all cement, and mixing water previously withheld.

5. Complete mixing using procedures for normal-weight concrete.

2.05 MASS CONCRETE

A. Do not use high early-strength cement (Type III) or accelerating admixtures.

B. Use high-range water-reducing admixture (superplasticizer) to minimize water content and cement content.

C. Specified water-reducing retarding admixture may be required to prevent cold joints when placing large quantities of concrete, to permit revibration of concrete, to offset effects of high temperature in concrete or weather, and to reduce maximum temperature or rapid temperature rise.

2.06 EQUIPMENT

A. Select equipment of size and design to ensure continuous flow of concrete at delivery end. Conform to following equipment and operations requirements.

B. Truck mixers, agitators and manner of operation: Conform to ASTM C94. Use of non-agitating equipment for transporting concrete is not permitted.

C. Belt conveyors: Configure horizontally, or at a slope causing no segregation or loss. Use approved arrangement at discharge end to prevent separation. Discharge long runs without separation into hopper.

D. Chutes: Metal or metal-lined (other than aluminum). Arrange for vertical-to-horizontal slopes not more than 1 to 2 nor less than 1 to 3. Chutes longer than 20 feet or not meeting slope requirements may be used if concrete is discharged into hopper before distribution.

E. Do not use aluminum or aluminum-alloy pipe or chutes for conveying concrete.

PART 3 E X E C U T I O N

3.01 SPECIAL CONSIDERATIONS

A. Concreting Under Water: Not permitted except where shown otherwise on Drawings or approved by the Owner's Representative. When shown or permitted, deposit concrete under water by methods acceptable to the Owner's Representative so fresh concrete enters mass of previously placed concrete from within, causing water to be displaced with minimum disturbance at surface of concrete.

B. Protection from Adverse Weather: Unless adequate protection is provided or the Owner's Representative's approval is obtained, do not place concrete during rain, sleet, snow or freezing weather. Do not permit rainwater to increase mixing water or to damage surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect Work.

3.02 PREPARATION OF SURFACES FOR CONCRETING

A. Earth Surfaces:

1. Under interior slabs on grade, install vapor barrier. Lap joints at least 6 inches and seal watertight with tape, or sealant applied between overlapping edges and ends. Repair vapor barrier damaged during placement of reinforcing and inserts with vapor barrier material; lap over damaged areas at least 6 inches and seal watertight.

2. Other Earth Surfaces: Thoroughly wet by sprinkling prior to placing concrete, and keep moist by frequent sprinkling up to time of placing concrete thereon. Remove standing water. Surfaces shall be free from standing water, mud and debris at the time of placing concrete.

B. Construction Joints:

1. Definition: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been interrupted so that, in the judgment of the, Owner's Representative new concrete cannot be incorporated integrally with that previously placed.

2. Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, use forms or other means to shape the working face to secure proper union with subsequent work. Make construction joints only where acceptable to the Owner's Representative.

3. Preparation: Give horizontal joint surfaces a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, clean joint surfaces of laitance, loose or defective concrete and foreign material by hydroblasting or sandblasting (exposing aggregate), roughen surface to expose aggregate to a depth of at least 1/4 inch and wash thoroughly. Remove standing water from the construction joint surface before new concrete is placed.

4. After surfaces have been prepared cover approximately horizontal construction joints with a 3-inch lift of a grout mix consisting of Class A concrete batched without coarse aggregate; place and spread grout uniformly. Place wall concrete on the grout mix immediately thereafter.

C. Set and secure reinforcement, anchor bolts, sleeves, inserts and similar embedded items in the forms where indicated on Contract Drawings, shop drawings and as otherwise required. Obtain the Owner's Representative's acceptance before concrete is placed. Accuracy of placement is the sole responsibility of the Contractor.

D. Place no concrete until at least 4 hours after formwork, inserts, embedded items, reinforcement and surface preparation have been completed and accepted by the Owner's Representative. Clean surfaces of forms and embedded items that have become encrusted with grout or previously placed concrete before placing adjacent concrete.

E. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), thoroughly clean and roughen the surface of the old concrete by hydro-blasting or sandblasting (exposing aggregate). Coat joint surface with epoxy bonding agent following manufacturer's written instructions, unless indicated otherwise. Unless noted otherwise, this provision does not apply to vertical wall joints where waterstop is installed.

F. Protection from Water: Place no concrete in any structure until water entering the space to be filled with concrete has been properly cut off or diverted and carried out of the forms, clear of the work. Deposit no concrete underwater. Do not allow still water to rise on any concrete until concrete has attained its initial set. Do not allow water to flow over the surface of any concrete in a manner and at a velocity that will damage the surface finish of the concrete. Pumping, dewatering and other necessary operations for removing ground water, if required, are subject to the Owner's Representative's review.

G. Corrosion Protection: Position and support pipe, conduit, dowels and other ferrous items to be embedded in concrete construction prior to placement of concrete so there is at least a 2 inch clearance between them and any part of the concrete reinforcement. Do not secure such items in position by wiring or welding them to the reinforcement.

H. Where practicable, provide for openings for pipes, inserts for pipe hangers and brackets, and setting of anchors during placing of concrete.

I. Accurately set anchor bolts and maintain in position with templates while they are being embedded in concrete.

J. Cleaning: Immediately before concrete is placed, thoroughly clean dirt, grease, grout, mortar, loose scale, rust and other foreign substances from surfaces of metalwork to be in contact with concrete.

3.03 HANDLING, TRANSPORTING AND PLACING CONCRETE

A. Conform to applicable requirements of Chapter 8 of ACI 301 and this Section. Use no aluminum materials in conveying concrete.

B. Rejected Work: Remove concrete found to be defective or non-conforming in materials or workmanship. Replace rejected concrete with concrete meeting requirements of Contract Documents, at no additional cost to the Owner.

C. Unauthorized Placement: Place no concrete except in the presence of the Owner's Representative. Notify the Owner's Representative in writing at least 24 hours before placement of concrete.

D. Placement in Wall Forms:

1. Do not drop concrete through reinforcing steel.

2. Do not place concrete in any form so as to leave an accumulation of mortar on form surfaces above the concrete.

3. Pump concrete or use hoppers and, if necessary, vertical ducts of canvas, rubber or metal (other than aluminum) for placing concrete in forms so it reaches the place of final deposit without separation. Free fall of concrete shall not exceed 4 feet below the ends of pump hoses, ducts, chutes or buggies. Uniformly distribute concrete during depositing.

4. Do not displace concrete in forms more than 6 feet in horizontal direction from place where it was originally deposited.

5. Deposit in uniform horizontal layers not deeper than 2 feet; take care to avoid inclined layers or inclined construction joints except where required for sloping members.

6. Place each layer while the previous layer is still soft. Rate of placement shall not exceed 5 feet of vertical rise per hour.

7. Provide sufficient illumination in form interior so concrete at places of deposit is visible from the deck or runway.

E. Conveyors and Chutes: Design and arrange ends of chutes, hopper gates and other points of concrete discharge in the conveying, hoisting and placing system so concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyors, if used, shall be of a type acceptable to the Owner's Representative. Do not use chutes longer than 50 feet. Slope chutes so concrete of specified consistency will readily flow. If a conveyor is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyors and chutes shall be covered.

F. Placement of Slabs: In hot or windy weather, conducive to plastic shrinkage cracks, apply evaporation retardant to slab after screeding in accordance with manufacturer's instructions and recommendations. Do not use evaporation retardant to increase water content of the surface cement paste. Place concrete for sloping slabs uniformly from the bottom of the slab to the top, for the full width of the placement. As work progresses, vibrate and carefully work concrete around slab reinforcement. Screed the slab surface in an up-slope direction.

G. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when the air temperature is at or below 40 degrees F and falling. Concrete may be mixed when temperature is 35 degrees F and rising. Take temperature readings in the shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until the concrete has cured for a minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.

When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.

H. No placing concrete when temperature is over

3.04 PUMPING OF CONCRETE

A. If pumped concrete does not produce satisfactory results, in the judgement of the Owner's Representative, discontinue pumping operations and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment: Use a 2-cylinder pump designed to operate with only one cylinder if one is not functioning, or have a standby pump on site during pumping.

C. The minimum hose (conduit) diameter: Comply with ACI 304.2R.

D. Replace pumping equipment and hoses (conduits) that do not function properly.

E. Do not use aluminum conduits for conveying concrete.

F. Field Control: Take samples for slump, air content and test cylinders at the placement (discharge) end of the line.

3.05 CONCRETE PLACEMENT SEQUENCE

A. Place concrete in a sequence acceptable to the Owner's Representative. To minimize effects of shrinkage, place concrete in units bounded by construction joints shown. Place alternate units so each unit placed has cured at least 7 days for hydraulic structures, or 3 days for other structures, before contiguous unit or units are placed, except do not place corner sections of vertical walls until the 2 adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for other structures.

B. Level the concrete surface whenever a run of concrete is stopped. To ensure straight and level joints on the exposed surface of walls, tack a wood strip at least 3/4-inch thick to the forms on these surfaces. Carry concrete about 1/2 inch above the underside of the strip. About one hour after concrete is placed, remove the strip, level irregularities in the edge formed by the strip with a trowel and remove laitance.

3.06 TAMPING AND VIBRATING

A. Thoroughly settle and compact concrete throughout the entire depth of the layer being consolidated, into a dense, homogeneous mass; fill corners and angles, thoroughly embed reinforcement, eliminate rock pockets and bring only a slight excess of water to the exposed surface of concrete during placement. Use ACI 309R Group 3 immersion-type high-speed power vibrators (8,000 to 12,000 rpm) in sufficient number and with sufficient (at least one) standby units. Use Group 2 vibrators only when accepted by the Owner's Representative for specific locations.

B. Use care in placing concrete around waterstops. Carefully work concrete by rodding and vibrating to make sure air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, work concrete under waterstops by hand, making sure air and rock pockets have been eliminated. Give concrete surrounding the waterstops additional vibration beyond that used for adjacent concrete placement to assure complete embedment of waterstops in concrete.

C. Concrete in Walls: Internally vibrate, ram, stir, or work with suitable appliances, tamping bars, shovels or forked tools until concrete completely fills forms or excavations and closes snugly against all surfaces. Do not place subsequent layers of concrete until previously placed layers have been so worked. Provide vibrators in sufficient numbers, with standby units as required, to accomplish the results specified within 15 minutes after concrete of specified consistency is placed in the forms. Keep vibrating heads from contact with form surfaces. Take care not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.07 PLACING MASS CONCRETE

A. Observe the following additional restrictions when placing mass concrete.

1. Use specified superplasticizer.

2. Maximum temperature of concrete when deposited: 70 degrees F.

3. Place in lifts approximately 18 inches thick. Extend vibrator heads into previously placed layer.

3.08 REPAIRING SURFACE DEFECTS AND FINISHING

A. Conform to Section 03345 - Concrete Finishing.

3.09 CURING

A. Conform to Section 03370 - Concrete Curing.

3.10 PROTECTION

A. Protect concrete against damage until final acceptance by the Owner.

B. Protect fresh concrete from damage due to rain, hail, sleet or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until all components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the Owner's Representative.

END OF SECTION

SECTION 03820

JOINT REPAIR

PART 1 GENERAL

1.01 SECTION INCLUDES

A. These specifications detail the requirements for the joint repair of storm drainage pipes and box culverts. The purpose of this process is to seal the box culvert and drainage pipe joints.

1.02 UNIT PRICES

A. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTAL

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. The Contractor shall submit a minimum of six (6) copies of the manufacturer's written product data sheets for the proposed materials, for the approval by the Engineer, before proceeding with the work. Product data should include manufacturer's recommended installation instructions and certified results of the testing on the mechanical properties of the material by an independent testing laboratory.

1.04 HANDLING AND STORAGE

A. All materials used for joint repair shall remain dry, clean and stored as per manufacturer's standards.

B. Material mixed with dirt, weeds or foreign matter will be rejected.

C. Packaging of component materials must be compatible with field storage and handling requirements. Packaging must provide for worker safety and minimize spillage during handling.

PART 2 PRODUCTS

2.01 MATERIALS

A. Chemical Grout:
   1. While being injected, the chemical sealant must be able to react/perform in the presence of water.

2. The cured material must be capable of withstanding submergence in water without degradation.
3. The resultant sealant formation must prevent the passage of water.
4. The sealant material, after curing, must be flexible as opposed to brittle or rigid.
5. In place, the resultant sealant formation should be able to withstand freeze/thaw and wet/dry cycles without adversely affecting the seal.
6. The sealant formulation must not be biodegradable and an acceptable integral herbicide shall be used where roots are present. Additives may be used to meet this requirement.
7. The cured sealant should be chemically stable and resistant to concentrations of acids, alkalis, and organics found in normal sewage
8. Capable of having an integral root inhibitor.
9. Compressive recovery; returns to original shape after repeated deformations.
10. Toxicity; essentially non-toxic in cured form.
11. Sealing materials shall be non-corrosive.
12. Solid content shall be 82 to 88%.

The chemical grout sealing compound shall be hydrophilic. When cured, the grouting compound shall exhibit strength properties of at least 90 PSI and 800% elongation. The material shall not change in linear dimension more than 18% when subjected to wet and dry cycles.

B. Acceptable products for the processes are:

<u>Cementatious Grout - EMACO S88 CI</u>

ChemRex
889 Valley Park Drive
Shakopee, MN 55379
1-800-243-6739

<u>Jute Fiber (OAKUM) - Fibrolite</u>

Avanti International
822 Bay Star Boulevard
Webster, Texas 77598-1528
281-486-5600

Builders Products
2440 McAllister
Houston, Texas 77092
713-686-8203

Chemical Grout

- Avanti International - AV 202
- Prime Resins - Prime Flex 900 LVSF
- DeNeef Construction Chemicals, Inc. - Hydro-Active Flex LVW/Hydro-Active Flex Cat Accelerator
  Hydro-Active cut with Hydro-Active Cat Accelerator

Avanti International
822 Bay Star Boulevard
Webster, Texas 77598-1528
281-486-5600

Prime Resins
2381 Rockaway Industrial Blvd.
Conyers, GA 30012
770-388-0936

Builders Products
2440 McAllister
Houston, Texas 77092
713-686-8203

- A tested, approved equivalent.

2.02 EQUIPMENT

A. Equipment: Conform to requirements of manufacturer's standards.

2.03 MIXING

A. In every case, mixing and handling of chemical sealing materials shall be in strict accordance with the manufacturer's recommendations.

B. Mixing of component materials must be compatible with field operations and not require precise measurements.

PART 3 EXECUTION

3.01 SAFETY

A. Contractor shall provide all necessary training, material, equipment, and personnel, etc. to comply with all applicable OSHA regulations for confined-space entry.

B. The Contractor shall provide written evacuation and safety plan, which shall be posted on the project site. Workers shall be made aware of the plan before the work proceeds and reviewed in weekly safety meetings.

3.02 WATER AND SOIL CONTROL

A. Adequate drainage shall be maintained at all times during construction, cleaning, and repair.

B. Contractor's activities are not to alter or change existing drainage pattern.

C. To effectively conduct the joint sealing operation, flow in the culvert must be controlled to an extent that the joint being sealed is not inundated by water. It is not necessary for the joint to be dry; but the water level shall be maintained at as low a level as is practical. Pumps, cofferdam, sandbags, or other means shall be used to maintain the water at a low level.

D. Existing fill shall be removed from the top of bottom joint. After the joint is repaired and inspected, the existing fill shall be replaced back to its original location and height. This project does not require contractor to remove existing fill from the system, but does require it to be returned to original condition as not to create additional problems for the system.

E. The Contractor is responsible for removing any impedance to flow, such as temporary cofferdams, sandbags, and equipment from the box culvert and junction boxes in the event of rain.

3.03 CLEANING

A. Contractor is responsible for cleaning of streets caused by associated construction at close of each workday.

B. The Contractor shall remove debris off site and dispose of in accordance with local, state, and/or Federal laws and regulations.

C. Cleanup must be done without inordinate use of flammable or hazardous chemicals.

D. Residual sealing materials must be removable from the sewer after injection to insure no flow reduction, restriction, or blockage of normal sewage flows.

E. Prior to sealing, the joints shall be cleaned by pressurized water blaster to remove all loose materials, dirt and grease where necessary. Soils and slimes will be effectively removed from the joint by the scouring action of the water. If necessary, the Contractor shall use a wet aggregate blasting method to provide for an acceptable joint surface. Additionally, the storm drainage pipe specified shall be generally cleared of debris adjacent to the joints prior to individual joint sealing.

3.04 CONTAINMENT DAM PROCESS

A. Joints are to have a patch or "containment dam" prior to injection. This includes approved cementitious grout, or chemical grout saturated jute oakum. This will provide containment for the grout injection. Cementitious grout shall be used only in containment dam process.

B. Cementitious grout shall only be used in non-submerged sections of joint. Non-submerged sections are identified as sections of joints that are a minimum of one (1) foot above the standing water level of the box culvert, at either pre-construction or construction phase, whichever is higher. All other areas of the joint are considered submerged and shall therefore require saturated jute oakum containment dam. Joints shall be filled with grout and allowed to curve for 24 hours before the injection process is to begin.

C. Cementitious Grout Sealing: Contractor shall clean and prepare joints prior to sealing of joints. Installation procedures shall comply with manufacturer's recommendation.

D. Chemical Grout Saturated Jute Oakum Sealing: A quantity of jute fiber is first placed in a mixing container. Plastic bags or other disposable containers such as plastic buckets are desirable. Hydrophilic polymer grout compound is them added and allowed to soak into the jute fiber strips. Squeezing and working the jute fiber by hand is important for complete and rapid saturation. After the application surface has been wetted, the jute fiber strand is picked up by one end and the excess grout stripped off by curling the thumb and index finger around the strand. The strand is them placed in the joint and lightly tamped in to place by use of putty knives, wooden dowels or other tools.

Water is applied during the tamping process by either a small hose or weed sprayer. Application of the water during the tamping causes hydration of the grout compound. Additional layers of material are built up in the same fashion with each being wetted and tamped in turn until the full gasket thickness is obtained. Only a light spray of water should be used since large volumes or high pressures wash away the grout before it sets. It is usually desirable to stop the application of materials somewhat below the surface so that hydration will not cause the seal to expand into the flow area.

The jute fiber shall be twisted rope form without tar or oil and practically free from hard, source fibers and extraneous matter.

Acceptable materials are:
- Fibrolite as distributed by Avanti International or DeNeef Construction Chemicals, Inc.
- A tested, approved equivalent

3.06 CHEMICAL GROUT INJECTION (ONLY)

A. - Multiple injection holes shall be drilled thru the wall of the structure, or an injection needle will puncture the oakum dam at locations and at spacing as determined by field conditions, and approved by Engineer.
- Chemical Grout is injected in multiple shots thru the injection holes or punctures, allowed to expand, void fill and seal the back side of the repair area.
- Chemical Grout shall be pumped until outcropped is seen or pressure of grout reaches 125 psi or as manufacturers suggested pressure.
- Outcropped grout material is removed with hand tools and disposed of.
- The new seal is inspected visually for completeness.
- A repair documentation form is completed by the technician.

B. Contractor shall monitor the movement of the box culverts to insure no damage is done to the repaired joints.

3.07 FINISHING

A. Residual sealing materials that extend into the pipe, reduce the pipe diameter, or restrict the flow shall be removed from the joint. The sealed joints shall be left reasonably "flush" with the existing pipe surface.

3.08 WARRANTY

A. Contractor warrants all materials and workmanship for a period of three year including shrinkage and deterioration.

B. Contractor shall re-inject material for any failure during the warranty period.

C. If the Contractor damages any utilities, he will immediately notify the appropriate utility provider (and the Engineer) and pay for all cost of repair at his own expense.

D. Cracks in pavement which occurs during the injection of grout will be considered as damage to the pavement due to the Contractor's operations. The damage shall be repaired by the Contractor at the Contractor's expense and as directed by the Engineer.

END OF SECTION