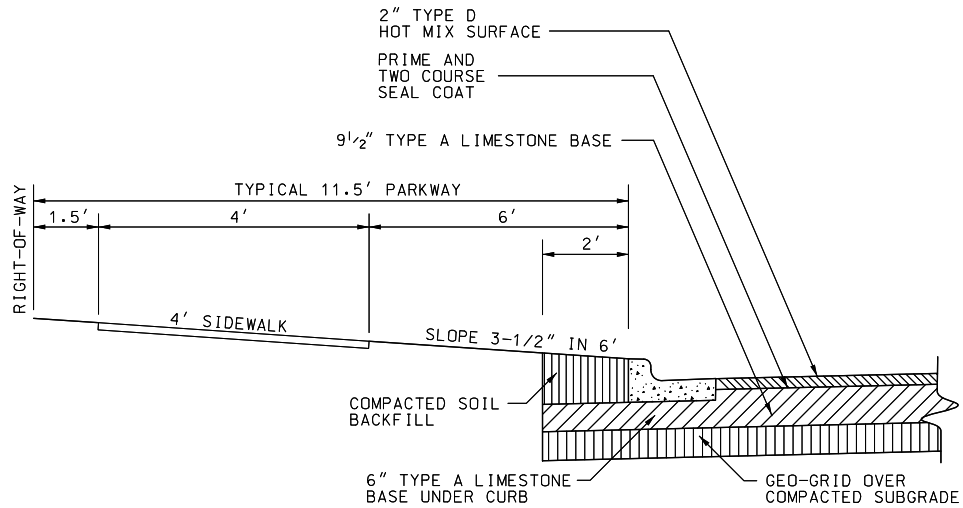
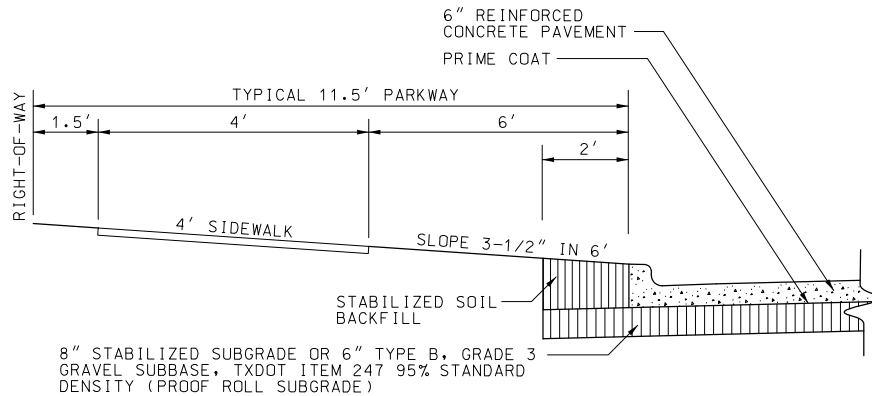


LIMESTONE BASE PAVEMENT SECTION



1. PRIME TO MEET CURRENT TXDOT SPECIFICATIONS; MC-30, AEP OR EQUAL.
2. SEAL COAT WITH AC-15P AND #3 PRE-COATED AGGREGATE FOLLOWED BY #4 PRE-COATED AGGREGATE. WINTER APPLICATIONS SHALL UTILIZE CRS-2P.
3. FOLLOW CURRENT CITY OF VICTORIA STANDARD SPECIFICATIONS.

CONCRETE SECTION



NOTES
 REINFORCEMENT SHALL CONSIST OF:
 #4 REBAR @ 24" O.C. TRANSVERSE
 #4 REBAR @ 8" O.C. LONGITUDINAL
 #3 "U" REBARS IN PAVEMENT FOR CURB, 12" LONG x 4" HIGH @ 30" O.C.
 #3 REBAR LONGITUDINAL IN CURB.
 EXPANSION JOINTS SHALL BE PLACED ALONG C/L OF STREET AND TRANSVERSELY EVERY 40 L.F.

1. PRIME TO MEET CURRENT TXDOT SPECIFICATIONS; MC-30, AEP OR EQUAL.
2. FOLLOW CURRENT CITY OF VICTORIA STANDARD SPECIFICATIONS.

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SECTION 01010

RELATED SECTIONS - For use by Specifier. Do not include list in Project Specifications.

Section 01015 - Contractor Use of Premises.

Section 01040 - Coordination and Meetings: Contractor coordination of Work

Section 01300 - Submittals

This section must be prepared for each project. The text gives standard provisions, as they may be appropriate to an individual Project. Edit this text for Project requirements and provide additional text or delete text as appropriate renumbering paragraphs as necessary.

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Summary of the Work including work by Owner, Owner furnished products, Work sequence, future Work, Contractor use of Premises, and Owner occupancy.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. Work of the contract is for the [construction] [rehabilitation] [alteration] [demolition] [] of [].

1.03 ALTERNATES

- A. Alternate bids quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option.
- B. Volunteer Alternates, any Alternate not specified in this Section, will not be considered.
- C. Accepted Alternates will be identified in the Agreement Between the Owner and Contractor.
- D. Bids will be evaluated on base bid price. After determination of lowest bidder, consideration will be given to Alternates and Bid Price adjustments.
- E. Description of Alternates:
- Alternate No. 1: []:
Base Bid Item: Specification Sections [], [], and [] []; and Drawings Numbered [], [], and []; including referenced details.
Alternate Item: Specification Sections [], [], and [] []; and Drawings Numbered [], [], and []; including referenced details.
 - (Continue listing of Alternates as appropriate. Delete if no alternates.)

1.04 WORK BY OWNER

Identify 'NIC' Work and coordinate the following with Engineer.

Delete if not applicable.

- A. Items noted as Not in Contract (NIC), [] will be furnished and installed by Owner [beginning] [before] [after] [].
- B. Owner will remove and retain possession of the following items prior to start of work:
- [].
 - [].

1.05 OWNER FURNISHED PRODUCTS

A. Products purchased and paid for by Owner:

1. [_____].
2. [_____].

B. Items Furnished by Owner for Installation and Final Connection by Contractor:

1. [_____].

C. Contractor's Responsibilities:

1. Arrange and pay for product delivery to site.
2. Receive and unload products at site; jointly with Engineer, inspect for completeness or damage.
3. Handle, store, install, and finish products.
4. Repair or replace damaged items.

D. CONSTRUCTION PHOTOGRAPHS

1. Submit preconstruction (and post construction) photographs in accordance with Section 01380 – Construction Photographs.

1.06 WORK SEQUENCE

A. Construct Work in [stages] [phases] [to accommodate Owner occupancy requirements] [_____] during the construction period, coordinate construction schedule and operations with Engineer:

1. [Stage] [Phase] 1: [_____].
2. [Stage] [Phase] 2: [_____].
3. [Stage] [Phase] 3: [_____].

B. Coordination of the Work: Refer to Section 01040 - Coordination and Meetings, and Section 01300 - Submittals (Construction Schedule).

1.07 FUTURE WORK

A. Provide [_____] for future installation of [_____].

1.08 CONTRACTOR USE OF PREMISES

A. Comply with procedures for access to the site and Contractor's use of rights-of-way as specified in Section 01015 - Contractor Use of Premises.

B. Utility Outages and Shutdown: [Specify notification procedures to Owner and separate Contractors.]

1.09 OWNER OCCUPANCY

A. The Owner intends to occupy the [_____] portion of the Project by [_____].

***** OR *****

B. The Owner will occupy the [site] [premises] [_____] during [the entire period of construction] [[Phase [____]] of construction for [the conduct of normal operations] [[installation of [_____]]].

SECTION 01010

CITY OF VICTORIA
STANDARD SPECIFICATIONS

SUMMARY OF WORK

- C. Cooperate with the Owner to minimize conflict, and to facilitate the Owner's operations. Coordinate Contractor's activities with Engineer.
- D. Schedule Work to accommodate this requirement.

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

PART 1 GENERAL

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; 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.

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.
- B. Notify Engineer 48 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. Operate all trucks in accordance with applicable provisions of the City of Victoria Truck Route Ordinance.
- C. Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment or exceptionally large or heavy trucks or equipment.
- D. 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. Acceptance of any portion of the Work will not be based on return of street to public use.
- D. Avoid obstructing driveways or entrances to private property.
- E. 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.
- F. 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 Engineer.
- B. Repair paved area in accordance with the details shown on the plans.

SECTION 01015

CITY OF VICTORIA

STANDARD SPECIFICATIONS

CONTRACTOR USE OF PREMISES

- C. Repair turf areas which become damaged, level with 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

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 the 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 is 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 Form, 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: Reinforcing steel, rolled or formed steel or other metal shapes will be measured by CRSI or AISC Manual of Steel Construction weights. Welded assemblies will be measured by CRSI or AISC Manual of Steel Construction 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 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.

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 schedule. Claims for payment as Unit Price Work, but not specifically covered in the list of unit prices contained in Bid Schedule, will not be accepted.
- C. Interim payments for stored materials will be made only for materials to be incorporated under items covered in unit prices, unless disallowed in Supplementary Conditions. Such materials must be stored on the job site or at a location approved by the Engineer. No payment will be made for street construction, backfill or landscape materials on hand.
- 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 - Not Used

END OF SECTION

PART 1 GENERAL

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 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01035

CITY OF VICTORIA
STANDARD SPECIFICATIONS

CHANGE ORDER PROCEDURES

NOTES TO SPECIFIER

RELATED SECTIONS - For use by Specifier. Do not include list in Project Specifications.

Bid Schedule -	Monetary values of established Unit Prices
Section 01300 -	Submittals: Construction schedules and schedule of values
Section 01720 -	Project Record Documents

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.

1.06 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.

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COORDINATION AND MEETINGS

- 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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cutting, patching and fitting of Work to existing facilities, or to accommodate installation or connection of Work with existing facilities, or to uncover work for access, inspection or testing.

1.02 CUTTING AND PATCHING

- A. Perform activities to avoid interference with facility operations and the Work of others in accordance with the General Conditions of the Contract.
- B. Execute cutting and patching, including excavation, backfill and fitting to:
 - 1. Remove and replace defective Work or Work not conforming to the Drawings and Specifications.
 - 2. Take samples of installed Work as required for testing.
 - 3. Remove construction required to provide for specified alteration or addition to existing work.
 - 4. Uncover Work to provide for inspection or reinspection of covered Work by the Engineer or regulatory agencies having jurisdiction.
 - 5. Connect any Work that was not accomplished in the proper sequence to completed Work.
 - 6. Remove or relocate existing utilities and pipes which obstruct Work to which connections must be made.
 - 7. Make connections or alterations to existing or new facilities.
 - 8. Provide openings, channels, chases and flues, if any, and do cutting, patching and finishing.
- C. Restore existing work to a state equal to or better than that prior to cutting and patching. Restore new Work to standards of these Specifications.
- D. Support, anchor, attach, match, trim and seal materials to the Work of others. Unless otherwise specified, furnish and install sleeves, inserts, hangers, required for the execution of the Work.
- E. Provide shoring, bracing and support as required to maintain structural integrity and protect adjacent Work from damage during cutting and patching. Before cutting beams or other structural members, anchors, lintels or other supports, request written instructions from the Engineer. Follow such instructions, as applicable.

1.03 SUBMITTALS

- A. Submit written notice to the Engineer requesting consent to proceed prior to cutting which may affect structural integrity or design function, Owner operations, or work of another contractor.
- B. Include the following in submittal:
 - 1. Identification of project.
 - 2. Description of affected Work.
 - 3. Necessity for cutting.
 - 4. Effect on other work and on structural integrity.
 - 5. Include description of proposed Work:
 - a. Scope of cutting and patching.
 - b. Contractor, subcontractor or trade to execute Work.
 - c. Products proposed to be used.

- d. Extent of refinishing.
 - e. Schedule of operations.
- 6. Alternatives to cutting and patching, if any.
- C. Should conditions of Work or schedule indicate change of materials or methods, submit a written recommendation to the Engineer including:
 - 1. Conditions indicating change.
 - 2. Recommendations for alternative materials or methods.
 - 3. Submittals as required for substitutions.
- D. Submit written notice to the Engineer designating time Work will be uncovered for observation. Do not begin cutting or patching operations until authorized by the Engineer.

1.04 CONNECTIONS TO EXISTING FACILITIES

- A. Perform construction necessary to complete connections and tie-ins to existing facilities. Keep all existing facilities in continuous operation unless otherwise specifically permitted in these Specifications or approved by the Engineer.
- B. Coordinate with the Engineer, interruption of service requiring connection into existing facilities. Bypassing of wastewater or sludge to waterways is not permitted. Provide temporary pumping facilities to handle wastewater if necessary. Use temporary bulkheads (e.g., inflatable plugs) to minimize disruption. Provide temporary power supply and piping to facilitate construction where necessary.
- C. Submit a detailed schedule of proposed connections, including shut-downs and tie-ins. Include in the submittal the proposed time and date as well as the anticipated duration of the Work. Submit the detailed schedule coordinated with the construction schedule.
 - 1. Provide specific time and date information to the Engineer 48 hours in advance of proposed Work.
- D. Procedures and Operations:
 - 1. The Contractor shall operate existing pumps, valves and gates required for sequencing procedures as directed by the Engineer. Do not operate any valve, gate or other item of equipment without the knowledge of the Engineer.
 - 2. Insofar as possible, equipment shall be tested and in operating condition before final tie-ins are made to connect equipment to the existing facility.
 - 3. Carefully coordinate Work and schedules. Provide written notice to the Engineer at least 48 hours before shut-downs or by-passes are required.

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

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. Notify Engineer immediately of any discrepancies discovered.

1.05 SURVEY REFERENCE POINTS

- A. Control datum for survey is that established by Owner-provided survey as indicated on 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 benchmarks 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.

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STANDARD SPECIFICATIONS

FIELD SURVEYING

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

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
Reford 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

SECTION 01090*CITY OF VICTORIA**STANDARD SPECIFICATIONS***REFERENCE STANDARDS**

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 Manufacturers 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

SECTION 01090*CITY OF VICTORIA**STANDARD SPECIFICATIONS***REFERENCE STANDARDS**

IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane P.O. Box 1331 Piscataway, NJ 0855-1331
IMSA	IMSA P.O. Box 539 E. Union Street Newark, NY 14513-0529
ITE	Institute of Transportation Engineers 1099 14 th Street, NW Suite 300 West Washington, DC 20053438
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

SECTION 01090

CITY OF VICTORIA

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REFERENCE STANDARDS

TCEQ	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 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

PART 1 GENERAL

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 five 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.
- C. Contractor's Certification
 - 1. Each submittal shall contain a statement, 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. When required by Section 01010 – Summary of Work, submit photographs in accordance with Section 01380 – Construction Photographs.
- 1.09 PROJECT RECORD DOCUMENTS
- A. Submit Project Record Documents in accordance with Section 01720 - Project Record Documents.
- 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.

SECTION 01300

CITY OF VICTORIA
STANDARD SPECIFICATIONS

SUBMITTALS

- 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

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Coordinate this section with related sections, including the following:
 - 1. Section 01630 - Product Options and Substitutions; substitution procedures and submittal requirements
 - 2. Section 01720 - Project Record Documents
 - 3. Section 02732 - Acceptance Testing for Sanitary Sewers
- B. For some projects, Paragraphs 1.03, 1.04, 1.06, 1.08 and 1.10 may not apply and should be deleted.

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 - Submittals for submittal requirements.
- B. Prints: Prepare two digital copies of each view and submit 1 digital copy directly to the Engineer within 7 days of taking photographs. One digital copy shall be retained by the Contractor and made available at all times for reference.

PART 2 P R O D U C T S

2.01 PRECONSTRUCTION PHOTOGRAPHS

- A. Prior to the commencement of any construction, take digital color photographs of the entire route of the project.
- B. Photographs: Digital photographs shall be submitted by DVD or "jump drive".
- C. The digital photographs shall show:
 - 1. Date photographs were taken
 - 2. Location of the photograph, house number and street name.
- D. Digital 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

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Testing Laboratory Services and Contractor responsibilities related to those services.

1.02 SELECTION AND PAYMENT

- A. Contractor will employ and pay for services of an independent testing laboratory to perform inspection and testing identified in individual Specification sections.
- B. Employment of testing laboratory shall not relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.
- C. Contractor shall schedule and monitor testing as required to provide timely results and to avoid delay to the Work.

1.03 LABORATORY REPORTS

- A. The Engineer will receive three copies, and the Contractor will receive two copies of laboratory reports from the testing laboratory. One of the Contractor's copies shall remain at site field office for duration of project. Test results which indicate non-conformance shall be transmitted immediately via fax from the testing laboratory to the Contractor and Engineer.

1.04 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume any duties of Contractor.
- D. Laboratory has no authority to stop the Work.

1.05 CONTRACTOR RESPONSIBILITIES

- A. Notify Engineer, and laboratory 24 hours prior to expected time for operations requiring inspection and testing services. Notify Consultant if specification section requires the presence of the Consultant.
- B. Cooperate with laboratory personnel in collecting samples to be tested or collected on site.
- C. Provide access to the Work and to manufacturer's facilities.
- D. Provide samples to laboratory in advance of their intended use to allow thorough examination and testing.
- E. Provide incidental labor and facilities for access to the Work to be tested; to obtain and handle samples at the site or at source of products to be tested; and to facilitate tests and inspections including storage and curing of test samples.
- F. Arrange with laboratory and pay for
 - 1. All failed tests.
 - 2. Retesting for nonconforming Work.

SECTION 01410

CITY OF VICTORIA
STANDARD SPECIFICATIONS

TESTING LABORATORY SERVICES

3. Additional sampling and tests requested by Contractor beyond specified requirements.

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 C O N D U C T I N G T E S T I N G

- A. Laboratory sampling and testing shall conform to ASTM D3740 and ASTM E329, plus other test standards specified in individual Specification sections.
- B. The frequency or number of tests specified in individual sections may be decreased at the discretion of the Engineer.

END OF SECTION

SECTION 01420

CITY OF VICTORIA
STANDARD SPECIFICATIONS

INSPECTION SERVICES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Inspection services and references.

1.02 INSPECTION

- A. The Owner will appoint an Inspector to perform inspections, tests, and other services specified in individual specification Sections.
- B. Reports will be submitted by the independent firm to Engineer, Consultant, and Owner, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- C. Assist and cooperate with the Inspector; furnish samples of materials, design mix, equipment, tools, and storage.
- D. Notify Engineer 24 hours prior to expected time for operations requiring services. Notify Consultant and independent firm when noted.
- E. Sign and acknowledge report for Inspector.

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

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 degrees 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 City of Victoria 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

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TEMPORARY FACILITIES AND CONTROLS

- 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. Give owners of these utilities at least 48 hours notice before commencing Work in the area, for locating the utilities during construction, and for making adjustments or relocation of the utilities when they conflict with the proposed Work.

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 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. 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 the 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, 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 five working days advance notice. Probe and flag the location of underground utilities prior to commencement of excavation. Keep flags in place until construction operation 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.
- 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

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TEMPORARY FACILITIES AND CONTROLS

- 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 earthwork 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 01505

CITY OF VICTORIA
STANDARD SPECIFICATIONS

MOBILIZATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Mobilization of construction equipment and facilities onto the site.

1.02 UNIT PRICES

- A. Measurement for mobilization is on a lump sum basis.
- B. Bid amount may not exceed 5% of the total base bid for the project.
- C. Mobilization payments will be included in monthly payment estimates upon written application by Contractor subject to the following provisions:
 - 1. Authorization for payment of 50 percent of the contract price for mobilization will be made upon receipt and approval by Engineer of the following items, as applicable:
 - a. Schedule of values, if required by Section 01010 – Summary of Work.
 - b. Trench safety program
 - c. Construction schedule
 - d. Pre-construction Photographs, if required by Section 01010 – Summary of Work.
 - 2. Authorization for payment of the remaining 50 percent of the Contract Price for mobilization will be made upon completion of Work amounting to 5 percent of the Contract Price less the mobilization unit price.
- D. Mobilization payments will be subject to retainage amounts stipulated in the 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

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Diversion pumping for the flow of wastewater around the section of sections of pipe designated for rehabilitation or replacement, including active services. The Work covered by this item consists of furnishing all labor, supervision, tools, equipment, appliances and materials to perform all operations in connection with pumping of wastewater and wet weather flows around pipe segment(s). The purpose of diversion pumping is to prevent sewage overflows and provide reliable sewer service to the users of the sanitary sewer at all times. The Contractor shall maintain sewage flow in the construction area in order to prevent back-up and/or overflow into upstream pipe segments and laterals, adjacent ditches, storm sewers and waterways.

1.02 UNIT PRICES

- A. No separate payment will be made for Diversion Pumping. The work performed and materials furnished as prescribed by this item shall be subsidiary to associated items such as, but not limited to:
 - 1. Pipe Costs
 - 2. Cured in Place Pipe Methods
 - 3. Cleaning and Televising of Sanitary Sewers
 - 4. Point Repairs/Obstruction Removal
 - 5. Pipe Bursting/Crushing of Sanitary Sewers

1.03 DEFINITIONS

- A. Diversion pumping is the installation and operation of bulkheads, plugs, hoses, piping and pumps to maintain wastewater flow and prevent backup and overflow. Diversion pumping provides continuous sewer service to the users of the sanitary sewer system while maintenance or construction operations are in progress by diverting flow when necessary around the construction location and pumping it to a downstream manhole.

1.04 CONTRACTOR'S RESPONSIBILITY

- A. It is the sole responsibility of the CONTRACTOR to locate and identify all existing sewer lines and services and to provide any and all labor, material equipment, techniques and methods to diversion pump as necessary for his construction methods and to monitor the effectiveness of this installed system and its effect on adjacent facilities.
- B. Operate, maintain and modify the system(s) as required to conform to this specification. Upon completion to the Construction, CONTRACTOR shall remove the system(s).
- C. Assume sole responsibility for diversion pumping systems and for all loss or damage resulting from partial or complete failure of protective measures and any spills or resultant damage caused by his operation.

1.05 SUBMITTALS

- A. Submit data in accordance with Section 01300 – Submittals.

- B. The Contractor will be required to provide a written plan/sketch for implementation and sequencing of diversion pumping for review and approval of the Engineer prior to installation of the diversion system. The plan shall include sufficient detail to show the location, number and size of pumps, the number, location, size and type of hoses and/or rigid piping and the location of the downstream discharge. Show any special features where pipes or hoses cross roadways, such as temporary trenches, support bridges, etc. A plan for each line segment(s) around which flows are being diverted is required. The plan shall include but not limited to details of the following:
1. Contact information for general contractor/submitting entity shall include the company name, contact person (24 hrs/day), phone number(s) and fax number.
 2. Staging areas for pumps including a schematic showing the arrangement and layout of the pumping and diverting facilities at various stages in the work.
 3. Sewer plugging method and types of plugs.
 4. Length, size, material, location and method of installation of suction piping (if required).
 5. Length, size, material, location, method of installation and location of discharge piping.
 6. Pump manufacturer, model, sizes, capacity and number of each size to be on site and power requirements.
 7. Calculations of static lift, friction losses and flow velocity, (pump curves showing pump operation range shall be submitted).
 8. Standby power generator size, location (if required).
 9. Downstream discharge plan.
 10. Method of protecting discharge manholes or structures from erosion and damage.
 11. Thrust and restraint block sizes and locations.
 12. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill.
 13. Method of noise control for each pump and/or generator.
 14. Any temporary pipe supports and anchoring required.
 15. Schedule for installation of and maintenance of diversion pumping lines.

PART 2 P R O D U C T S**2.01 MATERIALS**

- A. The pump and diversion pumping lines shall be of adequate capacity and size to handle the peak flow conditions. 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.
- B. Internal and or external diversion pumping operations shall use 100% leak proof pipe such as yellow mine or HDPE with positive, restrained joints. Discharge hose will only be allowed in short sections and by specific permission from the engineer.

- C. All pumps shall be fully automatic and solids handling, self-priming or submersible pumps in good working order with a working pressure gauge on the discharge. Self-priming pumps shall not require the use of foot-valves or vacuum pumps in the priming system. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows. The Contractor shall provide the necessary stop/start controls for each pump. A back-up pump of the same capacity as the primary pump shall be maintained on site at all times to be used in the event that the primary pump fails. No wastewater shall be allowed to drain or stand in earthen sump pits.
- D. The Contractor shall be required to demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 24 hours prior to beginning the Work.
- E. The Contractor shall be required to have all materials, equipment and labor necessary to complete the repair or replacement on the job site prior to isolating the wastewater manhole or line segment and beginning diversion-pumping operations.

PART 3 EXECUTION

3.01 GENERAL

- A. Maintain sewage flow to prevent back up or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers and waterways. Do not divert sewage outside of the sanitary sewer system. The Contractor shall take all necessary steps to prevent flooding of public or private property. Maintaining flow inside the existing pipe during rehabilitation operations is preferred.
- B. Any time the diversion pump(s) are operating, an experienced operator shall be on site to monitor the operations: adjust pump speed, valves, etc.; maintain and make minor repairs to the system; and report problems.
- C. Where work requires diverting beyond working hours, the Contractor shall operate diversion pumping and man the system for twenty-four (24) hours per day.
- D. Contractor shall ensure that no damage will be caused to private property as a result of diversion pumping operations. Access to adjacent properties shall be maintained at all times. Ramps, steel plates or other methods shall be employed by the Contractor to facilitate traffic over surface piping. High traffic commercial properties may require alternate methods.
- E. Contractor shall complete the Work as quickly as possible and satisfactorily pass all tests, inspections and repair all deficiencies prior to discontinuing diversion pumping operations and returning flow to the sewer manhole or line segment.
- F. During diversion pumping, do not allow sewage to be leaked, dumped or spilled in or onto any area outside of the existing sanitary sewer system.
- G. In the event of accidental spill of overflow, immediately stop the discharge and take action to clean up and disinfect the spill. Promptly notify the Owner so that required reporting can be made to the Texas Commission on Environmental Quality (TCEQ) by the Owner.
- H. In the event of accidental spill of overflow, the Contractor is responsible for any damages that may have occurred to public or private property including cleaning, disinfection and other corrections to the satisfaction of the Engineer at no cost to the Owner.
- I. Contractor shall not intentionally damage, alter or remove portions of the existing sewer system structures for the purpose of installing a diversion pumping system without specific

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- approval from the Engineer or Inspector. If a structure is damaged, it shall be reconstruct or replaced to the satisfaction of the Engineer at no additional cost to the Owner.
- J. The Contractor shall be responsible for any and all damage that results directly or indirectly from the interference of storm water runoff to diverting equipment, piping and/or appurtenances.
 - K. When diversion pumping operations are complete, piping shall be drained into the sanitary sewer prior to disassembly and all pumps and lines shall be flushed with clean water until all discharge is clear.
- 3.02 SCHEDULING
- A. The Contractor shall report any diversion pumping activities not included in the submitted plan to the Engineer prior to proceeding with these activities.
 - B. The Contractor shall cease diversion pumping operations when directed by the Engineer.
 - C. The Contractor shall perform leakage and pressure tests of the diversion pumping discharge piping using clean water prior to actual operation. The Engineer will be given 24 hours notice prior to testing.

END OF SECTION

PART 1 GENERAL**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. Measurement for trench safety systems used on trench excavations is on a linear foot basis measured along the centerline of the trench, including manholes and other line structures. No separate measurement will be made of shoring systems used by the Contractor for protection unless identified as Special Shoring on the Drawings. Shoring, other than Special shoring, will be included in the trench safety system measurements.
- B. Measurement for Special Shoring system installations shown on the Drawings and included in the bid schedule for trench excavations, is on a square foot basis.
- C. No payment will be made for trench safety systems for structural excavations under this section. Include payment for trench safety system in applicable structure installation sections.
- D. 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.
 - 1. Protective Systems: A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of an adjacent structure.
 - 2. Shoring System: A structure that supports the sides of an excavation and which is designed to prevent cave-ins, or to prevent movements of the ground affecting adjacent installations or improvements.
 - 3. Special Shoring: A shoring system meeting Special Shoring Requirements for locations identified on the Drawings.

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 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 INSTALLATION

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

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TRENCH SAFETY SYSTEM

- B. Install specially designed trench safety systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program. Install Special Shoring at the locations shown on the Drawings.
- 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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tree and plant protection.

1.02 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 poisoning from spilled solvents, gasoline, paint, 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 1-1/2 inches in diameter.

1.03 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 International Shade Tree Conference formula: $0.7854 \times D^2 \times \$10.00$ where D is diameter in inches of tree or shrub trunk measured 12 inches above grade.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Asphalt paint: Emulsified asphalt or other adhesive, elastic, antiseptic coating formulated for horticultural use on cut or injured plant tissue, free from kerosene and coal creosote.
- B. Burlap: Suitable for use as tree wrapping.
- C. Fertilizer: Liquid containing 20 percent nitrogen, 10 percent phosphorus, and 5 percent potash.
- D. All necessary tree replacements shall be as approved by Engineer.

PART 3 EXECUTION

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.
 - a. 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.
 - b. Temporarily cover exposed roots with wet burlap to prevent roots from drying out.
 - c. 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.

END OF SECTION

PART 1 GENERAL

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. No separate payment will be made for control of ground water and surface water. Include the cost to control ground water and surface water in unit price for work requiring such controls.

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 City Engineer prior to start of any fieldwork. 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 Natural Resource Conservation Commission regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.
- C. 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.
- D. 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 B, 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 EXECUTION

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 1.05 B, Submittals).
- 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 hour 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 1.05 B, Submittals.

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

PART 1 GENERAL

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 PRODUCTS - Not Used

PART 3 EXECUTION

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, Submittals 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, City or County.
- 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

PART 1 GENERAL

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 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 of which this work is a component.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

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. Construction exit and wash areas are specified in Section 01569 - Stabilized Construction Exit.
- 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, tarpaper, 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

NOTES TO SPECIFIER

When this section is used, show control devices on Drawings and include the following sections, as appropriate:

- Section 01567 - Filter Fabric Fence
- Section 01568 - Reinforced Filter Fabric Barrier
- Section 01569 - Stabilized Construction Exit

PART 1 GENERAL**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. Filter fabric fence will be measured by the linear foot of completed and accepted filter fabric fence between the limits of the beginning and ending of wooden stakes. Filter fabric fence, measured as stated, will be paid for at the unit price bid for Filter Fabric Fence, Complete in Place.
- B. Payment for filter fabric fence will include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to protection of trees, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, and removal of erosion and sediment control systems at the end of construction.

1.03 SUBMITTALS

- A. Manufacturer's catalog sheets and other product data on geotextile fabric.

PART 2 PRODUCTS**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.

PART 3 EXECUTION**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 controls 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 pre-assembled 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

PART 1 GENERAL

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. Filter fabric barrier will be measured by the linear foot of completed and accepted filter fabric barrier between the limits of the beginning and ending fence posts. Filter fabric barrier, measured as stated, will be paid for at the unit price bid for Reinforced Filter Fabric Barrier, Complete in Place.
- B. Payment for filter fabric barrier will include and be full compensation for all labor, equipment, materials, supervision, and incidental expenses for construction of these items, complete in place, including, but not limited to protection of trees, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, and removal of erosion and sediment control systems at the end of construction.

1.03 SUBMITTALS

- A. Manufacturer's catalog sheets and other product data on geotextile fabrics.

PART 2 PRODUCTS

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.

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 EXECUTION

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 City 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 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.

END OF SECTION

PART 1 GENERAL

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 PRODUCTS

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 0°F to 120°F.

2.02 COARSE AGGREGATES

- A. Coarse aggregate shall consist of crushed stone, gravel, crushed blast furnace slag, or a combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.
- B. Coarse aggregates shall conform to the following gradation requirements.

<u>Sieve Size</u> <u>(Square Mesh)</u>	<u>Percent Retained</u> <u>(By Weight)</u>
2-1/2"	0
2"	0 - 20
1-1/2"	15 - 50
3/4"	60 - 80
No. 4	95 - 100

PART 3 EXECUTION

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 Engineer 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 Engineer 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 Engineer. 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 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 Specification 01566 - Source Controls for Erosion and Sedimentation.

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 Engineer, 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 are 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 underlying 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.

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- 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 shall 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 Engineer.
- J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by the Engineer. 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

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Requirements for signs, signals, control devices, flagmen, lights and traffic signals, as well as construction parking control, designated haul routes and bridging of trenches and excavations.

1.02 SUBMITTALS

- A. If the Contractor proposes to implement traffic control different than the plan provided, he shall submit a traffic control plan in conformance with the Texas Manual on Uniform Traffic Control Devices (TMUTCD) for approval of the Engineer.
- B. Make submittals in accordance with Section 01300 - Submittals.

1.03 UNIT PRICES

- A. Traffic Control and Regulation. Measurement is on a lump sum basis for traffic control and regulation, including submittal of a traffic control plan if different from the plan shown on the Drawings, provision of traffic control devices, and provision of equipment and personnel as necessary to protect the work and the public. The amount invoiced shall be determined based on the schedule of values submitted for traffic control and regulation.

1.04 FLAGMEN

- A. Use flagmen to control, regulate and direct the even flow or movement of vehicular or pedestrian traffic when construction operations encroach on public traffic lanes.

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.
- 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. Notify the Engineer and City Engineer 48 hours prior to closing roadways.
- B. 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.
- C. Contractor shall maintain local driveway access to residential and commercial properties adjacent to work areas at all times, unless otherwise allowed on the Plans.
- D. Keep streets used for entering or leaving the job area free of excavated material, debris, and any foreign material resulting from construction operations.

- E. Control vehicular parking to prevent interference with public traffic and parking, and access by emergency vehicles.
- F. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- G. Prevent parking on or adjacent to access roads or in non-designated areas.

3.02 LIGHTS

- A. Provide lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.03 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 and applicable provisions of the City of Victoria Truck Route Ordinance.
- C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.04 TRAFFIC SIGNS AND SIGNALS

- A. 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.
- B. Relocate traffic signs and control devices as Work progresses to maintain effective traffic control.

3.05 BRIDGING TRENCHES AND EXCAVATIONS

- A. Whenever necessary, bridge trenches and excavation to permit an unobstructed flow of traffic.
- 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.

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CITY OF VICTORIA
STANDARD SPECIFICATIONS

TRAFFIC CONTROL AND REGULATION

3.06 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.

END OF SECTION

PART 1 GENERAL

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 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. Furnish information the Engineer deems necessary to judge equivalency of the alternate product.
- B. 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.
- C. 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 five 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.
- E. 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

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 the 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 – Project Record Documents.
- 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 the 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

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.
- 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 benchmark 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 02072

CITY OF VICTORIA
STANDARD SPECIFICATIONS

HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

- A. Horizontal Directional Drilling is not required in the proposed project, but the Contractor is allowed the option of utilizing these methods at equal cost of construction methods included in the base bid pricing.

1.01 SECTION INCLUDES

- A. Acceptable methods and materials for installing water mains by the horizontal directional drilling method.

1.02 UNIT PRICES

- A. No additional payment will be made for horizontal directional drilling. Payment will be according to construction methods included in base bid pricing.

1.03 INSTALLATION PLAN

- A. At least 7 days prior to mobilizing equipment Contractor shall submit his detailed installation plan to the Engineer. The plan shall include a detailed plan and profile of the bores and be plotted at a scale no smaller than 1 inch equals 20 feet horizontal and vertical.
- B. The plan shall also include a listing of major equipment and supervisory personnel and a description of the methods to be used.

1.04 VARIATIONS IN PLAN OR PROFILE

- A. The Contractor may request changes to the proposed vertical and horizontal alignment of the installation and the location of the entry and exit points. Proposed changes shall be submitted in writing to the Engineer and receive approval of the Engineer prior to construction.

1.05 QUALITY CONTROL

- A. Directional drilling and pipe installation shall be done only by an experienced Contractor specializing in directional drilling and whose key personnel have at least five (5) years experience in this work. Furthermore, the Contractor shall have installed directionally drilled pipe at least as large as 12 inches in diameter and successfully installed at least 75,000 feet in length.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Polyvinyl Chloride Pipe and Fittings.
 - 1. Products delivered under this specification shall be manufactured only for water distribution pipe and couplings conforming to AWWA C900. Restrained joint pipe shall also meet all performance requirements AWWA C900.
 - 2. Restrained joint PVC pipe products used in directional drilling applications shall have been tested and approved by an independent third-party laboratory for continuous use at rated pressures. Copies of Agency approvals or product listings shall be provided to the Engineer. Products intended for contact with potable water shall be evaluated, tested and certified for

SECTION 02072

CITY OF VICTORIA STANDARD SPECIFICATIONS

HORIZONTAL DIRECTIONAL DRILLING

conformance with NSF Standard 61 by an acceptable certifying organization, when required by the regulatory authority having jurisdiction.

3. PVC pipe and couplings shall be made from unplasticized PVC compounds having minimum cell classification of 12454-B, as defined in ASTM D1784. All compounds shall qualify for a Hydrostatic Design Basis (HDB) rating of 4000 psi for water at 73.4°F, in accordance with the requirements of ASTM D2837. Blue pipe shall be supplied for the potable water system.
4. Nominal outside diameters and wall thickness of thrust-restrained pipe shall conform to the requirements of AWWA C900. Restrained pipe shall be furnished in sizes 4": (Class 200, DR-18) and 6", 8" and 12" (Class 150, DR-18) in right-of-way. Restrained pipe installed under roadway pavement in sizes 6", 8" and 12" shall be Class 200, DR-18. Pipe shall be furnished in standard laying lengths of 20 ft. + 1 in. All restrained couplings (4", 6", 8" and 12") shall be furnished in DR 18.
5. Restrained Joint Couplings.
 - a. Pipe shall be joined using nonmetallic restrained type couplings. Pipe and couplings shall be designed as an integral system and shall be provided by a single manufacturer for maximum reliability and interchangeability. Pipe and couplings shall be joined using high-strength flexible plastic splines inserted into mating precision-machined grooves, which align when the pipe is fully inserted providing a full 360° restraint with evenly distributed loading. No external pipe-to-pipe restraining devices that clamp onto or otherwise damage the pipe surface as a result of point-loading shall be permitted.
 - b. Couplings shall be designed as minimum for use at the rated pressures of the pipe with which they are utilized and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Assembled joints shall meet the leakage test requirements of ASTM D3139.
 - c. Allowable axial jacking loads shall be supplied by the manufacturer. The Engineer and Contractor shall utilize appropriate instrumentation to insure that these loads are never exceeded. Only experienced personnel shall be used to install pipe. Coupling edges shall bevel to reduce drag force when pipe is installed by micro tunneling. Assembly of joints shall be accordance with the manufacturer's instructions.
 - d. Acceptable Manufacturers
 1. CertainTeed Certa-Lok C-900/RJ PVC Pipe.
 2. Approved Equal
6. Restrained Joints
 - a. Restrained joints that may be used at valves, tees, bends, and other fittings for Certa-Lok C-900/RJ pipe.
 - b. Manufacturer: CertainTeed
 - c. Materials
 1. Spline: High strength Polyamide Thermoplastic.
 2. Gaskets: Vulcanized SBR in accordance with AWWA C111/A21.11.

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CITY OF VICTORIA
STANDARD SPECIFICATIONS

HORIZONTAL DIRECTIONAL DRILLING

3. Tee Bolts: Shall meet requirements as described in AWWA C111/A21.11.

B. HDPE Pipe

1. HDPE pipe used in directional drilling applications shall be 2 inches in diameter and larger.
2. Refer to Section 02619 – High Density Polyethylene (HDPE) Solid Wall Pipe, for additional requirements pertaining to HDPE pipe.

PART 3 EXECUTION

3.01 DESCRIPTION

- A. Furnish all material, equipment, transportation, tools, and labor to install pipe by directional drilling method or direct trenchless pipe installation as required and all related work for a complete installation.
- B. The Contractor shall have all applicable permits in hand prior to construction.
- C. PVC pipe installed by directional drilling methods shall meet all requirements of AWWA C-900, with a minimum dimension ratio of DR-18. The diameter of the carrier pipe shall be as shown on the drawings. Pipe shall be Polyvinyl Chloride (PVC) pipe. Pipe joints shall be Certa-Lok as manufactured by Certainteed or an approved equal.
- D. HDPE pipe installed by directional drilling methods shall be 2 inches in diameter and larger and shall conform to the requirements outlined in Section 02619 – High Density Polyethylene (HDPE) Solid Wall Pipe.
- E. It shall be the Contractor's responsibility to perform the directional drilling work in strict conformance with the requirements of the Owner. Any special requirements of the Owner such as insurance, flagmen, etc., shall be strictly adhered to during the performance of work. The special requirements shall be performed by the Contractor at no additional cost to the Owner.
- F. Excavation
 1. Required directional drilling pits shall be excavated and maintained to minimum dimension. Said excavations shall be adequately barricaded, sheeted, braced and dewatered, as required, in accordance with the applicable portions of these Specifications.
 2. Excavation adjacent to the road pavement shall be performed in a manner to adequately support these facilities.
- G. Directional Drilling Operations
 1. Pipe shall be handled, stored and joined in accordance with manufacturer's specifications and these Specifications.
 2. Pre-excavate pipe entry and receiving areas to provide a gradual entry of the pipe without stress to the pipe or joints and to allow free movement into the bore hole at an acceptable depth. Carefully guide pipe in such a manner as to avoid deformation of, or damage to, the pipe.

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CITY OF VICTORIA STANDARD SPECIFICATIONS

HORIZONTAL DIRECTIONAL DRILLING

3. If unexpected subsurface conditions are encountered during the bore, the procedure shall be stopped. The installation shall not continue until approval has been given by the Engineer.
4. The drilling mud shall be bentonite slurry or approved equal and contained and disposed of in accordance with state/federal regulations and permit conditions. The Contractor shall install erosion and sedimentation control measures including, but not limited to, straw bales to prevent drilling mud from inadvertently spilling out of the entrance/exit pit and pressure relief vents.
5. The carrier pipe shall be pulled back through using the wet insertion construction technique. At the Contractor's option, the pipe may be installed full of water. The limits of the directional bore construction and plan view length of pipe are shown on the construction plans.
6. Every effort shall be made to maintain pipe installation to a depth of 36 inches. Where deeper or shallower installations are shown on the plans or required by the Owner, the Contractor shall make such adjustments without additional cost to the Owner. Deviations from the plans may be made ONLY with the approval of the Engineer. Minimum and maximum pipe installation depths are 36 inches and 60 inches from the ground surface elevation.
7. The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, movement or distortion of surface features.
8. The system must be remotely steerable and permit electronic monitoring of tunnel depth and location. The system must be able to control the depth and direction of the pipe and must be accurate to a window of ± 2 inches.
9. Equipment shall be fitted with a permanent alarm system capable of detecting an electrical current. The system shall have an audible alarm to warn the operator if the drill head contacts electrified cables.
10. All nonmetallic pipe installed as water mains shall have a 14 gauge copper locating wires attached at 10:00 and 2:00. Wires shall be attached using minimum 2" wide duct tape. Tape shall be at every joint and 4 to 5 feet spacing. Locating wires shall terminate 4 or more inches above the concrete valve paid and fold back inside a 3" PVC access pipe. Wires shall be installed on terminal water lines leading to fire hydrant. Access to tracer wires at the hydrant valve, shall be provided when the hydrant is more than 10 feet from the water main.
11. Depth of the pipe shall be shown on the Record Drawings at required locations.
12. The annular space between the pipe and bore hole shall be filled with an approved material (Bentonite or equal) to support and stabilize the pipe. If pressure grouting is used, caution should be exercised to insure that excess grout pressure does not distort or collapse the pipe.
13. Pipe shall be installed in a manner that will insure that external loads will not subsequently cause a decrease of more than five percent in the vertical cross-section dimension. When changes in direction are necessary, these shall be accomplished gradually such that the ratio of bend radius to nominal pipe size is not less than 300.
14. In the case of a pull-back where the bore will be abandoned, the Contractors shall inject an approved grout into the annular space. This action will be in conjunction with the removal of the bore tool to insure against collapse of the cover material.

END OF SECTION

PART 1 GENERAL

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. Excavation and fill.
- F. Disposal of waste materials.
- G. Disposal of excess materials.
- H. Salvaging of designated items.

1.02 UNIT PRICES

- A. Measurement for Right-of-Way preparation shall be in accordance with the various items listed in the Bid Schedule.
- B. Refer to Section 01025 - Measurement and Payment, for unit price procedures.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Imported Fill: Sand, gravel, earth or combination, which can be compacted to form stable embankments and fills conforming to select borrow standards:
 - 1. Liquid limit: 45 maximum, ASTM D 4318.
 - 2. Plasticity index: 12 minimum, 20 maximum, ASTM D 4318.
 - 3. Free from trash, vegetation, organic matter, large stones, hard lumps of earth and frozen, corrosive or perishable material.
 - 4. Well broken up, free of clods of hard earth, rocks, and stones greater than 2-inch dimension.

PART 3 EXECUTION

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 RIGHT-OF-WAY 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 6 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 in. in diameter, weeds, roots, leaves, 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.
- E. Removal of Obstructions:
1. Remove culverts, storm sewers, manholes, and inlets in proper sequence for maintenance of traffic and drainage.
 2. Backfill and tamp holes remaining after removal of below grade obstructions.
 3. Plug remaining ends of abandoned storm sewers, culverts, sanitary sewers, conduits, and water pipes, with concrete to form tight closure when backfilling is required.
 4. Removal of above-grade improvements:
 - a. Remove surfacing and pavements, including bases for pavements.
 - b. Remove concrete slabs, gutters, walks, concrete or wood headers, valve boxes, concrete and masonry walls, posts, poles, fences, manhole frames and covers, catch basin grates, and other work as specifically indicated.
 - c. Remove existing concrete pavement and curbs to joints or saw-cut lines where no near joint exists.
 5. 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.
- F. Privately Owned Obstructions:
1. Protect street side mailboxes. If necessary to remove mailboxes, temporarily install at an appropriate location near the original location. On completion of the work, permanently

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reinstall mailboxes at their original locations. It is the intent that no resident be without postal service at any time.

2. Remove fences and other structures in the right-of-way, only if necessary, and relocate to the property line.
3. If necessary to remove sprinkler systems from the right-of-way, restore the remainder of the system to operation. Upon completion of the work, replace the removed portion of the system.

3.03 UNSUITABLE MATERIAL

- A. Undercut and replace material which Engineer and City 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 roadway 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 MATERIAL

- A. Items designated by the Engineer and City Engineer to be salvaged are to be carefully removed, so as to cause no damage to the salvaged items and delivered to a location designated by the Engineer and City Engineer.

3.06 DISPOSAL

- A. Remove 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

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 payment will be made for embankment unless specifically listed in Bid Schedule. Include payment in unit price for Roadway Excavation.
- B. Measurement for embankment, when included as a separate pay item, is on a cubic yard basis for material placed and compacted in accordance with the Plans and Specifications.

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 - Topsoil.
- 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 City 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.

SECTION 02221

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

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.
- C. Section 02920 - Topsoil: Topsoil materials and placement.

1.02 UNIT PRICES

- A. No payment will be made for Roadway Excavation unless specifically listed in Bid Schedule. Include payment in unit price for Right-of-Way Preparation.
- B. Measurement for Roadway Excavation, when included as a separate pay item, is on a cubic yard basis for material excavated and disposed of in accordance with the Plans and Specifications.

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 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 City 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 and stockpile topsoil for areas to receive grass or landscaping from areas to be further excavated.
- 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. Subgrade compaction shall be in accordance with the details shown on the plans.

3.05 TOLERANCES

- A. Top of compacted surface: Plus or minus 1/2 inch in cross section, or in 16-foot length.

3.06 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

PART 1 GENERAL

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, ground 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 6 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 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 rainwater 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. 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.
- P. 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.
- Q. Trench Safety Systems include both Protective Systems and Shoring Systems as defined in Section 01526 - Trench Safety Systems.
- R. 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.

- S. 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.
- T. 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 1.08.
- 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 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.

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 Contractor's Professional Engineer to meet the project site requirements based on the manufacturer's standard design.

PART 2 PRODUCTS

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 and Minor Paving.
- C. Timber Shoring Left in Place: Untreated oak.

PART 3 EXECUTION

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 02100 – Right-of-Way Preparation, as applicable.
- E. Install and operate necessary dewatering and surface water control measures to conform with 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.

<u>Nominal Pipe Size, Inches</u>	<u>Minimum Trench Width, Inches</u>
Less than 24	O.D. + 12
24 to 30	O.D. + 18
Greater than 30	O.D. + 24

- 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 affected agency to 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 City 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.

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 embedment including bedding, haunching and initial backfill to meet requirements indicated on Drawings.
- C. For pipe installation, manually spread embedment materials around the pipe to provide uniform bearing and side support when compacted. Perform placement and compaction directly against the undisturbed soils in the trench sidewalls, or against sheeting which is to remain in place.
- D. 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.
- E. 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.
- F. 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 sandbags or other suitable means.
- G. 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. The type of embedment material shall be as indicated on the Plans.
 - 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.

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 trench excavations under pavement or less than two feet from back of curb, 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 24 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. Native soil - When approved by the City Engineer.
 - a. Windrow soil from trench excavation and eliminate clods larger than 6 inches, stones, organic matter and foreign material.
 - b. Maximum 8-inch compacted lift thickness.
 - c. Compaction by equipment providing tamping or kneading impact to the same density and moisture content as the adjacent undisturbed soil.
- D. For trench excavations outside pavements, a random backfill of suitable material may be used in the trench zone.
1. Fat clays (CH) may be used as trench zone backfill outside paved areas at the Contractor's option. 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.
 2. Maximum 9-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.
 3. 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.
 4. 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 is 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.

END OF SECTION

SECTION 02227

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EXCAVATION AND BACKFILL FOR UTILITIES

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. The Designer shall identify any areas requiring special shoring on the Drawings.
- B. Generic special shoring design requirements are included in Paragraph 1.08.A. The Designer shall include any additional design requirements for special shoring in Paragraph 1.08.A. These additional requirements shall be based on site specific conditions applicable to the areas shown on the Drawings.
- C. Special shoring will be paid by the square feet of installed shoring under Section 01526 – Trench Safety System, Item 1.02.B.

END OF NOTES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Material Classifications.
- B. Utility Backfill Materials:
 - 1. Pea gravel.
 - 2. Crushed stone.
 - 3. Crushed concrete.
 - 4. Bank run sand.
 - 5. Select backfill.
 - 6. 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 Bid Schedule. Include payment in unit price for applicable utility installation.
- B. Measurement for backfill material, when included as a separate pay item, is on a cubic yard basis for material placed and compacted within theoretical trench width limits and thickness of material according to Drawing details.
- C. 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 6 to 12 inches above top of pipe as shown on Plans, 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 and supply supporting data to document compliance with the plans and specifications to the Engineer for approval.
- 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 3.03 A.
- 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 3.03 B.
- 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 PRODUCTS

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 the Engineer. Soils classified as fat clay (CH) may be used as backfill materials where allowed by the applicable backfill installation specification. Refer to 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 the City 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. 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
1/2"	100
3/8"	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

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- F. 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
1/2"	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 material 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.
- G. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 12 and 18 or clayey soils treated with lime in accordance with Section 02570 – Pavement Repair and Resurfacing, to meet plasticity criteria.
- H. 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 02227 - Excavation and Backfill for Utilities.
- I. Cement Stabilized Sand: Conform to requirements of Section 02252 - Cement Stabilized Sand.
- J. Concrete Backfill: Conform to Class B concrete as specified in Section 03305 - Concrete for Utility Construction and Minor Paving.

PART 3 EXECUTION

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, sampling and testing required to change to a different material will be at the Contractor's expense.
- 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 Contractor if required 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. If required, the Contractor will assist the Engineer or City Engineer in obtaining material samples for verification testing at the source or at the production plant.
 4. Notify the Engineer and City Engineer in the field when non-conforming material is detected.
- B. Quality Control
1. The Engineer or City 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 or City 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 City 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 City 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

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STANDARD SPECIFICATIONS

UTILITY BACKFILL MATERIALS

NOTE TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. This section includes specifications for approved utility backfill material. Designate on Drawings the materials to be used on the Project.

END OF NOTE

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Furnishing and operating heavy pneumatic tire compaction equipment for locating unstable areas of subgrade, embankment or base.
- B. Reworking of unstable or non-uniform areas.

1.02 UNIT PRICES

- A. Measurement for proof rolling, when included as a separate pay item, will be on a square yard basis.
- B. Reworking unstable or non-uniform areas, removing and replacing materials, and all compaction and incidentals necessary to correct all irregularities will not be measured or paid for directly but shall be considered as subsidiary to proof rolling.

1.03 SUBMITTALS

- A. Submit a plan describing the condition of each roller proposed for the work, as well as the type of traction (self-propelled or drawn), type of roller, size, weight, tire pressure (if appropriate) and configuration of each individual roller, and the operating speed proposed for each individual roller.

PART 2 PRODUCTS**2.01 EQUIPMENT**

- A. The proof rolling equipment shall consist of not less than four pneumatic tired wheels, running on axles carrying not more than two wheels, and mounted in a rigid frame and provided with loading platform or body suitable for ballast loading. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces.
- B. The proof roller under working conditions shall have a rolling width of from 8 feet to 10 feet, and shall be so designed that, by ballast loading, the gross load may be varied uniformly from 25 tons to 50 tons. The tires shall be capable of operating under the various loads with variable air pressure up to 150 pounds per square inch. Tires shall be practically full of liquid. (Tires shall be considered as being practically full when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position.) The operating load and tire pressure shall be within the range of the manufacturer's chart as directed by the Engineer. The Contractor shall furnish the Engineer charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished.
- C. The proof roller shall be towed by a suitable crawler type tractor or rubber tired tractor of adequate tractive capacity, or may be of the self-propelled type. A proof roller unit shall consist of either a self-propelled roller or combination of roller and towing tractor.
- D. There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of 50 tons.
- E. Rubber tired tractive equipment shall be used on base courses and asphalt pavements. Other type tractive equipment may be used on embankment subgrade. The heavy pneumatic tire roller unit shall be capable of turning 180 degrees in the crown width or operating in forward and reverse modes.

- F. In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer, operate other compacting equipment that will produce equivalent results in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired results within the same period of time as would be expected of the specified equipment, as determined by the Engineer, its use shall be discontinued.

PART 3 EXECUTION**3.01 CONSTRUCTION METHODS**

- A. The subgrade, embankment and/or base layer shall be proof rolled to locate unstable areas only when required by the plans or when directed by the Engineer.
- B. The load and tire pressures shall be adjusted as directed by the Engineer and within the ranges set forth in paragraph 2.01.B.
- C. It is proposed to use a contact pressure corresponding as nearly as practical to the maximum supporting value of the earthwork or base.
- D. A minimum of two coverages of the proof roller will be required. Each succeeding trip of the proof roller shall be offset by not greater than one tire width.
- E. Rollers shall be operated at speeds directed by the Engineer which shall be between 2 and 6 miles per hour.
- F. Where the operation of the proof roller unit shows an area to be unstable or non-uniform, it shall be brought to satisfactory stability and uniformity by additional curing and compaction, or by removal and replacement with acceptable material. For natural subgrade, acceptable replacement material shall have similar physical properties as the surrounding material. For embankments or base layers, acceptable replacement materials shall meet the same specifications as the surrounding material.

END OF SECTION

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STANDARD SPECIFICATIONS

CRUSHED STONE FLEXIBLE BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foundation course of crushed stone.

1.02 UNIT PRICES

- A. Measurement for crushed stone flexible base is on a square yard basis. Separate measurement will be made for each different required thickness of base course.
- 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 samples of crushed stone 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 PRODUCTS

2.01 MATERIALS

- A. Crushed Stone: Material retained on the No. 40 Sieve meeting the following requirements:
 - 1. Durable particles of crusher-run broken limestone, obtained from an approved source.
 - 2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C131.
- 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.

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CRUSHED STONE FLEXIBLE BASE COURSE

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 EXECUTION**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 - Embankment and Section 02225 – Roadway Excavation or Sections 02241 – Lime Stabilized Subgrade.
- 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 98 percent of Standard Proctor density in accordance with ASTM D698, 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.

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STANDARD SPECIFICATIONS

CRUSHED STONE FLEXIBLE BASE COURSE

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 depth test 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 test. Rework and recompact areas that do not conform to compaction requirements.
- E. Fill test holes 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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Base course consisting of new flexible base stabilized with portland cement.

1.02 UNIT PRICES

- A. Measurement for cement stabilized base course is on a square yard basis.. Separate measurement will be made for each different required thickness.
- B. Measurement for asphaltic prime coat is by the square yard.
- C. Measurement for cement is by the ton of 2000 pounds, dry weight.

1.03 SUBMITTALS

- A. Submit samples of flexible base for testing.
- B. Submit weight tickets, certified by supplier, for each bulk delivery of cement to the site.
- C. Submit method of mixing, pug mill or road mix, along with characteristics of all associated equipment to be used.

1.04 TESTS

- A. Testing will be performed under provisions of Section 01410 – Testing Laboratory Services.
- B. Tests and analyses will be performed in accordance with ASTM C131, ASTM C150, ASTM C698, ASTM D1556, ASTM D1557, ASTM D2922, ASTM D3017, ASTM D4318, TxDOT Tex-101-E, TxDOT Tex-110-E and TxDOT Tex-120-E.
- C. Acceptance Testing:
 - 1. Unconfined compressive strength will be determined using Test Method Tex-120-E. A minimum of three (3) samples will be molded each day or for each 1000 square yards and the strength shall be the average of the three (3) samples for each lot.
 - 2. Depth shall be determined by coring in random locations at an average of one (1) test per 1000 square yards.
 - 3. Compaction and moisture content shall be determined in accordance with TxDOT Tex-120-E at random locations near each depth determination core.

PART 2 PRODUCTS

2.01 FLEXIBLE BASE

- A. Flexible base shall be Type B, Grade 4, in accordance with Section 02235 – Flexible Base with the following physical requirements:

SECTION 02233

CITY OF VICTORIA
STANDARD SPECIFICATIONS

CEMENT STABILIZED BASE COURSE

MASTER GRADING

Sieve Size	% Retained	% Passing
2 – 1/2"	0	100
1 – 3/4"	0 – 10	90 – 100
7/8"	10 – 35	65 – 90
3/8"	30 – 55	45 – 70
#4	45 – 70	30 – 55
#40	75 – 90	10 – 25
#200	85 – 100	0 – 15

Liquid Limit (LL): 40 Max
Plasticity Index (PI): 15 Max
Sand Equivalent: 25 Min

2.02 PORTLAND CEMENT

- A. ASTM C150 Type I, bulk or sacked.

2.03 WATER

- A. Clean, clear and free from oil, acids, alkali or vegetable matter.

2.04 ASPHALTIC PRIME COAT

- A. Prime shall conform to Section 2510 – Asphaltic Concrete Pavement, 3.02 A. Asphalt Emulsion Prime is recommended.

2.05 MIX DESIGN

- A. When used as a base course under portland cement concrete pavement.

The cement content shall be between **6%** and **10%** so as to provide a **7-day** compressive strength of **600** psi when tested in accordance with TxDOT Tex-120-E.

- B. When used as a base course under hot mix asphaltic concrete pavement.

The cement content shall be between **3%** and **7%** so as to provide a **7-day** compressive strength of **300** psi when tested in accordance with TxDOT Tex-120-E.

PART 3 EXECUTION

3.01 MIXING AND PLACEMENT

- A. General:
Cement treatment shall not be started when the air temperature is below 40 degrees F.

B. Plant Mix:

1. The cement, base material and water shall be thoroughly mixed in a stationary plant. After mixing is completed, no additional water shall be added to the mix.
2. Cement treated material shall be placed with an approved spreader in uniform layers not to exceed 8 inches.
3. Construction joints between new cement treated base and cement treated base that has been in place for four (4) hours or longer shall be approximately vertical and shall be treated using a header or by cutting back the face.

C. Road Mix:

1. Base material shall be uniformly spread and premixed prior to the addition of cement.
2. Cement shall be spread only in the area where the mixing, compacting and finishing operations can be completed during the same working day.
3. Cement shall be spread only in the area where the compaction can be completed within two (2) hours of the addition of water to the dry mixed material.
4. The cement shall be spread by an approved spreader or by bag distributor. It shall be distributed at a uniform rate and in a manner as to reduce to a minimum the scattering of cement by wind. Cement shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing cement becomes objectionable to adjacent property owners or dangerous to traffic.
5. Only single or multiple soil stabilizer mixers shall be used. The cement shall be **dry mixed** with the base material prior to the addition of water.
6. Immediately after dry mixing, water shall be uniformly applied to bring the moisture to between optimum and 3 percent above optimum as determined by TxDOT Tex-120-E. After mixing, the mixture shall be in a loose, evenly spread state, ready for compaction.

3.02 COMPACTION

- A. Compaction shall be completed within two (2) hours of the addition of water to the material. This requirement shall apply to both plant mix and road mix materials.
- B. The cement stabilized base course shall be compacted to 95% density as determined by TxDOT Tex-120-E.
- C. When the material fails to meet the density or strength requirements or the material loses the required stability, density or finish before the next course is placed, the treated material shall be removed and replaced at the Contractor's expense.

3.03 FINISHING

- A. Immediately after compaction, the surface of the mixture shall be clipped, skinned or tight bladed by a maintainer or subgrade trimmer to a depth of approximately 1/4", removing all loosened materials. The loosened materials shall be disposed of at the Contractor's expense and at a location approved by the Engineer. The surface shall then be rolled with a pneumatic tire roller, adding small increments of moisture as needed during rolling.
- B. Throughout this operation, the shape of the course shall be maintained and the surface upon completion shall be smooth and in conformity with the typical sections, lines and grades as shown on the plans or as established by the Engineer.

SECTION 02233

CITY OF VICTORIA
STANDARD SPECIFICATIONS

CEMENT STABILIZED BASE COURSE

3.04 CURING

- A. The completed section shall be prevented from drying by addition of an asphaltic prime coat.

3.05 PROTECTION

- A. Maintain stabilized base in good condition until application of next course. Repair defects by replacing base to full depth.
- B. Protect asphaltic prime coat from being picked up by traffic. Prime coat shall be reapplied as necessary at the Contractor's expense.

3.06 FIELD QUALITY CONTROL

- A. When base is under Portland cement concrete pavement:
 - 1. Material which fails to achieve a minimum 7-day compressive strength of 500 psi in accordance TEX-120-E will be rejected. If the 7-day compressive strength is greater than 500 psi and less than 600 psi, the contractor shall stop cement base placement. The contractor shall inform the city and the engineer of changes in methods and/or changes in cement content to produce the required compressive strength prior to placing additional base. Base will be rejected after two consecutive tests less than 600 psi.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Recycled Crushed Concrete Base (RCCB) course.

1.02 UNIT PRICES

- A. Measurement of and payment for RCCB is on a square yard basis for properly installed material. Separate measurement will be made for each different required thickness of base course.
- B. Follow Section 01025.

1.03 SYSTEM DESCRIPTION

- A. Provide RCCB with following performance:
 - 1. Minimum 5 percent cement.
 - 2. Minimum Compressive Strength: 650 psi at 7 days following TxDOT Tex-120-E.
 - 3. Prepare concrete product in an on- or off-site pug mill, or in an on- or off-site portable concrete mixer.
- B. Preliminary Design: Prepare preliminary mix for four cement ratios; 5, 6, 7 and 8 percent.
 - 1. Designate source of concrete for crushing. Follow Section 01410 – Testing Laboratory Services for tests of concrete from source.
 - 2. Results of compression tests will be used by Engineer to select the final mix design.

1.04 SUBMITTALS

- A. Follow Section 01300 - Submittals.
- B. Submit samples of crushed concrete, gravel, and soil binder for testing.
- C. Submit weight tickets, certified by supplier, for each delivery of crushed concrete and cement to mixing site.
- D. Submit manufacturer's description and characteristics for pug mill and associated equipment, mixer trucks, spreading machine, and compaction equipment for approval.

1.05 TESTS

- A. Follow Section 01410 – Testing Laboratory Services.
- B. Test and analyze aggregate and binder products following TxDOT Tex-110-E.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Make stockpiles from layers of processed aggregate without segregation of materials. Load material by making successive vertical cuts through entire depth of stockpile.
- B. Store cement in weatherproof enclosures. Protect from ground dampness.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT

- A. ASTM C150 Type I, II or III; bulk or sacked.

2.02 WATER

- A. Potable.

2.03 AGGREGATE

- A. Recycled Crushed Concrete: Material retained on the No. 40 Sieve, and durable coarse particles of crusher-run reclaimed cured Portland cement concrete, obtained from an approved source. Organic material is prohibited.
- B. Soil Binder (classified below): Meeting the following requirements when tested following TxDOT Tex-106-E:
 - 1. Maximum Liquid Limit: 35
 - 2. Maximum Plasticity Index: 10
- C. Mixed Aggregate and Soil Binder: Grading following Tex-101-E and Tex-110-E within the following limits:

<u>Sieve</u>	<u>Percent Crushed Concrete Retained</u>
1-3/4 inch	0 to 10
No. 4	45 to 75
No. 40	55 to 80; classified as "Soil Binder."

- 1. Obtain prior permission from City Engineer for use of additives to meet above requirements.

2.04 ASPHALTIC SEAL CURE

- A. Use following as Contractor's option to curing by sprinkling, at no additional cost or time.
- B. Prime or cutback asphalt shall conform to Section 02510, 3.02A. Asphalt Emulsion Prime is recommended.

2.05 MATERIAL MIX AND MIXING EQUIPMENT

- A. Design mix for minimum compressive strength of 650 psi at 7 days following Tex-120-E unconfined compressive strength.
- B. Cement Ratio: Follow Paragraph 1.04 A. Increase cement content in one percent steps up to 8 percent maximum if compressive strength of design mix samples and field samples of installed product fail above test.
- C. Mix following Paragraph 1.04 A, with metering devices adding specified quantities of crushed concrete, cement, and water into mixer. Dry mix crushed concrete and cement to prevent cement balls from forming when water is added. Produce homogeneous and uniformly mixed product.

2.06 SOURCE QUALITY CONTROL

- A. Test following Section 01410 – Testing Laboratory Services.

- B. Designate single source of crushed concrete for work.
- C. Test for unconfined compressive strength following Test Method Tex-120-E as follows:
 - 1. Mold 3 samples each day or for each 1,000 tons of production.
 - 2. Compressive Strength: Average of three tests for each production lot.

PART 3 PART 3 EXECUTION

3.01 EXAMINATION

- A. Follow Section 01410 – Testing Laboratory Services.
- B. Verify buried utility work is complete.
- C. Verify subgrade is ready to support imposed loads.
- D. Verify flatwork, foundations, projecting reinforcement and similar work interfacing to base is in place.
- E. Verify lines and grades are correct.

3.02 PREPARATION

- A. Have sufficient products and equipment on hand to expeditiously apply base.

3.03 MIXING

- A. Maintain moisture content of mixture between optimum and 10 percent above optimum.

3.04 PLACEMENT

- A. Do not mix and place cement stabilized base under following conditions:
 - 1. 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.
 - 2. When precipitation is falling or is forecast to fall before initial set takes place.
- B. Place base on prepared subgrade in uniform layers of 6 inches or less to produce thickness indicated on Drawings. Do not dump material in piles or windrows.
- C. Place mixture with approved spreading machine. Spread to eliminate planes of weakness or pockets of nonuniformly graded material resulting from hauling and dumping operations.
- D. Provide approximately vertical construction joints between fresh base and base in place 4 hours or longer. Form joint with a temporary header or make vertical cut of in-place base immediately before placing fresh base.
- E. Make cold joints at centerline of head-to-head parking stalls.
- F. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Provide proper bond between reinforcement and base.

3.05 COMPACTION

- A. Start compaction maximum 3 hours after start of moist mixing. Compact loose mixture with approved tamping rollers until entire depth is uniformly compacted. Do not allow base to mix with underlying material.
 - 1. Do not rework uncompacted material, which has sat for more than 30 minutes.
 - 2. Complete compaction within 6 hours from start of moist mixing.
- B. Correct irregularities or weak spots immediately by replacing material and recompacting.
- C. Apply water to maintain moisture between optimum and 5 percent above optimum moisture.
- D. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.
- E. Finish by blading surface to final grade after compacting final course. Seal with approved pneumatic tired rollers or flat wheel rollers, which are sufficiently light to prevent surface hairline cracking. Rework and recompact at areas where hairline cracking develops.
- F. Compact to minimum density of 95 percent of modified Proctor density, following TxDOT Tex -114-E, at a moisture content of treated material between optimum and 5 percent above optimum.
- G. Maintain surface to required lines and grades throughout operation.

3.06 CURING

- A. Moist cure for minimum of 72 hours before adding pavement courses. Prevent construction traffic on base for minimum 3 days, except light vehicles used to maintain proper cure are permitted on base after initial set or as permitted by the City Engineer.
- B. Use sprinkling or, at Contractor's option, apply following curing membrane as soon as initial set begins, using approved light-weight self-propelled pressure distributor:
 - 1. MC30: 0.1 gallon per square yard.
 - 2. EPR-1 Prime: 0.15 gallon per square yard.
- C. Do not use cutback asphalt during the period of April 16 to September 15.

3.07 TOLERANCES

- A. Completed Surface: Smooth and conform to typical section and established lines and grades.
- B. Top Surface of Base Course: Plus or minus 1/4 inch in cross section or in 16-foot length.

3.08 FIELD QUALITY CONTROL

- A. Test following Section 01410 – Testing Laboratory Services.
- B. Take minimum of one core at random locations per 1,000 square yards of base to determine in-place depth.
- C. Contractor may, at Contractor's 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.

SECTION 02234

CITY OF VICTORIA

STANDARD SPECIFICATIONS

RECYCLED CRUSHED CONCRETE BASE

- D. Perform compaction tests following TxDOT Tex-114-E at a random location near each depth determination core. Rework and recompact areas failing compaction requirements.
- E. Fill cores and density test sections with new and properly mixed, placed and compacted base product.
- F. Material which fails to achieve a minimum 7-day compressive strength of 500 psi in accordance TEX-120-E will be rejected. If the 7-day compressive strength is greater than 500 psi and less than 600 psi, the contractor shall stop cement base placement. The contractor shall inform the city and the engineer of changes in methods and/or changes in cement content to produce the required compressive strength prior to placing additional base. Base will be rejected after two consecutive tests less than 600 psi.

3.09 PROTECTION

- A. Maintain base in proper condition until completion of work. Repair defects immediately by replacing base to full depth.
- B. Curing membrane may remain in place at areas where surface courses or other base courses are applied.

END OF SECTION

SECTION 02234

*CITY OF VICTORIA
STANDARD SPECIFICATIONS*

RECYCLED CRUSHED CONCRETE BASE

NOTE TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. This Section requires inclusion of Section 02511- Prime Coat.

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This item shall include the delivery, stockpiling and/or the construction of foundation or base courses as herein specified and in conformity with the typical sections and to the lines and grades shown on the plans or established by the Engineer.

1.02 UNIT PRICES

- A. Measurement for flexible base is on a square yard basis, unless otherwise indicated on the plans or in the bid proposal. Separate measurements will be made for each different required thickness of base course.

1.03 SUBMITTALS

- A. Submit proposed gradations and physical properties of the gravel base.
- B. Submit manufacturer's description and characteristics for all equipment necessary to complete the installation of the base course(s). Equipment shall be in accordance with Item 247, "Flexible Base" of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Flexible Base materials shall be in accordance with Item 247.2, "Flexible Base" of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.
- B. The Engineer will designate the grade of flexible base in accordance with Item 247, of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004. If not otherwise specified the base shall be Type B, Grade 4 Base Material as listed below:

PI	Max	14
	Min	8
LL	Max	35
	% Retained on Sieves	% Passing on Sieves
1 3/4	0 – 10	90% - 100%
7/8	10 – 35	65% - 90%
3/8	30 – 60	40% - 70%
#4	45 – 75	25% - 55%
#40	70 – 85	15% - 30%

The lime percent to be added to the base shall typically be 3% by weight, unless otherwise determined by laboratory testing.

2.02 EQUIPMENT

- A. All equipment shall comply with the requirements of Item 247 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

2.03 QUALITY OF FLEXIBLE BASE

SECTION 02235

CITY OF VICTORIA
STANDARD SPECIFICATIONS

FLEXIBLE BASE

- A. The quality of the flexible base shall be in accordance with Item 247.2 and Item 247.3 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade and base coarse are ready to support imposed loads and meets compaction, moisture, and grading tolerances
- B. Verify lines and grades are correct.

3.02 PREPARATION

- A. Remove subgrade that will not support load. Replace and compact subgrade to required density.

3.03 CONSTRUCTION METHODS

- A. Construction methods, including, but not limited to, placement and compaction shall follow, Item 247.3 and Item 204 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foundation course of a compacted mixture of coarse and fine aggregates and asphaltic material.

1.02 UNIT PRICES

- A. Measurement for hot mix asphaltic base is on a square yard basis, unless otherwise indicated on the plans or in the bid proposal. Separate measurements will be made for each different required thickness of pavement or type of hot mix asphaltic base.
- B. Refer to Section 01025 – Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

- A. Submit proposed mix design and test data for hot mix asphaltic base.
- B. Submit manufacturer's description and characteristics for all equipment necessary to complete hot mix asphaltic base. Equipment shall be in accordance with Item 340, "Dense-Graded Hot-Mix Asphalt (Method) and Item 341 "Dense-Graded Hot-Mix Asphalt (QC/QA)" of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Hot mix asphaltic base materials shall be in accordance with Item 340, "Dense-Graded Hot-Mix Asphalt (Method) and Item 341 "Dense-Graded Hot-Mix Asphalt (QC/QA)," of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.

2.02 EQUIPMENT

- A. All equipment, including mixing plant and measuring equipment; haulers, spreading and finishing machine, compaction equipment and all other incidental equipment shall comply with the requirements of Item 340, "Dense-Graded Hot-Mix Asphalt (Method) and Item 341 "Dense-Graded Hot-Mix Asphalt (QC/QA)" of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.

2.03 QUALITY OF ASPHALT STABILIZED BASE

- A. The quality of the asphalt stabilized base shall be in accordance with Item 340, "Dense-Graded Hot-Mix Asphalt (Method) and Item 341 "Dense-Graded Hot-Mix Asphalt (QC/QA)" of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade and base course are ready to support imposed loads and meets compaction and moisture requirements.

- B. Verify lines and grades are correct.

3.02 PREPARATION

- A. A prime coat, if indicated on the drawings or in the bid proposal shall meet the requirements of Item 310 "Prime Coat" or Item 314 "Emulsified Asphalt Treatment" of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004
- B. A tack coat shall be applied prior to placement of the asphalt-stabilized base conforming to the requirements of Item 340, "Dense-Graded Hot-Mix Asphalt (Method)" and Item 341 "Dense-Graded Hot-Mix Asphalt (QC/QA)" of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.
- C. Remove subgrade that will not support load. Replace and compact subgrade to required density.

3.03 CONSTRUCTION METHODS

- A. Construction methods, including, but not limited to, placement and compaction shall follow Item 340, "Dense-Graded Hot-Mix Asphalt (Method)" and Item 341 "Dense-Graded Hot-Mix Asphalt (QC/QA)" of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

PART 2 Geo-grid type and placement over prepared sub-grade.

2.01 UNIT PRICES

- A. Measurement for geo-grid is on a square yard basis to include all installation procedures. Surface preparation of sub-grade, zip-ties and overlaps are all considered part of the installation process, unless otherwise indicated on the plans or in the bid proposal.
- B. Refer to Section 01025 – Measurement and Payment for unit price procedures.

2.02 SUBMITTALS

- A. Submit data sheet from manufacturer and/or supplier.
- B. Submit manufacturer's description and characteristics for all equipment necessary to complete the surface course.

PART 3 PRODUCTS

3.01 MATERIALS

- A. Geo-grid shall be Tensar TX130-S, Tensar BX-1200 or TerraGrid 1200. The geo-grid shall be supplied with zip-ties sufficient to tie every 15 feet.
- B. Geo-grid shall have an overlap of a minimum of 1 foot and tied at 15 foot intervals longitudinal and tied at 3 foot intervals transverse. It shall be flat and not have rolls, waves or folds, if necessary, cut and re-lay geo-grid around curves or intersections. Re-tie and maintain overlap, at no point shall there be a gap in the geo-grid. Follow manufacturer's recommendations for installation procedures.

3.02 EQUIPMENT

- A. Compact sub-grade with a sheep foot type roller followed by a flat wheel or pneumatic roller prior to geo-grid installation.

PART 4 EXECUTION

4.01 EXAMINATION

- A. Verify compacted sub-grade to support imposed loads that meets compaction and moisture requirements.
- B. Verify that lines and grades are correct.

4.02 PREPARATION

- A. Prior to placement of the geo-grid, sub-grade to be compacted to a minimum density of 90% Standard Proctor as determined by ASTM D698. Pumping areas shall be opened up and dried or lime may be applied in order to achieve proper density and to eliminate soft, pumping areas.

4.03 CONSTRUCTION METHODS

- A. Compact sub-grade in 8" lifts and verify compaction by proof rolling (Specification 02230) or by ASTM D698.

END OF SECTION

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. Measurement for Lime Stabilized Subgrade is on a square yard basis. Separate measurement will be made for each different required thickness of stabilized subgrade.
- B. Measurement for Lime is on a per ton basis.
- C. 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 PRODUCTS

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 $\text{Ca(OH)}_2 + \text{CaO}$	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 quicklime. The use of hydrated lime for onsite job mixing is only allowed

with approval of the Engineer and City Engineer. 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 EXECUTION

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.

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 1.06C concerning use of quicklime.
- 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 lime at the rate indicated on the Plans or as directed by the Engineer.

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 otherwise 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 hairline 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, prime, 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 locations 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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cement stabilized sand for backfill and bedding.

1.02 UNIT PRICES

- A. No payment will be made for cement stabilized sand under this Section unless an extra unit price item is included in the Bid Schedule and the application of the pay item is approved by the Engineer. Include payment for cement stabilized sand in unit price for applicable utility or structure installation section.
- B. If use of cement stabilized sand is allowed based on the Engineer's direction the extra unit price item will be paid on a per ton basis. A conversion between volume calculated based on theoretical limits and total weight will be made based on a ratio of 1.64 tons per cubic yard.

1.03 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 - Submittals.
- B. Submit proposed design mix and test data for sand-cement mixture.

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 D698. Mix shall contain a minimum of 1-1/2 sacks of cement per cubic yard.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cement: Type 1 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. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C94.

2.02 MIXING MATERIALS

- A. Add required amount of water and mix it thoroughly in a pugmill-type mixer.
- B. Stamp batch ticket at plant with time of loading. Material not placed and compacted within 4 hours after mixing shall be rejected.

- C. On-site manual mixing will be allowed, however, the cement content shall be increased to 2 sacks per cubic yard for manually mixed material.

PART 3 EXECUTION

3.01 PLACING

- A. Place sand-cement mixture in 8-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. Random samples of delivered product will be taken in the field at point of delivery and tested in accordance with ASTM D1633, method A.
- C. Four specimens shall be prepared and molded (for each sample obtained) in accordance with ASTM 698, Method A without adjusting the moisture content. A "split" type mold as described in ASTM D558 is allowed for molding to minimize specimen disturbance during removal. Careful preparation and handling are critical to avoid damage to the molded specimens and to consistently achieve accurate test results.
- D. After molding, specimens shall be removed from the molds and covered with a plastic bag or similar material to minimize moisture loss and cured at a room temperature between 60 and 80 F. until ready for testing.
- E. Specimens shall be tested for compressive strength in accordance with ASTM D1633, Method A. Capping is not required and can be avoided if specimens are carefully prepared. Specimens may be capped, if necessary to meet planeness requirements. Bad caps cannot be removed without damage to the specimen. Damaged specimens shall not be tested. Two specimens shall be tested at 48 +/- 2 hours and two specimens shall be tested at 7 days +/- 4 hours.
- F. A strength test shall be the average of the strengths of two specimens molded from the same sample of material and tested at the same age. The average daily strength shall be the average of the strengths of all specimens molded during one day's production and tested at the same age.

3.03 ACCEPTANCE

- A. The strength level of the material shall be considered satisfactory if:
 - 1. The average 48-hour strength is greater than 100 psi with no individual strength test (average of two specimens) below 60 psi.
 - 2. All 7-day individual strength tests (average of two specimens) exceed 100 psi.
- B. The material shall be considered acceptable for partial payment if any 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 60 psi.
- C. The material shall be considered unacceptable and subject to removal and replacement at the Contractor's expense if any individual strength test has a 7-day strength less than 60 psi.

SECTION 02252

CITY OF VICTORIA

STANDARD SPECIFICATIONS

CEMENT STABILIZED SAND

- D. If the moving average of any three daily 48-hour averages falls below 100 psi, the supplier shall discontinue shipment to the Owner's projects until that plant is capable of producing a material which exceeds 100 psi at 48-hours. A total of five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Work to be accomplished for augering casings with installation of sanitary sewer pipe or for direct installation of sanitary sewer pipes.

1.02 Contractor shall select a method of construction by augering, which can be demonstrated to successfully complete the Project.**1.03 MEASUREMENT AND PAYMENT**

- A. Payment of augered casing with sewer pipe will be full compensation for all labor, equipment, casing, sewer pipe, materials and supervision for construction complete in place including dewatering, augering, joints, spoil removal, pipe installation, grouting, utility adjustments, testing, and cleanup, and other work necessary for construction as shown on the Drawings and as specified.
- B. Augered casing with sewer pipe will be measured along the axis of the casing from end to end of the casing.
- C. Payment of augered pipe will be full compensation for labor, pipe, equipment, materials, and supervision for construction complete in place including dewatering, jacking, grouting, utility adjustments, testing, cleanup, and other work necessary for construction as shown on the Drawings and as specified.

1.04 Augered pipe will be measured along the axis of the pipe and shall include fittings. In the case of a branch pipe, the length of the pipe will be considered as the distance from the axis of the line to the end of the branch. The length of the pipe laid between two lines or from a line to an appurtenance will be measured between the centerlines of each.

- A. Auger pits and other excavations are incidental to the work. Trench Safety for Auger Pits and other excavations for work specifically performed for this section shall be included in Section 01526 - Trench Safety Systems.
- B. No separate payment will be made for pavement removal and replacement (i.e., lime stabilization, crushed limestone, hot mix asphalt surface course, cement sand base, and concrete pavement, etc.) associated with augering.

1.05 DEFINITIONS

- A. Dry augering shall be defined as installation of steel casing by excavating the soil at the advancing end of casing and transporting the spoil through the casing by an otherwise uncased auger, while advancing the casing by jacking at the same rate as the auger excavation progresses.
- B. Slurry augering shall be defined as installation of casing or sewer pipe by first drilling a small diameter pilot hole from shaft to shaft, followed by reaming the bore to full diameter by augering with slurry, and installing the casing or pipe by a pull-back or jacking method.
- C. Augering pipe or casing work plans shall be defined as written descriptions, together with sketches, drawings, schedules, and other documents defining Contractor's plans and procedures for installation of casing or sewer pipe by augering method. Such methods of construction shall be of the Contractor's choosing, in accordance with this specification. The submission of work plans including drawings shall be required for the sole purpose of

providing the Engineer sufficient details to verify that the Contractor's planned work and work in progress is in accordance with the intent of the project design and specifications.

- D. Augered pipe shall be defined as the Contractor's installed sewer pipe.

1.06 SUBMITTAL

- A. Review. Submittal shall be made in accordance with Section 01300 - Submittal. The Engineer will review submitted plans, details and data for compliance with specifications. Contractor shall not commence work on any items requiring pipe and casing augering work plan, or other submittal until the submittal have been reviewed and accepted by the Engineer. Such review by the Engineer shall not be construed in any way of relieving the Contractor of his responsibilities under the Contract, shall not be construed by the contractor as an endorsement by the Engineer that such methods are constructable or will work for the specific subsurface soils encountered. Structural designs and other engineered components shall be signed and sealed by a Professional Engineer registered in the State of Texas.
- B. Pipe and Casing Augering Operation.
1. Submit for review a Pipe and Casing Augering Work Plan with complete drawings and written description identifying details of the proposed method of construction and the sequence of operations to be performed during construction, as required. The drawings and descriptions shall be sufficiently detailed to demonstrate to the Engineer whether the proposed materials and procedures will meet the requirements of this Section.
 2. Depending on the Contractor's method of construction, the Pipe and Casing Augering Work Plan shall be submitted on the following items:
 - a. Arrangement drawings and technical specifications of the augering equipment and experience record of the Contractor.
 - b. Method of controlling line and grade of augering operation.
 - c. Method of spoil and slurry removal, including surface storage and disposal.
 - d. Details of the pipe or casing installation.
 - e. Grouting techniques to be used for filling annular void between casing and sewer pipe, where required, and for filling over excavation, if any, including equipment, pumping and injection procedures, pressure grout types, and mixtures.
 - f. Location and construction of auger pits, including details for all required ground support installation not included in the Trench Safety Plan.
 - g. Groundwater control system per requirements in this section and in accordance with Section 01563 - Control of Ground Water and Surface Water, as required by construction method.
 3. Casing and pipe fabrication drawings, including joint details.
- C. Trench Safety
1. Refer to Paragraph 3.04 regarding auger pits.
 2. To the extent that excavation for pipe and casing augering involves work not covered by Contractor's Trench Safety Plan, the safety provisions of these excavation shall be addressed in the Pipe and Casing Augering Work Plan.
- D. Quality Control Methods. At least 30 days prior to the start of augering, the Contractor shall submit a description of the quality control methods proposed for use in this operation to the Engineer. The submittal shall include:
1. Supervision. Supervisory control to ensure that work is performed in accordance with the Drawings and Specifications, and Pipe and Casing Augering Work Plan.
 2. Line Grade. Procedures for surveying, controlling and checking line and grade, including field forms.
 3. Augering Observation and Monitoring. Procedures for preparing and submitting daily logs of augering operations, including field forms.

4. Products and Materials. A plan for testing and submittal of test results to demonstrate compliance with the specification and Contractor's design criteria for permanent products, material and installations. The plan shall identify applicable standards and procedures for testing and acceptance.
5. Monitoring Settlement. A Settlement Monitoring Plan to meet the requirements of paragraph 3.05A.

1.07 INSTALLATION LOADS

- A. Verify that the casing, pipe and pipe joints shown on the Drawings will carry the thrust of the jacks or loads due to the pulling mechanism of the Contractor's installation method.

1.08 REGULATORY REQUIREMENTS

- A. The contractor shall conform to all requirements of the Texas Department of Transportation permit for installations in state rights-of-way. The Owner will prepare permit documents and ensure that a permit is acquired from the Texas Department of Transportation.
- 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 and City 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 PRODUCTS

2.01 MATERIALS

- A. Casing pipe shall be provided where shown on Drawings or indicated in Specifications and be new or used, coated welded steel pipe, manufactured in accordance with AWWA C200. Engineer reserves the right to inspect and to reject any used steel casing. Steel casing for street and highway crossings and river crossings shall have walls at least 3/8" (0.375 inch) thick, or as shown on the Drawings, whichever is thicker. Steel casing for railroad crossings shall have walls at least 9/16" (0.5625 inch), or as shown on the Drawings, whichever is thicker.
- B. Sewer pipe shall be provided in accordance with Section 02730 - Gravity Sanitary Sewers. The sewer pipe selected shall be verified by the Contractor to safely withstand all service loads, including overburden pressures and surcharge loads together with all forces and pressures induced in pipe and joints during installation.
- C. Sewer pipe to be installed into the augered hole by a pull-back method which will place tension on the pipe joints shall be fusion-welded or restrained joint sewer pipe.
- D. Grouting Materials:
 1. Pressure grout between casing and soil: sand-cement mortar mix 28-day strength at 1000 psi.
 2. Annular grout between pipe and casing: cellular grout, ASTM C 138, 28-day strength of 300 psi unless otherwise approved by City Engineer.
 3. Strength determined by ASTM C 942.
- E. Casing Spacers shall be polyethylene manufactured spacers. Specific manufacturers may be listed in the plans or approved materials list and spacers may include restrained joints.

- F. Casing end seal closures shall be pull-on type seal with stainless steel bands and clamps. Specific manufacturers may be listed in the plans or the approved materials list.

PART 3 EXECUTION

3.01 PROTECTION AND SAFETY

- A. The Contractor shall be responsible for means and methods for augering pipe and casing and shall ensure the safety of the work, the Contractor's employees, the public, and adjacent property, whether public or private.
- B. Perform construction operations in such a manner that will not interfere with the operation of street or railroad, affect underground installations, or weaken or damage any structure.

3.02 DRY AUGERING

- A. Provide horizontal augering equipment of sufficient capacity for the diameter and length of the casing to be installed and the anticipated ground conditions.
- B. Provide heavy-duty jacks of a capacity suitable for forcing the excavating auger and casing through the ground and a suitable jacking frame or backstop. Use operating jacks constructed so that even pressure is applied to all jacks used.
- C. Provide steerable front section of casing to allow vertical grade adjustments. A water level or other means shall be provided to allow monitoring of the grade elevation of the auger casing.
- D. Set casing to be jacked on guides, properly braced together, to support the section of pipe and direct it to proper line and grade. Place the whole jacking assembly so as to line up with the direction and grade of the pipe.
- E. In unconsolidated soil formations, bentonite may be used to seal the voids outside the wall and furnish lubrication for the installation of casing. The use of water to assist in lubrication to facilitate the removal of spoil is permitted, however, water jetting of the soil is not allowed when jacking the casing.
- F. Acceptance criteria for the sewer pipe when installed in casing shall be 6 inches in horizontal alignment from theoretical at any point between manholes, including the receiving end, and 1-1/2 inches in elevation from the theoretical. If the sewer pipe cannot be installed in the casing within these tolerances, the Contractor may be required to realign the casing at no additional cost to the Owner, including any backfill or grouting of the abandoned hole. Any redesign of the sewer and manholes made necessary by out of tolerance casing shall be at the Contractor's expense and shall be signed by a Professional Engineer registered in the State of Texas. The installed pipe must be capable of meeting the design flow and velocities for a full pipe condition.
- G. Insofar as practical and depending on the character of the soil encountered during the augering operation, conduct operations without interruption to prevent the pipe from seizing up in the hole before the installation is complete.
- H. Repair casing damaged in augering operations by method acceptable to the Engineer and City Engineer or remove and replace it.
- I. Grout all voids and over-excavated spaces between the casing and the surrounding soil.

3.03 SLURRY AUGERING

- A. Provide horizontal boring equipment for drilling of pilot hole, slurry augering equipment for excavating the full-sized hole for casing or pipe installation.
- B. Drill a small diameter pilot hole for the entire length of the augered pipe. Check the pilot hole for line and grade at the receiving end to determine if the larger diameter hole will comply with this Specification. The pilot hole shall be redrilled if the installed pipe would not meet the specified tolerances.
- C. Auger the large-diameter hole by mechanical means for reaming the pilot hole. The diameter of the augered hole shall be not more than 1 inch greater than the outside diameter of the installed pipe. Place excavated material outside the working pit and dispose of it, as specified in Section 01564 - Waste Material Disposal. Jetting is not permitted. Augered holes which do not meet the specified tolerances shall be backfilled or grouted and reaugered at no additional cost to the Owner.
- D. In unconsolidated soil formations, use a bentonite slurry to maintain a stable hole and furnish lubrication for the installation of the pipe. Install the pipe or casing in one operation with the displacement of cuttings and slurry from the hole in potentially unstable soils to prevent casing and settlement of the ground surface.
- E. Depending on the character of the soil encountered during the augering operation, conduct operations without interruption, insofar as practical, to prevent the pipe from seizing up in the hole before the installation is complete.
- F. Acceptance criteria for the installed sewer pipe shall be 6 inches in horizontal alignment from theoretical at any point between manholes, including the receiving end, and 1-1/2 inches in elevation from the theoretical. If a deviation exceeds these tolerances, the Contractor may be required to re-auger the pipe at no additional cost to the Owner, including any backfilling or grouting of the abandoned hole. Any redesign of the sewer and manholes made necessary by out-of-tolerance sewer pipe shall be at the Contractor's expense and shall be signed by a Professional Engineer registered in the State of Texas. The installed pipe must be capable of meeting the design flow and velocities for a full pipe condition.
- G. Unless a cathodic protection system is being provided, install polyethylene wrap as specified in Section 02630 - Polyethylene Wrap. Secure polyethylene for ductile iron pipe, installed by augering, with nine skids banded around the pipe. Space skids equally around the pipe and for the entire length of the pipe, exclusive of the bell. Skid thickness shall match the offset of the pipe's bell.
- H. Remove any pipe damaged in augering operations and replace it.
- I. Completely fill the annular space between the sewer pipe and the surrounding soil with grout.

3.04 AUGER PITS

- A. Contractor's Pipe and Casing Augering Work Plan shall identify the location, size, depth and layout, and ground support design of all augering and observation pits, as well as a schedule of dates that each pit is expected to be open.
- B. Auger pits that are excavated as a part of open-cut sewer construction shall be in accordance with Section 02227 - Excavation and Backfill for Utilities.
- C. Install sheeting, lining, shoring, and bracing required for the protection of the workmen and the public in accordance with Section 01526 - Trench Safety Systems.

3.05 SETTLEMENT SURVEYING

- A. Unless otherwise specified, the Contractor shall record the ground surface elevation ahead of the augering operation. The elevation of each survey point shall be recorded with an accuracy of 0.01 feet. As a minimum, survey points shall be located as follows:
 - 1. For road crossings. Centerline and each shoulder
 - 2. Railroads. Track subbase at centerline of each track.
 - 3. Utility and pipeline crossings. Directly above and 10 feet before and after the intersection
 - 4. Long bores under improved areas such as pavements. At locations not to exceed 50 feet apart (including points located per item 1, 2 and 3, above).
- B. Settlement observations shall be obtained for each shift while augering work is performed until the ground-supporting pipe or casing is in place. Observations shall continue until any noticeable settlement has stopped. Readings shall be reported daily to the Engineer. In the case of observed settlement, the monitoring points and observation frequency shall be increased as requested by the Engineer or City Engineer.

3.06 CASING SPACERS

- A. Install in accordance with manufacturer's instructions.

3.07 SEWER PIPE IN CASING

- A. Sewer pipe shall be installed in augered casings and shall be blocked and braced to prevent movement of the pipe during grout placement.
- B. When indicated on Drawings, the annular void between sewer pipe and casing shall be grouted as one monolithic placement from end to end of the casing to completely displace all voids, following procedures defined in Contractor's Work Plan.

3.08 INFILTRATION LEAKAGE TESTING

- A. Sewer pipe installed by augering shall be tested in accordance with Section 02732 - Acceptance Testing for Sanitary Sewer.

3.09 DISPOSAL OF EXCESS MATERIAL

- A. All spoil shall be removed from the job site. Spoil removal and its disposal from the job site shall be in accordance with Section 01564 - Waste Material Disposal.

END OF SECTION

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Details of casing, carrier pipe and skids must be shown on Drawings.
- B. Sewer pipe and casings shall be designed to carry overburden pressure and applicable surcharge and installation loads.
- C. The criteria to be used at railroad crossings shall be Cooper E-80 locomotive loading distributions in accordance with AREA's specifications for culverts. Additive loadings for multiple tracks shall be accounted for in the design.
- D. The criteria to be used for truck loading shall be HS-20 vehicle loading distributions in accordance with AASHTO.
- E. Select the diameter of the casing to meet the minimum dimensions defined in the Drawings, and to permit practical installation (including skids if applicable) and grouting, where required.
- F. Casing pipe shall be new, uncoated welded steel pipe, manufactured in accordance with AWWA C200. The design stress in the pipe wall shall be 50 percent of the minimum yield point of the steel or 18,000 psi, whichever is less, when subjected to the loading conditions. The design deflection to be used in determining wall thickness shall not exceed 3 percent of nominal casing pipe size.

END OF NOTES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installing water service pipe by methods of auguring.

1.02 UNIT PRICES

- A. Augered pipe will be measured along the axis of the pipe and shall include fittings. In the case of a branch pipe, the length of the pipe will be considered as the distance from the axis of the line to the end of the branch. The length of the pipe laid between two lines or from a line to an appurtenance will be measured between the centerlines of each.
- B. Auger pits and other excavations are incidental to the work. Trench Safety for Auger Pits and other excavations for work specifically performed for this section shall be included in Section 01526 - Trench Safety System.
- C. No separate payment will be made for pavement removal and replacement (i.e., lime stabilization, crushed limestone, hot mix asphalt surface course, cement sand base, and concrete pavement, etc.) associated with augering.
- D. If open-cut construction is requested by Contractor for his convenience in areas designated for augering, and if approved in advance by the Engineer and City Engineer, such areas shall be paid for at the Contract Unit Price for augering. Payment includes necessary surface restoration and pavement repair.
- E. 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 insulators 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 REGULATORY REQUIREMENTS

- A. The contractor shall conform to all requirements of the Texas Department of Transportation permit for installations in state rights-of-way. The Owner will prepare permit documents and ensure that a permit is acquired from the Texas Department of Transportation.
- 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 and City 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 PRODUCTS

2.01 MATERIALS

- A. Piping and Fittings: As required by Drawings.
- B. Casings: Where required by Drawings.
- C. Insulators: Where casings are required by Drawings, casing insulators or casing spacers with restrained joints may be specified by specific manufacturer.
- D. Casing End Seals shall be supplied as an integral part of the casing installation.

PART 3 EXECUTION

3.01 GENERAL

- A. Do not exceed 200 feet for length of auger hole for PVC pipe without intermediate pit.

3.02 PREPARATION

- A. Conform to applicable provisions of Section 02100 - Right-of-Way Preparation.

3.03 TRAFFIC CONTROL

- A. Conform to applicable provisions of Section 01570 - Traffic Regulation and Control.
- B. Secure right-of-entry for crossing railroad company's easement or right-of-way.

3.04 JACKING

- A. Comply with Section 01526 - Trench Safety Systems 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. During construction operations, furnish and maintain barricades and lights to safeguard traffic and pedestrians as directed by the Engineer or City Engineer, until such time as backfill has been completed and removed from site.
- F. Provide heavy-duty jacks suitable for forcing 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 pipe uniformly around ring of pipe. Set pipe to be jacked on guides, properly braced together, to support section of pipe and to direct it in proper line and grade. Place jacking assembly in line with direction and grade of pipe. Excavate embankment material just ahead of pipe and remove material through pipe. Force pipe through embankment with jacks, into space thus provided.

- G. Conform excavation for underside of 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 pipe. Taper off upper clearance to zero at point where excavation conforms to contour of pipe.
- H. Distance that excavation shall extend beyond end of 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 pipe.
- I. Jack pipe from low or downstream end. Lateral or vertical variation in final position of pipe from line and grade established by the Engineer will be permitted only to extent of 1 inch in 10 feet, provided such variation is regular and only in one direction and that final grade of flow line is in direction indicated on plans.
- J. Use cutting edge of steel plate around head end of pipe extending short distance beyond end of pipe with inside angles or lugs to keep cutting edge from slipping back onto pipe.
- K. Once jacking of pipe is begun, carry on without interruption, insofar as practicable, to prevent pipe from becoming firmly set in embankment.
- L. Remove and replace any pipe damaged in jacking operations.
- M. Backfill pits or trenches excavated to facilitate jacking operations immediately after completion of jacking of pipe.
- N. Grout annular space when loss of embankment occurs or when clearance of two inches is exceeded.

3.05 AUGURING (BORING)

- A. Auger from approved pit locations. Excavate for pits and install shoring as outlined above under "Jacking." 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 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.

3.06 CASING

- A. Install casings as required by Drawings, in accordance with this section.

3.07 INSULATOR 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 should be installed in accordance with manufacturer's instructions. Special care should be taken to ensure that all subcomponents are correctly assembled and evenly tightened, and that no damage occurs during tightening of insulators or carrier pipe insertion.
- D. Annulus between carrier pipe and casing should be sealed with casing end seals at each end of casing.
- E. Insulator Spacing:
 - 1. Spacing shall be as shown on Drawing with maximum distance between spacers to be 10 feet for pipe sizes 4 to 14 inches and 8 feet for pipe sizes 16 to 30 inches.
 - 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 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 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 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.

3.09 CLEANUP

- A. Conform to applicable provisions of Section 01564 - Waste Material Disposal.

3.10 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 and City 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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface courses of compacted mixture of coarse and fine aggregates and asphaltic material.

1.02 UNIT PRICES

- A. Measurement for asphaltic concrete pavement is on a square yard basis, unless otherwise indicated on the plans or in the bid proposal. Separate measurements will be made for each different required thickness of pavement or type of hot mix asphaltic concrete pavement.

1.03 SUBMITTALS

- A. Submit proposed mix design and test data for hot mix asphaltic concrete.
- B. Submit manufacturer's description and characteristics for all equipment necessary to complete asphaltic concrete pavement. Equipment shall be in accordance with Item 340, "Dense-Graded Hot-Mix Asphalt" and Item 341, "Dense-Graded Hot-Mix Asphalt (QA/QC)" of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Hot mix asphaltic concrete pavement materials in accordance with Item 340, "Dense-Graded Hot-Mix Asphalt" and Item 341 "Dense-Graded Hot-Mix Asphalt (QA/QC)" of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.
- B. The Engineer will designate the type of asphaltic concrete pavement. (Type C, Type D, etc.) In accordance with Item 340 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

2.02 EQUIPMENT

All equipment, including mixing plant and measuring equipment; haulers, spreading and finishing machine, compaction equipment and all other incidental equipment shall comply with the requirements of Item 340.4 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

2.03 QUALITY OF HOT MIX ASPHALTIC CONCRETE

- A. The quality of the hot mix asphaltic concrete shall be in accordance with Item 340 and Item 341 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade and base coarse are ready to support imposed loads and meets compaction and moisture requirements.

SECTION 02510

- B. Verify lines and grades are correct.

3.02 PREPARATION

- A. A prime coat, if indicated on the drawings or in the bid proposal shall meet the requirements of Item 310, "Prime Coat" or Item 314 "Emulsified Asphalt Treatment" of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.
- B. A tack coat shall be applied prior to placement of the hot mix asphaltic concrete conforming to the requirements of Item 300, "Asphalts, Oils & Emulsions", Item 340 and Item 341 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004 .
- C. Remove sub-grade that will not support load. Replace and compact subgrade to required density.

3.03 CONSTRUCTION METHODS

- A. Construction methods, including, but not limited to, placement and compaction shall follow, Item 340 and Item 341 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

3.04 RIDE QUALITY

- A. Follow the requirements of Item 340 and Item 341 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004, with the exception that a bonus for each section will not be made to the Contractor.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grinding of existing asphalt surface, salvaging and placing existing broken-up asphalt surface and recycled flexible base materials on an existing subgrade and compacting the base course in conformity with the typical section or as directed by the Engineer and as herein specified.

1.02 UNIT PRICES

- A. Measurement for street reclaiming is on a square yard basis to include all surface preparation, pulverization, mixing, finishing and compacting and other incidentals associated with street reclaiming. It may also include the addition of fly-ash, lime or cement, the prime coat, the surface treatment or the asphaltic concrete pavement as indicated on the bid sheet.
- B. Refer to Section 01025 – Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

- A. Submit manufacturer's description and characteristics for all equipment necessary to complete street reclaiming.

PART 2 EQUIPMENT

- A. All equipment, including mixers and measuring equipment; haulers, spreading and finishing machine, compaction equipment and all other incidental equipment shall comply with the requirements of Item 265 "Fly Ash or Lime-Fly Ash Treated (Road-Mixed)" of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines and grades are correct. Contractor to set blue-tops for final grade.

3.02 PREPARATION

- A. The existing right of way shall be cleared of any vegetation that would be in the path of the recycling equipment. The existing asphalt pavement and underlying base course shall be reclaimed to a maximum depth of 8" utilizing a reclaimer. The reclaimer depth shall be set so that no subgrade materials will be mixed with the base course.

3.03 CONSTRUCTION METHODS

- A. The reclaimed material shall be pulverized in place to where 95% of the pieces do not exceed 2" in size. The processed gravel to be added, if necessary, shall have a maximum size of 1¾".
- B. The contractor shall add fly-ash, lime or cement as listed in the bid sheet to the reclaimed base and surfacing to the full reclaimed depth. The Contractor shall use a cutting and pulverizing machine to mix the fly-ash, lime or cement to the existing salvage base. The contractor shall incorporate blade work for finishing the road surface after the second mixing process. The rate of fly-ash shall be 9% by weight of base. Estimated amount of fly-ash for 6" reclaimed depth is approximately 55 lbs/S.Y.

- C. The Contractor may use fly-ash supplied from the Coletto Creek Power Plant. Provide the following items by submittal for all fly-ash used:
 - 1. Chemical analysis of the fly-ash.
 - 2. Recommendation of the rate of fly-ash from the Coletto Creek Power Plant or any other source to meet the cementitious reaction expected of a Type "C" fly-ash.
- D. The Contractor shall adjust manholes and valves to accommodate reclaiming and mixing equipment to obtain specified full depth mixture. Upon completion, the Contractor shall raise manholes and valves to grade as part of the manhole and valve adjustment item. With respect to new installation of water, storm sewer and/or sanitary sewer lines, the price for grade adjustment shall be included in the bid price for the installation of the water valve, storm sewer junction box or inlet, or sanitary sewer manholes (no separate pay for adjustments when installing new lines as stated above).
- E. The Contractor shall compact reclaimed base to 95% Standard Density. The completed base course shall receive an application of prime coat (MC-30 or AE-P) at a rate of 0.20 gal/SY in accordance with Item 310, "Prime Coat" of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004. The prime coat is to be followed with a single or double course surface treatment and a 1-1/2" or as specified Type D or Type C Asphaltic Concrete Pavement Course as listed in the bid sheets.

PART 4 FIELD QUALITY CONTROL

- 4.01 After compaction, the finished reclaimed treated base will be kept continuously moist for between 24 and 48 hours. The finished course shall then be vibrated with between 2 and 4 passes of a 12 ton steel-wheel vibratory roller, traveling at a speed of approximately 2 mph and vibrating at maximum amplitude (or as directed by Engineer). The section shall have 100% coverage exclusive of the outside 1 foot or so as to induce minute cracks in the treated base course. Additional passes may be required to achieve the desired crack pattern or section modulus as directed by the Project Engineer. Rolling will be stopped when the average base stiffness has been reduced by 40% or greater.
- 4.02 The following sequence shall be used unless otherwise directed by the Project Engineer:
 - A. Step 1: The stiffness of the base course shall be tested by an approved device, such as a Humboldt stiffness gauge. One reading shall be taken in each 100 foot section, or as directed by the Project Engineer.
 - B. Step 2: After two passes with the vibratory roller, the stiffness of the treated base course will be determined and the section will be inspected by the Project Engineer or designee. Based on the target total stiffness reduction of 40%, it will be decided if additional passes are necessary.
 - C. Step 3: After two additional passes with the vibratory roller, the stiffness of the treated base course will be determined and the section shall be inspected. Rolling shall be stopped if the total stiffness reduction of 40% or greater is achieved. At this phase, it will be decided if additional passes are necessary.
 - D. Step 4: After cessation of micro-cracking section, it shall be moist cured for a period of 48 hours.
 - E. Step 5: Follow standard procedures for prime and sealing of the base course to seal in optimum moisture in the base, if left uncovered, the treated base will continue to be sprinkled with water until it is primed and sealed.

- 4.03 Payment for this item is inclusive of the reclaiming of base item in the bid sheets and shall not be paid as a separate item.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

PART 2 Surface courses consisting of an asphalt material covered with aggregate.

2.01 UNIT PRICES

- A. Measurement for surface course is on a square yard basis to include all surface preparation, application of asphalt, application of aggregate, rolling and sweeping and other incidentals associated with the application of a surface course not specifically listed in this section., unless otherwise indicated on the plans or in the bid proposal.
- B. Refer to Section 01025 – Measurement and Payment for unit price procedures.

2.02 SUBMITTALS

- A. Submit aggregate composition sheet and from supplier.
- B. Submit manufacturer's description and characteristics for all equipment necessary to complete the surface course. Equipment shall be in accordance with Item 316, "Surface Treatments" of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

PART 3 PRODUCTS

3.01 MATERIALS

- A. Asphalt shall be in accordance with Item 300, "Asphalt, Oils and Emulsions" of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004. Aggregates shall be in accordance with Item 302, "Aggregates for Surface Treatments" of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.
- B. The asphalt material used shall be dependent upon weather conditions and time of year the surface treatment operations are performed. The final selection of the asphalt to be used shall be at the discretion of the Owner and the asphalt shall be as follows unless otherwise determined by the Owner:
 - 1. AC – 15P (for summer operations/high temperatures)
 - 2. AC – 10 (for fall and spring operations/moderate temperatures)
 - 3. HFRS – 2P (for winter operations/cold temperatures)
- C. The bid sheet will identify the type of asphalt and aggregate used for the project.

3.02 EQUIPMENT

- A. All equipment, including mixing plant and measuring equipment; haulers, spreading and finishing machine, compaction equipment and all other incidental equipment shall comply with the requirements of Item 316 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

3.03 QUALITY OF ASPHALT STABILIZED BASE

- A. The quality of the asphalt and aggregate shall be in accordance with Item 300 and Item 302 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.

PART 4 EXECUTION

4.01 EXAMINATION

- A. Verify compacted subgrade and base coarse are ready to support imposed loads and meets compaction and moisture requirements.
- B. Verify lines and grades are correct.

4.02 PREPARATION

- A. Follow all standard procedures listed in Item 316, "Surface Treatments" of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.
- B. It will be the responsibility of the Contractor to trim all trees that may interfere with the project or his equipment. The contractor shall hand deliver notices to those residents who have trees that will interfere with the project. This notice will need to be given seven (7) days prior to any trimming operations by the Contractor. This will enable the residents to make other arrangements if they choose.

4.03 CONSTRUCTION METHODS

- A. Construction methods, including, but not limited to, application of asphalt and aggregate, rolling and clean-up shall follow, Item 316 and Item 213 of the TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.
- B. The rates of application shall be as follows or as otherwise specified:

Pre-coated Aggregate

1CY/105-110SY/1CY of Grade 4

1CY/105-110SY/1CY of Grade 4 Modified

1CY/80-85SY/1CY of Grade 3

Asphalt

0.25-0.35 gal/SY of AC-15P

0.25-0.35 gal/SY of AC-10

0.30-0.46gal/SY of HFRS-2P

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Continuously Reinforced, Portland Cement, Concrete Pavement.

1.02 UNIT PRICES

- A. Measurement for continuously reinforced concrete pavement is on a square yard basis. Separate measurements will be made for each different required thickness of pavement.
- B. Refer to Deficient Pavement Thickness and Ride Quality for price adjustments.

1.03 SUBMITTALS

- A. Submit proposed mix design and test data for concrete.
- B. Submit manufacturer's description and characteristics for planners, concrete spreader, slipform paver, floats, mechanical vibratory equipment, finishing machine and texturing equipment.
- C. Submit manufacturer's certificates for reinforcing steel.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Portland Cement Concrete shall be Class 'P' in accordance with Item 421, "Portland Cement Concrete" of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004. with the following exceptions:
 - 1. Minimum cementitious material – 6 sacks per cubic yard.
 - 2. Maximum fly ash replacement – 30% by absolute volume.
 - 3. Minimum average compressive strength of 3,500 psi at 7 days or a minimum average compressive strength of 4,400 psi at 28 days as shown in TxDOT 2004 Edition, Item 360, Concrete Pavement. High Early strength requirements shall follow TxDOT 2004 Edition, Item 360.
- B. Joint sealants and fillers; dowels for expansion and contraction joints; positioning and support devices for reinforcement and joint assemblies; reinforcing steel and curing materials shall comply with the requirements of Item 360 of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.

2.02 EQUIPMENT

- A. All equipment, including weighing and measuring equipment; mixer; hauling equipment; grade control equipment; planers and templates; concrete spreader; slipform paver; floats; mechanical vibratory equipment; finishing equipment; mechanical dowel and reinforcement inserting equipment; and texturing equipment shall comply with the requirements of Item 360 of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.
- B. For Continuously Reinforced Concrete Paving, contractor shall provide approved self-propelled paving equipment that uniformly distributes the concrete with minimal segregation and provides a smooth machine-finished consolidated concrete pavement conforming to plan line grade.

2.03 QUALITY OF CONCRETE

- A. The quality of concrete shall be in accordance with Item 360 of the TxDOT “Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges” 2004..

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is ready to support imposed loads and meets compaction requirements.
- B. Verify lines and grades are correct.

3.02 PREPARATION

- A. A template shall be used to verify the final contour of the subgrade.
- B. Use subgrade planer to shape subgrade to its final cross section.
- C. Remove subgrade that will not support load. Replace and compact subgrade to required density.

3.03 REINFORCING STEEL AND JOINT ASSEMBLIES

- A. Reinforcing steel and joint assemblies shall comply with the requirements of Item 360 of the TxDOT “Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges” 2004.

3.04 CONCRETE MIXING AND PLACEMENT

- A. Concrete mixing and placing shall comply with the requirements of Item 360 of the TxDOT “Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges” 2004.

3.05 JOINTS

- A. Joints shall be constructed in accordance with the plans and shall comply with Item 360 of the TxDOT “Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges” 2004 and in accordance with Standard Details.

3.06 SPREADING AND FINISHING

- A. Spreading and finishing shall comply with the requirements of Item 360 of the TxDOT “Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges” 2004.

3.07 CONCRETE CURING

- A. Concrete shall be cured using membrane curing in accordance with Item 306 of the TxDOT “Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges” 2004.

3.08 PROTECTION OF PAVEMENT AND OPENING TO TRAFFIC

- A. Protect pavement in accordance with Item 360 of the TxDOT “Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges” 2004.

3.09 DEFICIENT PAVEMENT THICKNESS

- A. Pavement thickness shall be checked and unit price adjustments may be made in accordance with the requirements of Item 360 of the TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.

3.10 RIDE QUALITY

- A. Ride quality may be evaluated using Surface Test Type B longitudinally and Surface Test Type A transverse in accordance with the requirements of Item 585, "Ride Quality for Pavement Surfaces", TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.
- B. Pavement evaluation and corrections shall be in accordance with Item 585.4, TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.
- C. Pay adjustments for unsatisfactory ride quality may be determined in accordance with Item 585, TxDOT "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" 2004.

END OF SECTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Joints for concrete driveways, sidewalks, medians, 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.
- B. 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 product data sheets for 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. Preformed Expansion Joint Material: Bituminous fiber and bituminous mastic composition material conforming to ASTM D994 and ASTM D1751.
- C. Pre-Molded Water stop:
 - 1. Pre-molded water stop attached to expansion material; Vinylex VX-Seal Model VX-750, #610 "G Seal" by Groundstreak or approved equal.
- 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. 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 1-1/2 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.

3.03 EXPANSION JOINTS

- A. Place 3/4-inch expansion joints at locations shown on Drawings. Use no boards shorter than 6 feet. 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 pre-molded water stop.

3.04 CONTRACTION JOINTS

- A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Seal groove with joint sealing compound.

3.05 SAWED JOINTS

- A. Contractor may use sawed joints as an alternate to contraction 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. 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.

3.06 JOINTS FOR 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.

3.07 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 40 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.

3.08 JOINTS FOR CONCRETE DRIVEWAYS

- A. Provide 3/4-inch expansion joints conforming to ASTM D1751 across driveway in line with right-of-way line, 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.

3.09 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 the Engineer and City 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.
- E. Pre-Molded water stop is the required method of sealing. This section is only for reference and shown for special instances when shown on plans.

3.10 PROTECTION

- A. Maintain joints in good condition until completion of Work.
- B. Replace damaged joint material with new material as required by this Section.

END OF SECTION

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.

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/m² 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 intimate 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 intimate 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 degrees 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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforced concrete sidewalks.

1.02 UNIT PRICES

- A. Measurement for concrete sidewalks is on square foot basis.
- 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 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 Engineer or City Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete: Class 'A' in accordance with Section 03305 – Concrete for Utility Construction and Minor 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 Joint.
- D. Joint Sealing Compound: Conform to material requirements of Section 02523 – Concrete Joint.
- E. Sand Bed: Conform to material requirements for bank run sand of Section 02229 – Utility Backfill Materials.
- F. Macro Fibrous (1 ½ inch fiber) Reinforced concrete at a minimum of 4 ½ lbs per CY of concrete can be utilized in lieu of steel reinforcement as per Section 3240 – Fibrous Reinforcing.

PART 3 EXECUTION

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. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to the line, grade and cross section. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D698.

3.03 PLACEMENT

- A. Forms: Straight, unwarping 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 reinforcing steel bars spaced in accordance with Drawing detail. 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 Joint.
- 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 3/8 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.

END OF SECTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Portland cement concrete driveways.

1.02 UNIT PRICES

- A. Measurement for concrete driveways is on square yard basis.
- 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 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: Class 'A' in accordance with Section 03305 – Concrete for Utility Construction and Minor Paving.
- B. Reinforcing Steel: Conform to material requirements of Section 03305 – Concrete for Utility Construction and Minor 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. Identify and protect utilities which are to remain.
- B. Protect living trees, other plant growth, and features designated to remain.
- C. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to the line, grade and cross section. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D698.

3.02 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 reinforcing steel bars spaced in accordance with Drawing detail. Support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.

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- 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. Finish edges with tool having 1/4-inch radius.
- G. After concrete has set sufficiently, refill space along sides of driveway with suitable material. Tamp unit firm and solid. Dispose of excess material in accordance with Section 01564 – Waste Material Disposal.

3.03 CONCRETE CURING

- A. Cure concrete driveway in accordance with Section 02525 – Concrete Pavement Curing.

3.04 PROTECTION

- A. Maintain driveway in good condition until completion of work.

END OF SECTION

SECTION 02532

CITY OF VICTORIA
STANDARD SPECIFICATIONS

CURB, CURB & GUTTER, & HEADERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb.
- B. Paving headers and railroad headers poured monolithically with concrete base or pavement.

1.02 UNIT PRICES

- A. Measurement for curbs and for curbs and gutter is on linear foot basis measured along face of curb.
- B. Measurement for headers is on linear foot basis measured between lips of gutters adjacent to concrete base and measured between backs of curbs adjacent to concrete pavement.
- C. 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 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 Engineer or City Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete: Class 'A' in accordance with Section 03305 – Concrete for Utility Construction and Minor Paving.
- B. Reinforcing Steel: Conform to material requirements for reinforcing steel of Section 03305 – Concrete for Utility Construction and Minor Paving.
- C. Grout: Nonmetallic, nonshrink grout containing no chloride-producing agents conforming to the following requirements.

Compressive strength, psi	
at 7 days	3500
at 28 days	8000
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 and City Engineer.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Prepare subgrade, base or pavement in accordance with applicable portions of these specifications.

3.02 PLACEMENT

- A. Forms: Brace sufficiently to maintain position during pour. Use metal templates cut to section shown on Drawings.
- B. Reinforcement: Secure in proper position so that steel will remain in place throughout placement.
- C. Joints: Place in accordance with Section 02523 – Concrete Joints. Place dummy groove joints at 10-foot centers at right angles to curb lines. Cut dummy grooves 1/4 inch deep using an approved edging tool.
- D. 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, if used. 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.
- G. At locations perpendicular to the curb; stamp "V" for water valve, "W" for water service and "S" for sanitary sewer service.

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 Engineer and City Engineer. Use of mechanical methods shall provide specified curb design and finish.

SECTION 02532

CITY OF VICTORIA
STANDARD SPECIFICATIONS

CURB, CURB & GUTTER, & HEADERS

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

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Repairing and resurfacing streets, highways, driveways, sidewalks, and other pavements that have been cut, broken, or otherwise damaged during construction.

1.02 UNIT PRICES

- A. No separate payment will be made for pavement repair and resurfacing under this Section unless included as a bid item in Bid Schedule and approved in advance by the Engineer. Include payment in unit price for work in appropriate sections.
- B. Payment for pavement repair, when included in bid documents, is on a square yard basis. Limits for measurement will be as follows:
 - 1. Extend 18 inches beyond outside trench or trench slopes for utilities and appurtenant structures excavation or for pavement removed to construct utility appurtenances, as indicated on Drawings.
 - 2. Extend 5 feet beyond outside excavation limits for structural excavation.
 - 3. If removed pavement is greater than one-half of pavement lane width, or within 18 inches of a longitudinal joint, on concrete pavement, replace pavement for full lane width or to nearest longitudinal joint.
 - 4. No payment will be made for work outside maximum payment limits, or in areas removed or replaced for Contractor's convenience. The maximum payment limit is the maximum trench width plus 36 inches, or as shown on the Drawings. The maximum trench width is defined in Section 02227- Excavation and Backfill for Utilities. If the extent of pavement replacement is increased to full lane width or to the nearest longitudinal joint, the maximum payment limits are increased to the same extent.
- C. Refer to Section 01025 - Measurement and Payment for other unit price procedures.

1.03 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittals.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Subgrade:
 - 1. Provide new backfill material as required by applicable portions of Sections 02221 – Embankment through 02227 - Excavation and Backfill for Utilities.
 - 2. Provide material for stabilization as required by applicable portions of Section 02241 – Lime Stabilized Subgrade.
- B. Base: Provide new base material as required by applicable portions of Sections 02231 – Crushed Stone Flexible Base Course through 02238 – Hot Mix Asphaltic Base Course.
- C. Pavement: Provide new paving materials as required by applicable portions of Sections 02510 – Asphaltic Concrete Pavement and Sections 02520 – Reinforced Concrete Paving through 02532 - Curb, Curb & Gutter & Headers.

PART 3 EXECUTION**3.01 PREPARATION**

SECTION 02570

- A. Conform to requirement of Section 02100 - Right-of-Way Preparation, for removals.
- B. Saw cut pavement 36 inches wider than width of trench needed to install utilities unless otherwise indicated on Drawings.
- C. Protect edges of existing pavement to remain from damage during removals, utility placement, backfill, and paving operations. For concrete pavement, leave and protect minimum of 18 inches of undisturbed subgrade on each side of trench to support replacement slab.

3.02 INSTALLATION

- A. Parking areas, service drives, driveways, and sidewalks: Replace with material equal to or better than existing or as indicated on Drawings. Conform to applicable requirements of sections referenced in Paragraph 2.01, Materials of this Section.
- B. Street pavements and curbs, curbs and gutters: Replace subgrade, base, and surface course with like materials or as indicated on Drawings. Curbs and curbs and gutters shall match existing. Conform to requirements of sections referenced in Paragraph 2.01, Materials of this Section.
- C. For concrete pavement, install size and length of reinforcing steel and pavement thickness indicated on Drawings. Place types and spacing of joints to match existing or as indicated on Drawings.
- D. Where existing pavement consists of concrete pavement with asphaltic surfacing, resurface with minimum 2-inch depth asphaltic pavement.
- E. Repair state highway crossings in accordance with highway department permit and within 1 week after utility work is installed.

3.03 WASTE MATERIAL DISPOSAL

- A. Dispose of waste material in accordance with requirements of Section 01564 - Waste Material Disposal.

3.04 PROTECTION

- A. Maintain all pavement in good condition until completion of Work.
- B. Replace pavement damaged by Contractor's operations at no cost to Owner.

END OF SECTION

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. Blast cleaning to remove existing pavement markings will not be measured or paid for directly, but shall be considered subsidiary to other bid items.
- B. Blast cleaning to prepare the pavement surface for new pavement markings will not be measured or paid for directly, but shall be considered subsidiary to other bid items.
- C. 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 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 and City 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

SECTION 02581

CITY OF VICTORIA
STANDARD SPECIFICATIONS

BLAST CLEANING OF PAVEMENT

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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Durable retroreflective preformed pavement markings.

1.02 UNIT PRICES

- A. Measurement for linear pavement markings is on a linear foot basis for each width, measured in place.
- B. Measurement for words and symbols is on a lump sum basis for each word or symbol.
- C. Measurement for railroad crossing markings, to include stop line and two transverse lines, is on a lump sum basis for each crossing marked.
- D. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DURABLE PAVEMENT MARKING DEFINITIONS

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; primers, solvents, and adhesives; 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 marking material.

1.05 DELIVERY AND STORAGE

- A. Deliver preformed plastic marking material in rolls or strips. Deliver words and symbols in precut convenient sizes to provide for ease in application. Ship word and symbol markers with easily removable protective liners.
- B. Store material in cool dry conditions until application.

PART 2 PRODUCTS

2.01 PREFORMED MARKINGS

- A. Preformed markings shall be 3M "STAMARK" Series 380 and 381.
- B. Quality performance characteristics shall be as follows:

	CLASS I		CLASS II		CLASS III		CLASS IV		CLASS V		TEST METHOD
	White	Yellow	White	Yellow	White	Yellow	White	Yellow	White	Yellow	
1. Thickness without adhesive, mils, min.	60		65 (Peak) 20 (Valley)		60		60		12		Caliper Gauge
2. Refractive index of beads, min.	—		1.5 Rubber 1.7 Surface*		1.5		1.5 & 1.9		1.7		Liquid Oil Immersion

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PREFORMED DURABLE PAVEMENT MARKING

3. Init. retroreflectance (mcd. ft ⁻² . fc ⁻¹), min. ** @ 86.0°, 0.2° ** @ 86.5°, 1.0°	550	410	1100	800	550	410	700	500	960	680	ASTM D4061
	300	175	700	500	300	175	400	300	650	470	
4. Retained retroreflectance (mcd.ft ⁻² . fc ⁻¹), min. ** @ 86.5°, 1.0°	--	--	100	--	--	--	--	--	--	--	ASTM D4061
5. Init. skid resistance (avg.) -BPN	45		45		45		50		45		ASTM E303
6. Tensile strength (psi), min.	150		20		150		100		--	--	ASTM D638***
7. Percent elongation at break, min.	75		20		75		50		--	--	ASTM D638***
8. Daytime reflectance factor "Y" %, min.	65	36	65	36	65	36	65	36	65	36	ASTM E97

* Tough Ceramic Beads.

** (Entrance Angle, Observation Angle).

*** Crosshead speed of 10-12 inches per minute when tested with a gap of 4" between jaws and 1" X 6" sample.

2.02 ADHESIVES AND SOLVENTS

2.03 FABRICATION

- A. Manufacture markings to conform to color, shape, and size requirements of TxDOT "Texas Manual on Uniform Traffic Control Devices for Streets and Highways".

PART 3 EXECUTION

3.01 GENERAL

- A. Prepare pavement surfaces and install markings in accordance with manufacturer's recommendations.
- B. Accurately locate and install approved markings to conform to classes, colors, lengths, widths, and configurations indicated on Drawings.
- C. Apply line markings with a mechanical applicator capable of applying pavement lines in a neat, accurate, and uniform manner. Applicator shall be equipped with a film cut-off device. Apply words and symbols by hand so as to attain neat, accurate, and uniform results.

3.02 PREPARATION

- A. Clean and repair surfaces to receive markings. Blast clean surfaces in accordance with requirements of Section 02581 – Blast Cleaning of Pavement. Do not clean portland cement concrete pavements by grinding.

3.03 INLAID INSTALLATION ON ASPHALTIC CONCRETE PAVEMENTS

3.04 SURFACE INSTALLATION

- A. This installation procedure applies to asphaltic concrete or portland cement concrete surfaces.
- B. 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.
- C. 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.
- D. Prime pavement surface and apply markings as recommended by manufacturer.

3.05 FIELD QUALITY CONTROL

- A. Pavement markings shall present a neat, uniform appearance and shall be free of unsightly spread of excess adhesive. Markings shall be free of ragged edges and misshapen lines or contours.
- B. Markings shall adhere to pavement sufficiently to prevent lifting, shifting, smearing, spreading, flowing or tearing by traffic.
- C. 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. Contractor should be aware of any product warranties that extend beyond the standard twelve month warranty and shall be responsible that the materials are placed in accordance with the manufacturer in order for the extended manufacturer warranty to remain in effect.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Raised reflective pavement markers.

1.02 UNIT PRICES

- A. Measurement for Type I raised reflective pavement markers with one reflective face is on a lump sum basis for each marker installed.
- B. Measurement for Type I raised reflective pavement markers with two reflective faces is on a lump sum basis for each marker installed.
- C. Measurement for Type II raised reflective pavement markers with one reflective face is on a lump sum basis for each marker installed.
- D. Measurement for Type II raised reflective pavement markers with two reflective faces is on a lump sum basis for each marker installed.
- E. 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 in 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 PRODUCTS

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:

	<u>Nominal Dimensions</u>	<u>Reflecting Face Slope</u>	<u>Reflecting Face Surface Area</u>
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:	<u>White</u>	<u>Yellow</u>	<u>Red</u>
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:	<u>White</u>	<u>Yellow</u>	<u>Red</u>
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 three 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 degrees 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 four test samples will cause lot rejection. Retest an additional 20 markers if three samples fail; failure of one lens of resample group will cause lot rejection.

E. Impact Resistance: Test in accordance with ASTM D2444 Tup 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 EXECUTION**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 or City Engineer in accordance with requirements of Section 02581 – Blast Cleaning of Pavement. 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 degrees F or above 120 degrees 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. Contractor should be aware of any product warranties that extend beyond the standard twelve month warranty and shall be responsible that the materials are placed in accordance with the manufacturer in order for the extended manufacturer warranty to remain in effect.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary retroreflective preformed pavement markings.
- B. Wet retroreflective markers.

1.02 UNIT PRICES

- A. Measurement for temporary pavement markings is on a linear foot basis, for each class, measured in place.
- 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 manufacturers' replacement policy for each class of marker.

1.05 DELIVERY AND STORAGE

- A. Deliver preformed plastic marking material in rolls or strips.
 - 1. Store material in cool dry conditions until application.

PART 2 PRODUCTS

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.

SECTION 02590

CITY OF VICTORIA STANDARD SPECIFICATIONS

TEMPORARY AND REMOVABLE REFLECTORIZED PAVEMENT MARKINGS

- 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:

	<u>CLASS I</u>		<u>CLASS II</u>		<u>TEST METHOD</u>
	<u>White</u>	<u>Yellow</u>	<u>White</u>	<u>Yellow</u>	
1. Init. Retroreflectance (mcd·ft ⁻² ·fc ⁻¹), min.					
* @ 86.0°, 0.2°	1770	1310	1360	820	ASTM D4061
* @ 86.5°, 1.0°	750	450	500	350	
2. Daytime Reflectance Factor "Y" %, min.	65	36	65	36	ASTM E97
3. Init. Skid Resistance, Avg. BPN	50		35		ASTM E303
4. Refractive Index of Beads, min.	1.9		1.9		Liquid Immersion
5. 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° 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.

SECTION 02590**CITY OF VICTORIA
STANDARD SPECIFICATIONS****TEMPORARY AND REMOVABLE
REFLECTORIZED PAVEMENT MARKINGS**

1. Retroreflective lenses elements shall have the following initial minimum reflectance when measured in accordance with ASTM E809:

Color	<u>White</u>	<u>Yellow</u>	<u>White</u>	<u>Yellow</u>	<u>White</u>	<u>Yellow</u>	<u>White</u>	<u>Yellow</u>
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. Test 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 EXECUTION**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 or City 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 – Blast Cleaning of Pavement.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Durable reflectorized pavement markings.

1.02 UNIT PRICES

- A. Measurement for linear pavement markings is on a linear foot basis for each class and width, measured in place.
- B. Where double stripes are placed, each stripe will be measured separately.
- C. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DURABLE PAVEMENT MARKING DESCRIPTION

- A. This item shall govern for furnishing and placing reflectorized pavement markings of the colors, and widths shown on the plans.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Marking Materials. Markings are paint-type materials that are applied at ambient or slightly elevated temperatures. Marking materials shall conform to Departmental Materials Specifications D-9-8200, YPT-10 and/or WPT-10 and D-9-8290.
- B. Source of Supply. All glass traffic beads shall be purchased on the open market.

2.02 EQUIPMENT

- A. Equipment used to place pavement markings shall:
 1. Be maintained in satisfactory operating condition.
 2. Be considered in satisfactory operating condition if it has an average placement rate of 5,000 linear feet per hour of acceptable four-inch solid or broken lines over any five (5) consecutive working days.
 3. Meet or exceed the material handling at elevated temperatures requirements of the National Fire Underwriters and the Texas Railroad Commission.
 4. Be capable of placing a minimum of 3,500 linear feet of four-inch solid or broken markings per working day.
 5. Have production capabilities similar to four-inch marking equipment and shall be capable of placing linear markings up to eight (8) inches in width in a single pass when used for placing markings in widths other than four (4) inches.
 6. Have production capabilities considered satisfactory by the Engineer when used to place markings other than solid or broken lines.
 7. Be capable of placing a centerline configuration consisting of one (1) broken line with two (2) solid lines at the same time to the alignment and spacing shown on the plans.
 8. Be capable of placing broken and/or continuous double yellow line.
 9. Be capable of placing lines with clean edges and of uniform cross-section. All lines shall have a tolerance of plus or minus 1/8 inch per four (4) inch width.
 10. Have an automatic cut-off device with manual operating capabilities to provide clean, reasonably square marking ends to the satisfaction of the Engineer, and to provide a method of applying broken line in an approximately stripe-to-gap ratio of 10 to 30. The length of the stripe shall not be less than 10 feet or more than 10.5 feet. The total length of any stripe-gap cycle shall not be less than 39.5 feet or more than 40.5 feet.

11. Provide continuous mixing and agitation of the pavement marking material. The use of pans, aprons or similar appliances, which the die overruns, will not be permitted for longitudinal striping application.
12. Apply beads by an automatic bead dispenser attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly upon the marking as the marking is being applied to the road surface. The bead dispenser shall have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment.

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

- A. General. When required by the Engineer, the Contractor and the Engineer shall review the sequence of work to be followed and the estimated progress schedule.
- B. Markings may be placed on roadways either free of traffic or open to traffic. On roadways already open to traffic, the markings shall be placed under traffic conditions that exist with a minimum of interference to the operation of the facility. Traffic control shall be as shown on the plans or as approved by the Engineer in writing. All markings placed under open-traffic conditions shall be protected from traffic damage and disfigurement.
- C. Guides to mark the lateral location of pavement markings shall be established as shown on the plans or as directed by the Engineer. The Contractor shall establish the pavement marking guides and the Engineer will verify the location of the guides.
- D. Markings shall be placed in proper alignment with the guides. The deviation rate in alignment shall not exceed one (1) inch per 200 feet of roadway. The maximum deviation shall not exceed two (2) inches nor shall any deviation be abrupt.
- E. Markings shall essentially have a uniform cross-section. The density and quality of markings shall be uniform throughout their thickness. The applied markings shall have no more than five (5) percent, by area, of holes or voids and shall be free of blisters.
- F. Markings, in place of the roadway, shall be reflectorized both internally and externally. Glass beads shall be applied to the materials at a uniform rate sufficient to achieve uniform and distinctive retroreflective characteristics when observed in accordance with Test Method Tex-838-B.
- G. The Contractor's personnel shall be sufficiently skilled in the work of installing pavement markings.
- H. Markings placed that are not in alignment or sequence, as shown on the plans or as stated in this specification, shall be removed by the Contractor at the Contractor's expense. Guides placed on the roadway for alignment purposes shall not establish a permanent marking on the roadway.
- I. Unless otherwise shown on the plans, pavement markings may be applied by a method that will yield markings meeting the requirements of this specification.

3.02 SURFACE PREPARATION

- A. Pavement to which material is to be applied shall be completely dry. Pavements shall be considered dry if, on a sunny day after observation for 15 minutes, no condensation occurs on the underside of a one (1) foot square piece of clear plastic that has been placed on the pavement and weighted on the edges.

3.03 APPLICATION OF MARKINGS

- A. The application of marking materials shall be done only on surfaces with a minimum surface temperature of 50 F.
- B. The application rate for marking material shall be: between 15 and 20 gallons per mile of solid four (4) inch line and between 30 and 40 gallons per mile for solid eight (8) inch line except that, for new surface treatment projects the application rate shall be between 25 and 30 gallons per mile of solid four (4) inch line and between 40 and 50 gallons per mile for solid eight (8) inch line.

3.04 PAYMENT

- A. The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Reflectorized Pavement Markings" of the colors and widths specified. This price shall be full compensation for furnishing all materials; for application of pavement markings; and for all other labor, tools, equipment and incidental necessary to complete the work, except as shown below.
- B. When replacement markings are required due to damage to the original markings from rain, sleet, hail, etc., and the original markings were placed at the direction of the Engineer, the plan quantity requirements under "Measurement" do not apply to the original and replacement markings. The Contractor will be paid for the actual quantity of original and replacement markings at the unit price bid for that bid item.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Raised pavement markers.

1.02 UNIT PRICES

- A. Measurement will be for each raised pavement marker measured in place.
- B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 RAISED PAVEMENT MARKER DESCRIPTION

- A. This item shall govern for furnishing and installing raised pavement markers of the various classes and types shown on the plans.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Raised pavement markers shall comply with the requirements of TxDOT Specifications.
 1. Class A, Jiggle Bar Tile D-9-4100
 2. Class B, Pavement Markers (Reflectorized) D-9-4200
 3. Class C, Traffic Buttons D-9-4300
 4. Class D, Traffic Buttons (Oval) D-9-4300
 5. Class E, Pavement Markers (All-Weather Reflectorized) D-9-4210
- B. Raised pavement markers shall be of the following classes and types:
 1. Class A, Raised Pavement Marker (Jiggle Bar Tile). Class A raised pavement markers shall include types: I-A, I-C, II-A-A, W and Y.
 2. Class B, Raised Pavement Markers (Pavement Markers, Reflectorized). Class B raised pavement markers shall include types: I-A, I-C, I-R, II-A-A and II-C-R.
 3. Class C and D, Raised Pavement Markers (Traffic Buttons). Class C and D raised pavement markers shall include types: I-A, I-C, I-R, II-A-A, II-C-R, W and Y.
 4. Class E, Raised Pavement Markers (All-Weather Reflectorized). Class E raised pavement markers shall include types: I-A, I-C, I-R, II-A-A and II-C-R. The body color descriptions do not apply to Class E raised pavement markers.
- C. The following are descriptions for each type of raised pavement marker:
 1. Type I-A. Type I-A shall contain an approach face that reflects amber light. The body, other than the reflective face, shall be yellow.
 2. Type I-C. Type I-C shall contain an approach face that reflects white light. The body, other than the reflective face, shall be white, silver-white or light gray.
 3. Type I-R. Type I-R shall contain a trailing face that reflects red light. The body, other than the reflective face, shall be white, silver-white, light gray or may be one-half red on the side which reflects red light.
 4. Type II-A-A. Type II-A-A shall contain two (2) reflective faces (approach and trailing) each of which shall reflect amber light. The body, other than the reflective faces, shall be yellow.
 5. Type II-C-R. Type II-C-R shall contain two (2) reflective faces, an approach face which shall reflect white light and a trailing face which shall reflect red light. The body, other than the reflective faces, shall be white, silver-white or light gray. Optionally, the body may be one-half white, silver-white or light gray on the side that reflects white light and one-half red on the side that reflects red light.
 6. Type W. Type W shall have a white body and no reflective faces.

- 7. Type Y. Type Y shall have a yellow body and no reflective faces.
- D. The reflective faces of all Type II markers shall be positioned so that the direction of reflection of one (1) face shall be directly opposite to the direction of reflection of the other face.
- E. Bituminous adhesive shall conform to the requirements of TxDOT Materials Specification D-9-6130. Epoxy adhesive shall conform to the requirements of Item 575, "Epoxy".

2.02 SAMPLING

- A. Sampling will be in accordance with Test Method Tex-729-I.

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

- A. Each class of raised pavement marker shall be from the same manufacturer.
- B. Surfaces to which markers are to be attached by an adhesive shall be prepared by any method approved by the Engineer to ensure that the surface is free of dirt, curing compound, grease, oil, moisture, loose or unsound pavement markings and any other material which would adversely affect the adhesive bond. Unless otherwise shown on the plans, surface preparation for installation of raised pavement markers will not be paid for directly, but shall be considered subsidiary to this Item.
- C. Guides to mark the lateral location of pavement markings shall be established as shown on the plans or as directed by the Engineer. The Contractor shall establish the pavement marking guides and the Engineer will verify the location of the guides.
- D. The pavement markers shall be placed in proper alignment with the guides. The deviation rate in alignment shall not exceed one (1) inch per 200 feet of roadway. The maximum deviation shall not exceed two (2) inches nor shall any deviation be abrupt.
- E. Markers placed that are not in alignment or sequence, as shown on the plans or as stated in this specification, shall be removed by the Contractor at the Contractor's expense. Guides placed on the roadway for alignment purposes shall not establish a permanent marking on the roadway.
- F. Unless otherwise shown on the plans, the Contractor shall use the following adhesive materials for placement of markers:
 - 1. Epoxy adhesive for Class E markers.
 - 2. Bituminous adhesive for Class A, B, C and D markers on bituminous pavement.
 - 3. Epoxy adhesive for Class A, B, C and D markers on Portland cement concrete pavements.
- G. Adhesive shall be applied in sufficient quantity to ensure the following:
 - 1. 100 percent of the bonding area of raised pavement markers shall be in contact with the adhesive.
 - 2. Raised pavement markers, except for Class E, shall not be in contact with the pavement surface but shall be seated on a continuous layer of adhesive.
- H. Unless otherwise required by this Item, adhesives shall be applied in accordance with the manufacturer's recommendations.

SECTION 02592

CITY OF VICTORIA
STANDARD SPECIFICATIONS

RAISED PAVEMENT MARKERS

- I. When bituminous adhesive is used, pavement and raised pavement marker temperature shall be at least 40° F. The bituminous adhesive shall not be heated above 400° F. The bituminous adhesive shall be agitated intermittently to ensure even heat distribution.
- J. Epoxy adhesive shall be machine mixed.
- K. Raised pavement markers shall be free of rust, scale, dirt, oil, grease, moisture or contaminants which might adversely affect the adhesive bond.
- L. Raised pavement markers shall be placed immediately after the adhesive is applied and shall be firmly bonded to the pavement. Adhesive or any other material that impairs functional reflectivity will not be acceptable.

3.02 PAYMENT

- A. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Raised Pavement Markers" of classes and types specified. This price shall be full compensation for furnishing all materials, surface preparation, installation, labor, equipment, tools and incidental necessary to complete the work.

3.03 WARRANTY

- A. Contractor shall warrant material and labor for a period of twelve months from date of installation of markings.

END OF SECTION

SECTION 02600

CITY OF VICTORIA

STANDARD SPECIFICATIONS

CAST-IN-PLACE MANHOLES & JUNCTION BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place storm sewer manholes and junction boxes.

1.02 UNIT PRICES

- A. Measurement for payment for cast-in-place manholes and junction boxes is on a unit price basis per manhole or junction box. Payment will be made for each manhole installed, complete in place, including manhole/junction box, excavation, foundation, connection to pipe, and backfill. Separate measurement will be made for manholes/junction boxes of various depths.
- B. 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 for stubs and stub plugs.

PART 2 PRODUCTS

2.01 CONCRETE

- A. Class 'A' in accordance with the requirements of Section 03305 – Concrete for Utility Construction and Minor Paving.

2.02 REINFORCING STEEL

- A. Conform to requirements of Section 03305 – Concrete for Utility Construction and Minor Paving.

2.03 MORTAR

- A. Conform to requirements of ASTM C270, 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 SEALANT MATERIALS

- A. Sealing materials between precast concrete adjustment ring and manhole cover frame shall be Adeka Ultraseal P201 or approved equal.

2.06 BACKFILL MATERIALS

- A. Backfill materials shall conform to the requirements of Section 02227- Excavation and Backfill for Utilities.

2.07 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 C1107 and shall have a minimum 28-day compressive strength of 7000 psi.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify lines and grades are correct.
- B. Verify subgrade will support loads imposed.

3.02 MANHOLES AND JUNCTION BOXES

- A. Construct manholes and junction boxes 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 and City Engineer to determine if the subgrade has heaved upwards after being excavated. If heaving has 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.
- C. Place, finish and cure concrete for manholes following the procedures given in Section 03305 - Concrete for Utility Construction, for concrete containing microsilica admixtures.
- D. Where the Drawings indicate a cast-in-place manhole base, place concrete as shown on the Drawings on a 4-inch (minimum) layer of either cement stabilized sand or seal slab. When unstable Subgrade is identified, over-excavate the Subgrade to allow for placement of a 12-inch-thick layer of crushed stone wrapped in filter fabric.

3.03 MANHOLE FRAME AND ADJUSTMENT RINGS

- A. Combine precast concrete adjustment rings so that the elevation of the installed casting cover is flush with 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 2 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.

3.04 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

SECTION 02600

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CAST-IN-PLACE MANHOLES & JUNCTION BOXES

trench zone backfill, as specified for the adjacent utilities, above the embedment zone backfill.

- B. In unpaved areas, provide positive drainage away from manhole frame to natural grade.

3.05 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 02600

CITY OF VICTORIA

STANDARD SPECIFICATIONS

CAST-IN-PLACE MANHOLES & JUNCTION BOXES

SECTION 02600 - NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. On sanitary sewer work, use this section only when the conditions of the installation preclude the use of precast manholes or fiberglass manholes; conditions require the design of a manhole or junction structure.
- B. Paragraph 3.02B. Include a detail for pile-supported manhole foundation when the geotechnical investigation indicates that there is a potential for unstable soils to be encountered at the bottom elevation of the manhole.

END OF NOTES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete sanitary and storm sewer manholes.
- B. Precast concrete sanitary sewer manholes with PVC liner where corrosion-resistant manholes are specifically indicated in the Drawings.

1.02 UNIT PRICES

- A. Measurement and payment for normal depth manholes, up to six feet deep, is on a unit price basis for each manhole installed. Depth is measured from top of cover to sewer invert.
- B. Measurement and payment for shallow depth manholes is on a unit price basis for each manhole installed. Shallow manholes have a depth of 4 feet or less measured from the top of cover to sewer invert.
- C. Measurement and payment for extra depth manholes is on a unit price basis per vertical foot for each foot of depth greater than 6 feet or on a unit price for each manhole based on the depth of the manhole. Depth is measured from top of cover to sewer invert.
- D. Measurement and payment for normal depth corrosion resistant manholes, up to 6 feet deep, is on a unit price basis for each manhole installed. Depth is measured from top of cover to sewer invert.
- E. Measurement and payment for extra depth corrosion resistant manholes is on a unit price basis per vertical foot for each foot of depth greater than 6 feet or on a unit price for each manhole based on the depth of the manhole. Depth is measured from top of cover to sewer invert.
- F. 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.

PART 2 PRODUCTS

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 8 inches under the invert.
 - C. Provide cone tops to receive cast iron frames and covers, unless indicated otherwise. Use tops designed to support an H-20 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 H-20 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 and storm 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 4000 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 4000 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 FOR SANITARY SEWERS

- 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.

2.08 SEALANT MATERIALS

- A. Sealing materials between precast concrete adjustment ring and manhole cover frame shall be installed in accordance with the manufacturer's recommendations.

2.09 CORROSION RESISTANT MANHOLE MATERIALS

- A. Where corrosion-resistant manholes or PVC-lined manholes are indicated on the Drawings, provide one of the following:
 - 1. PVC liner for precast cylindrical manhole section, base sections, and cone sections. For PVC liner, refer to Section 02752 - Plastic Liner for Concrete Sewer Structures.
 - 2. Precast base sections, as specified above, lined with PVC or equal and fiberglass manholes in accordance with Section 02602 - Fiberglass Manholes.
- B. Seal internal PVC liner at pipe penetrations using manufacturer's recommended methods.

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 7000 psi.

2.12 PROHIBITED MATERIALS

- A. Do not use brick masonry for construction of sanitary and storm sewer manholes, including adjustment of manholes to grade. Use only specified materials listed above.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines and grades are correct.
- B. Determine if the subgrade, when scarified and recompact, 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 City 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, and pipe intersections.

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 and City 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 or City 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 flat-top sections as required to adjust the finished elevation and to support manhole frame.
- C. Seal any lifting holes with non-shrink grout.

- D. Where PVC liners are required, seal joints between sections in accordance with manufacturers' recommendations.

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. 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
- 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 a drop connection when a sewer line enters a manhole higher than 30-inches above the invert of a manhole.

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 flush with 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 3 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.

SECTION 2601

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 2601

NOTE TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Engineer is responsible for ensuring that manufacturer engineered precast manhole can be supported by the foundation and will adequately resist all hydrostatic (uplift) pressures. Precast concrete manhole manufacturer is responsible for supplying a manhole design in accordance with ASTM C 478 and this specifications section, but it is not responsible for determining the appropriateness of the design for the geotechnical conditions or against uplift forces.
- B. Paragraph 2.01E. Adjust the soil unit weight (maximum damp in place weight, not dry unit weight) and the saturated equivalent fluid pressure (assume ground water adding to soil pressure whether or not geotechnical report shows ground water present) listed below to match values recommended by the geotechnical report for the specific site conditions.
- C. Paragraph 3.03B. Include a detail for pile supported manhole foundation when geotechnical information indicates that unstable soils may be encountered near the elevation of the manhole bottom.

END OF NOTES

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Fiberglass sanitary sewer manholes.

1.02 UNIT PRICES

- A. Measurement and payment for normal depth manholes, up to six feet deep, is on a unit price basis for each manhole installed. Depth is measured from top of cover to sewer invert.
- B. Measurement and payment for shallow depth manholes is on a unit price basis for each manhole installed. Shallow manholes have a depth of 4 feet or less measured from the top of cover to sewer invert.
- C. Measurement and payment for extra depth manholes is on a unit price basis per vertical foot for each foot of depth greater than 6 feet or on a unit price for each manhole based on the depth of the manhole. Depth is measured from top of cover to sewer invert.
- D. 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. Design and fabrication details of fiberglass manhole components.
 - 2. Manufacturer's installation instruction for fiberglass manholes.
 - 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. Plugs to be used for sanitary sewer hydrostatic testing.
 - 8. Manufacturer's data for pre-mix (bag) concrete if used for channel inverts and benches.

PART 2 PRODUCTS**2.01 FIBERGLASS MANHOLES AND BASE SECTIONS**

- A. Use prefabricated fiberglass manholes which conform in shape, size, dimensions, and details shown on Drawings. Unless modified by the Drawings, use manhole sections conforming to ASTM D 3753.
- B. Mark date of manufacture and name or trademark of manufacturer in 1-inch-high stenciled letters on inside of barrel.
- C. Unless a larger size is required, use a 48-inch-diameter barrel for fiberglass manholes. Make wall section of the appropriate thickness for depth of manhole according to ASTM D 3753, but not less than 0.48 inches in thickness.
- D. Provide a fabricated reducer bonded at the factory to form one continuous unit at the top of the manhole barrel to accept concrete grade rings and cast iron frame and cover. For the reducer, use an acceptable design with sufficient strength to safely support H-20 loading.
- E. Manhole base shall be a precast concrete base conforming to Section 02601 - Precast Concrete Manholes, unless a cast-in-place base is required by the Drawings. For precast

manhole bases, use an approved steel-reinforced design of sufficient strength to withstand imposed loads. Form the base so that the joint with the fiberglass manhole barrel, as shown on the Drawings, is sealed against leakage.

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, with a minimum compressive strength of 3000 psi, or Class A concrete.
- 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 3000 psi for cast-in-place base and for 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 FOR SANITARY SEWERS

- A. Use resilient connectors conforming to requirements of ASTM C 923 for connection to precast concrete base. Metallic mechanical devices as defined in ASTM C 923 shall be made of the following materials:
 - 1. External clamps: Type 316 stainless steel
 - 2. Internal expandable clamps on standard manholes: Type 304 stainless steel, 11-gauge minimum.
 - 3. Internal expandable clamps on corrosion-resistant manholes:
 - a. Type 316 stainless steel, 11 gauge minimum, or
 - b. Type 304 stainless steel, 18-gauge minimum, coated with minimum 16-mil fusion-bonded epoxy conforming to AWWA C 213.
- B. For drop pipes, provide a manufactured connector, such as Insert-a-Tee or equal, which provides a positive seal between the pipe and the fiberglass manhole wall.

- C. For cast-in-place concrete manhole base, use sealant material specified in this Section at locations and to dimensions shown on the Drawings.

2.08 SEALANT MATERIALS

- A. Water Swelling Sealant: Provide and install in accordance with the manufacturer's recommendation.

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. Non-shrink grout shall be prepackaged, inorganic, flowable, non-gas-liberating, nonmetallic, 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 7000 psi.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines and grades are correct.
- B. Determine if the subgrade, when scarified and recompact, 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 City Engineer.

3.02 PLACEMENT

- A. Install fiberglass 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 identified, the subgrade will be examined by the Engineer and City 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 or City Engineer.

3.04 CAST-IN-PLACE FOUNDATION

- A. Where the Drawings indicate a cast-in-place manhole base, place concrete as shown on the Drawings on a 4-inch (minimum) layer of either cement stabilized sand or seal slab. When unstable subgrade is identified, over-excavate the subgrade to allow for placement of a 12-inch-thick layer of crushed stone wrapped in filter fabric.

3.05 MANHOLE BARREL

- A. Lower manhole barrel onto base section. Seal with manufacturer's gasket or approved sealant.
- B. Where a cast-in-place base is used, support the manhole barrel in place and brace it from the sides of the excavation to prevent any movement of the barrel during concrete placement and while concrete is setting. Provide a minimum clearance between the reinforcing steel and the manhole barrel bottom as shown on the Drawings. Do not support the manhole barrel on reinforcing steel. Place a bead of water swelling sealant around the inside of the barrel near the bottom, as shown on the Drawings, to form a seal.

3.06 PIPE CONNECTIONS AT PRECAST MANHOLE BASE

- 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. Test connection for watertight seal before backfilling.

3.07 PIPE CONNECTIONS AT CAST-IN PLACE BASE

- A. Cut the manhole barrel for pipe penetrations following the curvature of the pipe and with a maximum of 1-inch clearance. Seal cut edges with resin. The hole may be circular or a cutout with a semi-circular top which extends to the bottom of the barrel.
- B. Place a continuous bead of water swelling sealant, as shown on the Drawings, around pipe penetrations on the interior of the manhole barrel. Roughen the surface of the fiberglass prior to placement to improve the bond with the sealant. Allow the sealant to completely cure before placing concrete against it.
- C. Extend pipe entering the manhole at least 8 inches into the manhole. Fit the pipes with a neoprene waterstop gasket seal placed tightly around the pipe using a stainless steel clamp. Alternately, pipes may have a continuous bead of water swelling sealant, as detailed on the Drawings, placed around the pipe circumference.
- D. When forming the invert surface in the bottom of the manhole, mound the concrete around the pipe penetrations so that the water swelling sealant beads and neoprene waterstop gasket have a minimum 2 inches of concrete cover.
- E. Test connection for watertight seal before backfilling.

3.08 INVERTS FOR SANITARY SEWERS

- A. Construct invert channels to provide a smooth flow transition waterway with no disruption of flow at pipe-to-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. Pipe smaller than 15 inches: 1/2 largest pipe diameter.
 - b. Pipe 15 to 24 inches: 3/4 largest pipe diameter.
 - c. Pipe 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.
- 3.09 DROP CONNECTIONS FOR SANITARY SEWERS
- A. Backfill drop assembly to form a solid mass with cement stabilized sand or Class A concrete. Extend cement stabilized sand or concrete outside of bells a minimum 4-inches.
- B. Install a drop connection when a sewer line enters a manhole higher than 30-inches above the invert of a manhole.
- C. At drop pipe connections through the fiberglass barrel, cut a circular hole sized to the requirements of the manufactured connector. Seal the cut edge with resin. Install the watertight connector according to the manufacturer's recommendations.
- 3.10 STUBS FOR FUTURE CONNECTIONS
- A. Where future connections are indicated on the Drawings, install resilient connectors and pipe stubs with approved watertight plugs in manholes.
- B. At cast-in-place base, where future connections are indicated on the Drawings, install a section of pipe extending no further than 12 inches from the edge of the foundation, ending in a bell, and provided with a rubber-gasketed watertight plug.
- 3.11 ADJUSTMENT RINGS AND FRAME
- A. Install concrete grade rings for height adjustment, as required. Construct chimney on flat shoulder. Do not load manhole except on load bearing shoulder of manhole. Adjustment height is limited to 18 inches. Do not use brick for adjustment of manholes to grade.
- B. Set cast iron frame on top of cone or adjustment rings using water swelling sealant materials and adjust elevation of casting cover to be 3/8 inch below pavement surface. For manholes in unpaved areas, set the top frame a minimum of 6 inches above existing ground line unless otherwise indicated on Drawings.

3.12 BACKFILL

- A. Place and compact backfill material 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. 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 and seed in accordance with Section 02932 - Hydromulch Seeding. If shown on Drawings, sod disturbed areas in accordance with Section 02935- Sodding.

3.13 FIELD QUALITY CONTROL

- A. Conduct leakage testing of manholes in accordance with requirements of Section 02732 - Acceptance Testing for Sanitary Sewers.

3.14 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 02602

CITY OF VICTORIA
STANDARD SPECIFICATIONS

FIBERGLASS MANHOLES

NOTE TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Paragraph 3.04. Cast-in-place foundations are intended for shallow manholes, less than 12-foot-depth, where access for equipment needed to place a precast base is not available.

END OF NOTE

PART 1 GENERAL**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.

PART 2 PRODUCTS**2.01 CASTINGS**

- A. Castings for frames, grates, rings and covers shall conform to ASTM A48, Class 30. Provide locking covers if indicated on Drawings.
- B. Castings shall be capable of withstanding the application of an AASHTO H-20 loading 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.

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.

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.

SECTION 02603

CITY OF VICTORIA
STANDARD SPECIFICATIONS

FRAMES, GRATES, RINGS, AND COVERS

PART 3 EXECUTION

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.

END OF SECTION

PART 1 GENERAL

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. No separate payment will be made for valve boxes under this section. Include payment in unit price for Section 02640 - Gate Valves.
- B. Measurement for meter vaults is on a lump sum basis or installation of each meter vault type and size.

1.03 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 - Submittals.
- B. Submit manufacturers 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.
- D. Submit manufacturer's certification that plastic meter boxes purchased for Work meet the requirements of paragraph of this Section on Plastic Meter Boxes.

PART 2 PRODUCTS

2.01 VALVE BOXES

- A. Provide cast-iron, slide-type, valve boxes as indicated on the Drawings. 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.
- 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 'B' concrete conforming to requirements of Section 03305 – Concrete for Utility Construction and Minor Paving.

2.02 METER BOXES GENERAL

- A. The City of Victoria will not furnish meter boxes for meters unless stated otherwise on plans or on bid sheet.

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 and Minor Paving.
- C. Reinforcing steel for meter vaults: Conform to requirements of Section 03305 – Concrete for Utility Construction and Minor Paving.
- D. Grates and Covers: Conform to requirements of Section 02603 – Frames, Grates, Rings and Covers.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Obtain approval from the City 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. Riser may rest on valve flange, or provide suitable footpiece to support riser pipe.

3.03 METER BOXES

- A. Install cast iron or plastic boxes in accordance with manufacturer's instructions.
- B. Construct concrete meter boxes to dimensions shown on Drawings.
- C. Adjust top of meter boxes to conform to cover elevations specified in paragraph of this section for Frame and Cover for Meter Vaults.
- D. Do not locate under paved areas unless approved by City 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 inch above adjacent concrete.
- 3.06 BACKFILL
- A. Provide cement sand in accordance with Section 02252 – Cement Stabilized Sand a minimum of 12 inches around the valve stand and 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

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Cast-in-place inlets for storm sewers, including cast iron frame and plate or grate.
- B. Cast-in-place headwalls and wingwalls for storm sewers.

1.02 UNIT PRICES

- A. Measurement for installed inlets is on a lump sum basis for each depth category as specified on the Bid Sheet.
- B. Measurement for headwalls and wingwalls is on a lump sum basis for each headwall and wingwall installed.
- C. Payment for inlets and for culvert headwalls and wingwalls includes connection of lines and furnishing and installing frames, grates, rings and covers.
- D. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

- A. Inlet Depth: Depth measured from the top of the inlet lid or grate to the lowest flow line of the inlet.

1.04 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 PRODUCTS**2.01 MATERIALS**

- A. Concrete: Class 'A' concrete in accordance with Section 03305 – Concrete for Utility Construction and Minor Paving.
- B. Reinforcing steel: Conform to requirements of Section 03305 – Concrete for Utility Construction and Minor Paving.
- 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 – Frames, Grates, Rings and Covers.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify lines and grades are correct.

- B. Verify that subgrade will support loads imposed by inlets.

3.02 INSTALLATION

- A. Construct inlets, headwalls, and wingwalls complete in place to the dimensions, lines and grades as shown on Drawings.
- B. Excavate in accordance with requirements of Section 02227 – Excavation and Backfill for Utilities.
- 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 and City 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 – Concrete for Utility Construction and Minor Paving.

3.04 BACKFILL

- A. Backfill the area of excavation surrounding each completed inlet according to the requirements of Section 02227 – Excavation and Backfill for Utilities.

END OF SECTION

PART 1 GENERAL**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. Measurement for installed inlets is on a lump sum basis for each depth category as specified on the Bid Sheet.
- B. Measurement for headwalls and wingwalls is on a lump sum basis for each headwall and wingwall installed.
- C. Payment for inlets and for culvert headwalls and wingwalls includes connection of lines and furnishing and installing frames, grates, rings, and covers.
- D. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

- A. Submittal 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 PRODUCTS**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: Conform to requirements of Section 03305 – Concrete for Utility Construction and Minor Paving.. 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 C270, Type S using portland cement.
- D. Miscellaneous metal: Cast-iron frames and plates conforming to requirements of Section 02603 – Frames, Grates, Rings and Covers.

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 misshapen 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 and City Engineer, repaired units conform with requirements of these specifications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines and grades are correct.

3.02 Verify compacted subgrade will support loads imposed by inlets. INSTALLATION

- A. Install inlets, headwalls, and wingwalls complete in place to the dimensions, lines and grades as shown on the Drawings.
- B. Excavate in accordance with requirements of Section 02227 – Excavation and Backfill for Utilities.
- 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 cement-sand mortar mix 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. Use jointing material as shown on the Drawings or as approved. 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 – Excavation and Backfill for Utilities.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Adjusting elevation of existing manholes, inlets, and valve boxes below subgrade elevations.
- B. Adjusting elevation of existing manholes, inlets, and valve boxes to new grades.

1.02 UNIT PRICES

- A. Measurement for adjusting utility structures to grade is on a lump sum basis for:
 - 1. Adjusting manholes.
 - 2. Adjusting inlets.
 - 3. Adjusting valve boxes.
- B. Each manhole, inlet, and valve box will only be measured once. Price shall include the cost of lowering the structure below subgrade and then raising the structure to final grade.
- C. Only existing manholes, inlets, and valve boxes will be measured.
- D. Refer to Section 01025 - Measurement and Payment for unit price procedures.

PART 2 PRODUCTS**2.01 CONCRETE MATERIALS**

- A. For cast-in-place concrete, refer to Section 03305 - Concrete for Utility Construction and Minor Paving.
- 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 C270, 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 – Ductile Iron Pipe and Fittings through 02620 – PVC Pipe.

PART 3 EXECUTION**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 and City Engineer. Repair in a manner subject to the Engineer's and City Engineer's approval.

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.
- 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 and City Engineer's approval.

3.04 ADJUSTING VALVE BOXES

- A. Salvage and reuse valve box.
- B. Remove and replace 6-inch 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.

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.
- C. In unpaved areas, grade surface at a uniform slope of 1 to 5 from the manhole frame to natural grade.

END OF SECTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Ductile iron pipe and fittings for water mains and wastewater force mains.

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 and force mains.

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 station numbers for pipe and fittings corresponding to Drawings. Production of pipe and fittings prior to review by the Engineer and City 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.
- 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 mechanical joint, ANSI A21.15 flanged end. For bolted joints, bolts shall conform to requirements of AWWA C111.
- B. Where restrained joints for buried service are required by Drawings, provide one of the following, or equal:
 - 1. Super-Lock Joint by Clow Corporation.
 - 2. Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.
 - 3. TR-Flex Joint by U.S. Pipe and Foundry Company.
- 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 Sewage 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 manufacture

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 or C153); pressure rated at 250 psi.
- E. Ductile Iron Compact Fittings for Water Mains: ANSI A21.53 (AWWA C153); 12-inch through 24-inch diameter; cement-mortar lining; wrap in 8-mil polyethylene film.

2.05 COATINGS AND LININGS

- A. Water Main Interiors: ANSI A21.4, cement lined with seal coat.
- 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.

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DUCTILE IRON PIPE AND FITTINGS

- 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: 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 EXECUTION

3.01 INSTALLATION

- A. Conform to installation requirements of Sections 02664 - Water Mains, 02730 - Gravity Sanitary Sewers, and 02731 - Sanitary Sewage Force 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.

END OF SECTION

SECTION 02610

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DUCTILE IRON PIPE AND FITTINGS

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. The following Paragraphs may require editing to provide complete and correct information:
 - 1. Paragraph 2.05.B.: Unless otherwise specified, use of polyurethane, polyethylene, or ceramic epoxy lining is at the option of the Contractor.
 - 2. In Paragraph 2.05, replace subparagraph D with the following if polyurethane coating for corrosive soils applications is required: "Conform to requirements of Section 02629 - Polyurethane Coatings on Steel or Ductile Iron Pipe".
 - 3. Paragraph 3.01.A.: May require additions or deletions of Sections, depending on specific needs of the Project.
- B. The following Paragraphs require coordination with the Drawings:
 - 1. Paragraph 2.01.A.: Indicate pipe pressure class on Drawings.
 - 2. Paragraph 2.02.B.: Restrained joints, if required must be indicated on the Drawings.
 - 3. Paragraph 2.02.E.: For bonding of joints in cathodically protected pipe, a detail is required on the Drawings. Insulated joints must also be indicated.

END OF NOTES

PART 1 G E N E R A L**1.01 SECTION INCLUDES**

- A. Copper tubing for water service lines.

1.02 UNIT PRICES

- A. No payment will be made for copper tubing under this Section. Include cost in unit price for water taps and service lines.

1.03 QUALITY CONTROL

- A. Provide manufacturer's certification that copper tubing purchased for Work conforms to requirements of ASTM B88 and that it has been tested in accordance with ASTM B88 except that number of samples of each size of tubing is modified as follows:
 - 1. For each 7,500 feet of tubing: 1 sample.
 - 2. For each set of tubing less than 7,500 feet: 1 sample.

PART 2 P R O D U C T S**2.01 MATERIALS**

- A. Provide Type K annealed, seamless, copper tubing, 3/4-inch to 2-inch in diameter conforming to requirements of ASTM B88.
- B. Furnish 3/4-inch and 1-inch tubing in coils of a minimum 60 feet in length. Furnish 1-1/2-inch and 2-inch tubing in coils 40 feet in length.
- C. All tubing shall be manufactured in United States of America. Copper tubing may be inspected and tested by a laboratory designated by the Engineer and City Engineer at point of manufacture or locally. Furnish tubing, without cost, to designated testing laboratory with mil compliance certificates.
- D. Provide compression-type brass fittings for use with Type K annealed copper tubing in accordance with AWWA C800.

PART 3 E X E C U T I O N**3.01 INSTALLATION**

- A. Conform to installation requirements of Section 02665 – Water Tap and Service Line Installation except as modified herein.

3.02 JOINTS

- A. Minimum joint spacing for 3/4-inch and 1-inch tubing shall be in multiples of 60-feet and for 1-1/2-inch and 2-inch tubing shall be in multiples of 40-feet.
- B. Cut copper tubing squarely by using an approved cutting tool and avoiding excessive pressure on the cutting wheels which might bend or flatten pipe walls.
- C. For compression fittings, cut copper tubing squarely prior to insertion into the fitting. Final assembly shall be in accordance with manufacturer's recommended procedure.

3.03 BENDS

- A. Bending of tubing shall be accomplished by using appropriate sized bending tool. No kinks, dents, flats, or crimps will be permitted, and should such occur, the damaged section shall be cut out and replaced. Bends shall have no smaller radius than radius of coil of tubing as packaged by manufacturer. Copper tubing shipped in straight lengths conform to following:
1. For 2-inch diameter: Maximum of one 45-degree bend per 4-foot section.
 2. For 1-1/2-inch diameter: Maximum of one 45-degree bend per 3-foot section.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforced concrete pipe for storm sewers.

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 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 PRODUCTS

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 tongue and groove or rubber gasketed conforming to ASTM C443.
- 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 EXECUTION

3.01 INSTALLATION

- A. Conform to requirements of Section 02720 - Storm Sewers.
- B. Install reinforced concrete pipe in accordance with manufacturer's recommendations.

END OF SECTION

NOTES TO SPECIFIER

THE FOLLOWING CONSIDERATIONS ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Paragraphs 2.01 - Determine through loading calculations the specific class of concrete pipe (Class III, IV, or V) required for the project applications. Class III pipe is the minimum acceptable for projects. Delete paragraphs for pipe configurations (circular, arch, or elliptical) not used.
- B. The following paragraphs may require editing to provide complete and correct information:
 - 1. Paragraph 2.01.A - Note that Class III is specified.
 - 2. Paragraph 2.01.B - Note that Class A-III is specified.
 - 3. Paragraph 2.01.C - Note that Classes VE-III and HE-III are specified.

END OF NOTES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Monolithic reinforced concrete box sewer.

1.02 UNIT PRICES

- A. No payment will be made for monolithic reinforced concrete box sewer under this Section. Include payment in unit price for Sections 02720 – Storm Sewers.
- 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 for approval, shop drawings of design and construction details for monolithic reinforced concrete box sewer.

PART 2 PRODUCTS

2.01 CONCRETE

- A. Concrete for construction of monolithic reinforced concrete box sewers shall conform to requirements of Section 03310 - Structural Concrete or Section 03305 - Concrete for Utility Construction and Minor Paving.

2.02 REINFORCING STEEL

- A. Reinforcing steel for construction of monolithic reinforced concrete box sewer is specified in Section 03305 - Concrete for Utility Construction and Minor Paving.

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

- A. After the trench has been excavated to the bottom in accordance with Section 02227 – Excavation and Backfill for Utilities, grade the trench to a fine graded condition and to the subgrade established. Do not backfill below the established grade line.
- B. Where a seal slab is installed, finish the top of the seal slab to the established subgrade.
- C. Upon completion of the trench, place the reinforcing steel and forms. Securely brace them in proper position. Place concrete in accordance with Section 03310 – Structural Concrete or 03305 – Concrete for Utility Construction and Minor Paving.
- D. Furnish and place in position, all necessary stakes, grade, and batter boards for locating the work. Use grade boards of timber sized and supported as shown on the Drawings. For batter boards, use 1" by 6" wood planed on all four sides to truly parallel faces. Protect grade boards, batter boards and location stakes to keep them from being damaged or knocked out of alignment. Furnish sound twilled lines for use in setting lines and grades. Also provide the necessary plummets and graduated poles.

3.02 FORMS

- A. Provided suitable forms with smooth surfaces. The bracing shall be rigidly fixed, adequate to prevent deviation from the correct lines. Use steel forms that are neatly and accurately made with all similar parts in each longitudinal section interchangeable with other sections. Build wooden forms of clean, sound lumber, reasonably free from knots, dressed on all sides, and neatly fitted. Use tongue and groove or ship lap material. Make form surface watertight and securely fasten it to ribs or supports. Do not use forms unless they are clean, properly shaped, sufficiently strong, and in every way suitable.
- B. Before placing concrete or reinforcement, coat forms with lubricants to prevent adherence of concrete.
- C. Leave wall forms in place until concrete has attained a compressive strength of 1000 psi or a minimum of 24 hours after the concrete is placed, whichever is the later.
- D. Place a structural support at center of the span for forms supporting the roof slab or use standard manufactured forms not requiring center supports. Do not disturb forms and center supports until concrete has attained a compressive strength of 2,000 psi or 3 days after the roof slab is placed whichever is later.
- E. Use trench sheathing for the outside form for sewers with semicircular bottom. During the trench excavation, place one set of rangers and struts immediately above the construction joint in the wall located 5'-9" above the flow line and a second set of rangers and struts immediately above the top of the sewer. Do not remove rangers and struts located 5'-9" above the flow line until the concrete in the lower section of the sewer has attained a strength of 2000 psi. Similarly, do not remove the bracing immediately above the top of the sewer until the concrete in the walls and top slab has attained a strength of 2500 psi.

3.03 JUNCTIONS AND ANGLE INTERSECTIONS

- A. Build angles in box-type sewers according to details on the Drawings.
- B. Where junctions with the future sewers are to be made, leave openings in the sewer walls to match the outside dimensions of the connecting sewer. Leave bond length of each reinforcing bar in the opening for connecting with the future sewer. Where the sewer or stub will be built under a future contract, close the opening with a watertight 12-inch brick bulkhead.

3.04 CONCRETE FINISHING

- A. After form removal, finish pipe interior and any exposed concrete to a smooth surface. Conform to requirements of Section 03305 – Concrete for Utility Construction and Minor Paving.

END OF SECTION

SECTION 02617

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PRECAST REINFORCED CONCRETE BOX SEWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast reinforced concrete box sewers.

1.02 UNIT PRICES

- A. No payment will be made for precast reinforced concrete box sewer under this Section. Include payment in unit price for Sections 02720 – Storm Sewers.
- B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

PART 2 PRODUCTS

2.01 PRECAST REINFORCED CONCRETE BOX SEWERS

- A. All box sewer sections shall conform to ASTM C789 or ASTM C850, 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 concrete.

2.02 CONCRETE

- A. Conform to requirements of Section 03305 – Concrete for Utility Construction and Minor Paving.
- 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.

PART 3 EXECUTION

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.

SECTION 02617

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STANDARD SPECIFICATIONS

PRECAST REINFORCED CONCRETE BOX SEWERS

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 of Utilities.

END OF SECTION

SECTION 2618

CITY OF VICTORIA
STANDARD SPECIFICATIONS

CENTRIFUGALLY CAST FIBERGLASS PIPE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Centrifugally Cast Fiberglass Reinforced Plastic (FRP) Pipe for sanitary sewers.

1.02 UNIT PRICES

- A. No payment will be made for fiberglass pipe under this Section. Include in unit price for Section 02730 - Gravity Sanitary Sewers or Section 02731 - Sanitary Sewage Force Mains.

1.03 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittals.
- B. Provide sufficient data for the Engineer and City Engineer to properly evaluate the pipe.
- C. Product data submittals shall include the following, as a minimum:
 - 1. Details of the proposed pipe.
 - 2. Properties and strengths of the pipe.
 - 3. Details of pipe joint.
 - 4. Pipe design analysis.
 - 5. Instruction on storage, handling, transporting, and installation.
 - 6. Standard catalog sheets.
- D. Test Reports: Provide test reports upon request, certifying that the pipe has been tested in accordance with and exceeds minimum requirements of ASTM D 3262 and ASTM D 3681.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer for centrifugally cast fiberglass pipe shall provide submittals.

2.02 MATERIALS

- A. Resin Systems: The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been collected from applications of a composite material of similar construction and composition as the proposed product.
- B. Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.
- C. Fillers: Silica sand or other suitable materials may be used.
- D. Additives: Resin additives, such as pigments, dyes, and other coloring agents, if used, shall in no way be detrimental to the performance of the product nor shall they impair visual inspection of the finished products.
- E. Rubber Gaskets: Supply from an approved gasket manufacturer in accordance with ASTM F 477, when no contaminant is identified and suitable for the service intended. Gaskets shall either be affixed to the pipe by means of a suitable adhesive or shall be installed in such a manner so as to prevent the gasket from rolling out of the pre-cut groove in the pipe or sleeve coupling. When pipe is to be installed in potentially contaminated areas, especially where

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free product is found near the elevation of the proposed sewer, provide 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

- F. The internal liner resin shall be suitable for service as sewer pipe, and shall be highly resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases. Pipe shall meet or exceed requirements of ASTM D 3681.

2.03 MANUFACTURE AND CONSTRUCTION

- A. Pipes
1. Furnish pipes in the diameters specified and within the tolerances specified below.
 2. Manufacture pipe by the centrifugal casting process to result in a dense, nonporous, corrosion-resistant, consistent composite structure to meet the operating conditions as shown on the Drawings.
 3. Do not use stiffening ribs or rings.
- B. Couplings: Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D 4161.
- C. Fittings: Flanges, elbows, reducers, tees, and other fittings shall be capable of withstanding operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays.
- D. Manhole Connections: Provide a water stop flange (wall pipe) for connection to a cast-in-place manhole base or other structure.
- E. Grout Ports: Provide grout ports in the wall of pipe when required by Section 02330 - Tunnel Grout. Provide plugs of 316 stainless steel or other corrosion-resistant material compatible with the pipe. Grout port plugs shall be designed and installed to meet the test pressure of the pipe.

2.04 DIMENSIONS

- A. Diameters: The actual outside diameter of the pipes shall be in accordance with Table 3 of ASTM D 3262 for gravity sewers, or ASTM D 3754 for force mains.
- B. Lengths: The pipe standard length will be approximately 20 feet. A maximum of 10 percent of the lengths, excluding special order pipes, may be supplied in random lengths.
- C. Wall Thickness: The minimum average wall thickness shall be the stated design thickness. The minimum single point thickness shall not be less than 90 percent of the stated design thickness.
- D. End Squareness: Pipe ends shall be square to the pipe axis.
- E. Tolerance of Fittings: The tolerance of the angle of an elbow and the angle between the main and leg of a wye or tee shall be plus or minus 2 degrees. The tolerance on the laying length of a fitting shall be plus or minus 2 inches.

2.05 STIFFNESS CLASSES

- A. Stiffness class of FRP pipe shall satisfy design requirements, but shall not be less than 72 psi, when used in direct bury operation; 72 psi or as stated in the bid sheet or plans, when installed within a primary tunnel liner.
- B. Stiffness class of FRP in a pipe jacking operation shall be governed either by the ring deflection limitations or by a pipe design providing longitudinal strength required by the jacking method and shall satisfy design requirements stated below. Submit design calculations as required in Paragraph 1.04, Submittals.
 - 1. Ring deflection calculations shall conform with design requirements of 30 TAC Chapter 317.20 pertaining to flexible pipe used in gravity sewers. The pipe deflection calculations shall ensure that predicted deflection will be less than 5 percent under long-term loading conditions (soil prism load) for the highest density of soil overburden and surcharge loads. Deflection on calculations shall be prepared using long-term (drained) values for soil parameters contained in the geotechnical investigation report for the Project, or other site-specific data obtained by the Contractor as approved by the Engineer and City Engineer.

2.06 TESTING

- A. Pipes shall be tested in accordance with ASTM D 3262 or ASTM D 3754, as applicable, except that the factory hydrostatic pressure testing is not required.
- B. Joints: Coupling joints shall be qualified per the tests of Section 7 of ASTM D 4161.

2.07 CUSTOMER INSPECTION

- A. The Engineer or City Engineer shall be entitled to inspect pipes or witness the pipe manufacturing. Such inspection shall not relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications.
- B. Manufacturer's Notification to Customer: Should the Engineer or City Engineer wish to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Engineer or City Engineer with adequate advance notice of when and where the production of those pipes will take place.
- C. Failure to Inspect: Should the Engineer or City Engineer elect not to inspect the manufacturing, testing, or finished pipes, it in no way implies approval of products or tests.

2.08 PACKAGING, HANDLING, AND SHIPPING

- A. Packing, handling, and shipping should be done in accordance with the manufacturer's instructions.

PART 3 EXECUTION

3.01 INSTALLATION

- A. The installation of pipe and fittings shall be in accordance with requirements of Section 02730 - Gravity Sanitary Sewers and 02731 - Sanitary Sewage Force Mains.
- B. The manufacturer must supply a suitable qualified field service representative to be present periodically during the installation of pipe.

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- C. Pipe Bedding: Conform to requirements of Section 02227 - Excavation and Backfill for Utilities.
- D. Pipe Handling: Use textile slings.
- E. Jointing
 - 1. Clean ends of pipe and coupling components.
 - 2. Check pipe ends and couplings for damage. Correct any damage found.
 - 3. Coupling grooves must be completely free of dirt.
 - 4. Apply joint lubricant to pipe ends and rubber seals of coupling. Use only lubricants approved by the pipe manufacturer.
 - 5. Use suitable auxiliary equipment, such as a wire rope puller, to pull joints together.
 - 6. Do not exceed forces recommended by the manufacturer for coupling pipe. If excessive force is required, remove coupling, determine source of problem, and correct it.
 - 7. In the process of jointing the pipe, do not allow the deflection angle to exceed the deflection permitted by the manufacturer.
- F. If pressure grouting of the pipe is conducted as part of a pipe-jacked tunnel installation, seal the grout holes with liner resin to a thickness equal to the pipe liner thickness, or with a threaded plug for that purpose.
- G. Tests: Conform to requirements of Section 02732 - Acceptance Testing for Sanitary Sewers.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. High Density Polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.
- B. HDPE pipe for sanitary sewer force mains, including fittings.
- C. HDPE pipe for water service lines, including fittings.

1.02 UNIT PRICES

- A. No separate payment will be made for HDPE pipe under this Section. Include cost in unit prices for gravity sanitary sewers and storm sewers.

1.03 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittals.
- B. Submit shop drawings showing design of pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

1.04 QUALITY CONTROL

- A. Provide the manufacturer's certificate of conformance to the Specifications.

PART 2 PRODUCTS

2.01 APPROVED AND PREAPPROVED PRODUCTS

- A. Provide HDPE pipe as follows:

WALL CONSTRUCTION	MANUFACTURER	PRODUCT OPTIONS	ASTM DESIGNATION	PIPE STIFFNESS (MIN)	DIAMETER RANGE (INCHES)
Solid Wall	Provide Submittals	Approved	F714	115 psi	8 to 10
				72 psi or as shown in bid sheet or on plans	12 to 48

- B. Solid wall pipe shall be produced with plain end construction for heat joining (butt fusion) conforming to ASTM D2657. Utilize controlled temperatures and pressures for joining to produce a fused leak-free joint.
- C. Water service line to be copper tubing size (CTS) and conform to ASTM D2737 and AWWA C901 Standards. It can be joined with heat fusion or mechanical fittings designed for CTS tubing.

2.02 MATERIALS

- A. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting the requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D1248. Material meeting the requirements of cell classification in accordance with ASTM D3350 are also suitable for making pipe products under these specifications.
- B. Gaskets
1. Use gaskets meeting requirement of ASTM F477. Use gasket molded into a circular form or extruded to the proper section and then spliced into circular form. When no contaminant is identified, use gaskets of a properly cured, high-grade elastomeric compound. The basic polymer shall be natural rubber, synthetic elastomer, or a blend of both.
 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

- C. Lubricant. Use a lubricant for assembly of gasketed joints which has no detrimental effect on the gasket or on the pipe, in accordance with manufacturer's recommendations.

2.03 WORKMANSHIP

- A. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.

2.04 INSPECTIONS

- A. The Engineer or City Engineer reserves the right to inspect pipes or witness pipe manufacturing. Such inspection shall in no way relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications.
- B. Manufacturer's Notification to Customer. Should the Engineer or City Engineer wish to witness the manufacture of specific pipes, the manufacturer shall provide the Engineer or City Engineer with adequate advance notice of when and where the production of those specific pipes will take place.
- C. Failure to Inspect. Approval of the products or tests is not implied by the Engineer's or City Engineer's decision not to inspect the manufacturing, testing, or finished pipes.

2.05 TEST METHODS

- A. Conditioning. Conditioning of samples prior to and during tests are subject to approval by the Engineer and City Engineer. When referee tests are required, condition the specimens in accordance with Procedure A in ASTM D618 at 73.4 degrees F plus or minus 3.6 degrees F (23 degrees C plus or minus 2 degrees C) and 50 percent relative humidity plus or minus 5

- percent relative humidity for not less than 40 hours prior to test. Conduct tests under the same conditions of temperature and humidity unless otherwise specified.
- B. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in a suitable press until the internal diameter has been reduced to 40 percent of the original inside diameter of the pipe. The rate of loading shall be uniform and at 2-inches per minute. The test specimens, when examined under normal light and with the unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of the pipe walls or bracing profiles.
 - C. Joint Tightness. Test for joint tightness in accordance with ASTM D3212, except replace the shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to the pipe's outer contour.
 - D. Purpose of Tests. The flattening and the joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

2.06 MARKING

- A. Mark each standard and random length of pipe in compliance with these Specifications with the following information:
 - 1. Pipe size
 - 2. Pipe class
 - 3. Production code
 - 4. Material designation

PART 3 EXECUTION

3.01 INSTALLATION

- A. Conform to requirements of the following Sections:
 - 1. Section 02720 - Storm Sewers
 - 2. Section 02730 - Gravity Sanitary Sewers
- B. Install pipe in accordance with the manufacturer's recommended installation procedures.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Polyvinyl chloride pressure pipe for water distribution in nominal diameters 4 inches through 24 inches.
- B. Polyvinyl chloride sewer pipe for gravity sanitary sewers in nominal diameters 4 inches through 48 inches.
- C. 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 water mains, gravity sanitary sewer, and force mains.

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 and City Engineer for review. Cost of testing shall be borne by Contractor or Supplier.

PART 2 PRODUCTS

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.

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- C. For PVC pressure pipe used for water mains, 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.
- D. Gaskets:
1. Gaskets shall meet the requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight, Reiber Gasket or equal.
 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 4-inch through 12-inch: AWWA C 900, Class 150, DR 18; nominal 20-foot lengths; cast iron equivalent outside diameters.
- B. Pipe 16-inch to 24-inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast iron equivalent outside diameter.
- C. 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.
- D. Make curves and bends by deflecting the joints. Do not exceed 1/2 maximum deflection recommended by the pipe manufacturer. Submit details of other methods of providing curves and bends for review by the Engineer and City Engineer.
- E. Hydrostatic Test: AWWA C900, AWWA C905, 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/AWWA C110 or C153, ductile iron: ANSI A21.11/AWWA C111, mechanical joint fittings, minimum 250 psi pressure rating.
- B. All bolts on mechanical joint fittings shall be coated with Texaco rust proofing compound.
- C. Fittings shall be wrapped in 8-mil polyethylene film conforming to ANSI A21.5/AWWA C105.

2.04 GRAVITY SANITARY SEWER PIPE

- A. PVC gravity sanitary sewer pipe shall be SDR 26/ PS 115, 4 inch through 24 inch diameter, ASTM D3034, manufactured by J-M Pipe, Certain Teed, Carlon, North American, Diamond or approved equal.
- B. When solid wall PVC pipe 18 inches to 24 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.
- C. For sewers up to 12-inch-diameter crossing over waterlines, or crossing under waterlines with less than 2 feet separation, provide minimum 150 psi pressure-rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.
- D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM
- E. D 3139 and ASTM F 477, shall be provided. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. The manufacturer shall test a sample from each batch conforming to requirements ASTM D2444.
- F. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable. Fittings shall be same ASTM designation and pipe class as the pipe.

SANITARY SEWER FORCE MAIN PIPE

- A. Provide PVC pressure pipe conforming to the requirements for water pipe, and conforming to the minimum working pressure rating specified in Section 02731 - Sanitary Sewage 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 1500 restrainer, or equal joint restraint device conforming to UNI-B-13, for PVC pipe 24-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 8-mil polyethylene wrapping of ductile iron fittings.
- E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02 E.

- F. Manufacturers: Approved manufacturers of pressure rated, solid wall PVC pipe for sanitary sewer force mains are:
 - 1. J & M Manufacturing Company, Inc.
 - 2. CertainTeed Corporation
 - 3. Diamond Plastics Corporation
 - 4. Carlon Company
 - 5. North American Pipe Corporation (NAPCO)

PART 3 EXECUTION

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 Sewage Force Mains, and Section 02763 - Point Repairs to Sanitary Sewers and Obstruction Removals, 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 3 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.
- E. Avoid imposing strains that will overstress or buckle the pipe when lowering pipe into trench.
- F. Hand shovel pipe bedding under the pipe haunches and along the sides of the pipe barrel and compact to eliminate voids and ensure side support.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Cross linked polyethylene (PEX) tubing for water service lines, including fittings.

1.02 UNIT PRICES

- A. No separate payment will be made for PEX tubing. Include cost in the unit price for water service complete and in-place.

1.03 SUBMITTALS

- A. Conform to requirements of Section 01300 - Submittals.
- B. Submit shop drawings showing design of pipe and fittings, including alignment and grade, laying dimensions, fabrication, fittings, flanges and special details.

1.04 QUALITY CONTROL

- A. Provide the manufacturer's certificate of conformance to the Specifications.
- B. ASTM F876 and ASTM F877 Cross Linked Polyethylene (PEX) Tubing.
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Cross-linked Polyethylene (PEX) manufactured by PEX-a or Engel method (80% plus cross linked).
- B. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third party agency.
- C. Fire rated assembly listings in accordance with ANSI/UL 263.
 - 1. UL Design No. L557 – 1 hour wood frame floor/ceiling assemblies.
 - 2. UL Design No. K913 – 2 hour concrete floor/ceiling assemblies.
 - 3. UL Design No. U372 – 1 hour wood stud/gypsum wallboard wall assemblies.
 - 4. UL Design No. V444 – 1 hour steel stud/gypsum wallboard wall assemblies.
- D. Water service line to be copper tubing size (CTS) .

2.02 WORKMANSHIP

- A. Furnish pipe and fittings that are homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density and other physical properties.

2.03 INSPECTIONS

- A. The Engineer or City Engineer reserves the right to inspect pipes or witness pipe manufacturing. Such inspection shall in no way relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications.
- B. Manufacturer's Notification to Customer. Should the Engineer or City Engineer wish to witness the manufacture of specific pipes, the manufacturer shall provide the Engineer or City Engineer with adequate advance notice of when and where the production of these specific pipes will take place.
- C. Failure to Inspect. Approval of the products or test is not implied by Engineer's or City Engineer's decision not to inspect the manufacturing, testing or finished pipes.

2.04 MARKING

- A. Mark each standard and random length of pipe in compliance with these Specifications with the following information:
 - 1. Pipe size
 - 2. Pipe class
 - 3. Production code
 - 4. Material designation

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Conform to requirements of the following Sections:
 - 5. Section 02665 – Water Tap and Service Line Installation
- B. Install pipe in accordance with the manufacturer's recommended installation procedures.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tapping sleeves and valves for connections to existing water system.

1.02 UNIT PRICES

- A. Measurement is on a lump sum basis for each tap.
- B. 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 PRODUCTS

2.01 MATERIALS

- A. Tapping Sleeves:
 - 1. Tapping Sleeve Bodies: All stainless steel tapping sleeve with an alloy flange, Smith Blair #662, Ford FAST or approved equal.
 - 2. Branch Outlet of Tapping Sleeve: Flanged; machined recess; AWWA C207, Class D, ANSI 150 lb drilling. Gasket: Affixed around recess of tap opening to preclude rolling or binding during installation.
 - 3. Where fire service from 6-inch main is approved, use cast iron split sleeve.
- B. 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 or push-on 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; double disc.
- C. Valve Boxes: Furnish and install according to Section 02604 – Valves Boxes, Meter Boxes and Meter Vaults.

PART 3 EXECUTION

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.

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- 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 02630 – Polyethylene Wrap.
- 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

PART 1 GENERAL

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 and City 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 PRODUCTS

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 five 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 EXECUTION

3.01 SURFACE PREPARATION

- A. Remove deposits of oil, grease or other organic contaminants 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 and City 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

Over 70 degrees F
50 to 70 degrees F
0 to 50 degrees F

Minimum Full Cure Time

7 days
9 days
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 or City 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 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

NOTE TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. When determined that design requirements necessitate cathodic protection for water line, add requirements for repairing coating for thermite-brazed connections.

END OF NOTE

PART 1 GENERAL

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 PRODUCTS

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.
 - i. Type : I
 - ii. Class: C (black)
 - iii. Grade: E-5
 - iv. Flow rate (formerly melt index): 0.4 g/10 minute, maximum
 - v. Dielectric strength: Volume resistivity, 10^{15} ohm-cm, minimum
 - b. Physical properties.
 - i. Tensile strength: 1200 psi, minimum
 - ii. Elongation: 300 percent, minimum
 - iii. Dielectric strength: 800 V/mil thickness, minimum
 - c. Thickness: Low-density polyethylene film shall have a normal 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.
 - i. Type: III
 - ii. Class: C (black)
 - iii. Grade: P33
 - iv. Flow rate (formerly melt index): 0.4 to 0.5g/10 minute, maximum
 - v. Dielectric strength: Volume resistivity, 10^{15} ohm-cm, minimum
 - b. Physical properties.
 - i. Tensile strength: 5000 psi, minimum
 - ii. Elongation: 100 percent, minimum
 - iii. 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.

PART 3 EXECUTION

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, 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.

SECTION 02630

- 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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnishing and installing gate valves.

1.02 UNIT PRICES

- A. Measurement for gate valves is on a lump sum basis for installation of each valve of each size.

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 and C515.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Gate Valves: AWWA C500, 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. If type of valve is specified, no substitute will be allowed.
- C. Gate Valves 1-1/2 Inches in Diameter and Smaller: 125 psig; bronze; rising-stem; single-wedge; disc type; screwed ends; Crane No. 428, 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 in Diameter: Iron body; double gate; non-rising stem; 150-pound test; 2-inch square nut operating clockwise to open.
- F. Gate Valves 4 Inches to 24 inches in Diameter: Resilient seated, epoxy coated meeting the latest AWWA C500 specification, 200 psig, mechanical joint type, Clow F6100, Mueller A2360, American Darling AFC-500, US Pipe Metroseal 200 or approved equal. Gate valves over 16 inches in diameter shall be furnished with an enclosed bevel gear assembly.
- G. 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.
- H. 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.

- I. Provide flanged joints when valve is connected to steel.

PART 3 EXECUTION

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 City 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. Regardless of type of pipe used in water line construction, pipe section of each valve box must be of cast iron or ductile iron. Size to allow proper 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 Waterlines.

3.04 PAINTING OF VALVES

- A. Paint valves in vaults, stations and aboveground using ACRO Paint No. 2215 or approved equal, unless otherwise directed.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air release and vacuum relief valves.

1.02 UNIT PRICES

- A. Measurement is on a lump sum basis for each valve installed.
- B. Payment includes air release valve manholes and fittings and appurtenances necessary for complete installation of valve.
- C. 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, were manufactured and tested in the United States, and conform to applicable requirements of this Section.
- B. Alternatively, provide manufacturer's ISO 9002 Certification and certificates stating that air release and vacuum relief valves purchased for Work, were manufactured and tested under strict quality control, and they conform to applicable performance requirements of this Section.

PART 2 PRODUCTS

2.01 GENERAL

- A. Combination air valves called for on Drawings are air valves designed to fulfill the functions of air release valves (discharge air accumulated in line at high points of elevation while line is under pressure), as well as the functions of air/vacuum valves (large volume air discharge at pipe filling and vacuum relief at draining or water column separation). The air release and the air/vacuum components of the combination air valves shall be self-contained in one unit (body).

2.02 MATERIALS

- A. Air Release Valves:
 - 1. 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.
 - 2. ANSI/NSF Standard 61 certified, A.R.I. D-040-C, Combination Air Valves or equal. Materials: body and base – ASTM A48, Class 35B, cast iron; float – Foamed Polypropylene; seal plug, plug cover, clamping stem – nylon; body sleeve - nylon 6; plug screws – SAE 316 stainless steel; rolling seal – E.P.D.M. rubber; O-ring – NBR-70; and base fastening nuts and bolts – ASTM A-307 GR-B Galvanized Steel, Chromate Plated.

3. A.R.I. S-050-C, Air Release Valves or equal. Materials: body – ASTM A48, Class 20B, cast iron; float – Foamed Polypropylene; clamping stem and body sleeve – reinforced nylon; rolling seal – E.P.D.M. rubber; O-ring – Buna-N; and base – ASTM B-124 Brass.
- B. Air Release and Vacuum Valves: 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.
 - a. 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.
 - b. Combination air valves will be ANSI/NSF Standard 61 certified, A.R.I. D-040-C, Combination Air Valves or equal. Materials: body and base – ASTM A48, Class 35B, cast iron; float – Foamed Polypropylene; seal plug, plug cover, clamping stem – nylon; body sleeve – nylon 6; plug screws – SAE 316 stainless steel; rolling seal – E.P.D.M. –61 rubber; O-ring – NBR-70; and base fastening nuts and bolts – ASTM A-307 GR-B Galvanized Steel, Chromate Plated.
 2. For 3-inch and larger duplex body valves as shown on Drawings, provide:
 - a. 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.
 - b. ARI HF (High Flow) Series air valves, or equal. Air and vacuum valve will be ANSI/NSF Standard 61 certified, such as ARI K-060 HF or ARI K-060 HF NS or equal. Materials: body, cover, and strainer protective cover – ASTM A48, Class 35, cast iron; float – SAE 316L stainless steel; orifice seat – SAE 304 stainless steel; orifice seal – E.P.D.M. 60; O-ring – NBR-70; screen – SAE 304 stainless steel; bolts and domed nuts for screen protective covers and cover bolts and nuts – ASTM A-307 GR-B Galvanized Steel, Chromate Plated; disc for NS model – SAE 316 stainless steel. Air release valve: A.R.I. S-050-C, Air Release Valves or equal. Materials: body – ASTM A48, Class 20B, cast iron; float – Foamed Polypropylene; clamping stem and body sleeve – reinforced nylon; rolling seal – E.P.D.M. rubber; O-ring – Buna-N; and base – ASTM B-124 Brass.
- C. Vacuum Relief Valves: 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:
1. 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.
 2. ANSI/NSF Standard 61 certified, A.R.I. D-040-C, Combination Air Valves with one-way, vacuum relief attachment, or equal. Materials: body and base – ASTM A48, Class 35B, cast iron; float – Foamed Polypropylene; seal plug, plug cover, clamping stem – nylon; body sleeve – nylon 6; plug screws – SAE 316 stainless steel; rolling seal – E.P.D.M. rubber; O-ring – NBR-70; and base fastening nuts and bolts – ASTM A-307 GR-B Galvanized Steel, Chromate Plated.
 3. For 3" and higher, ANSI/NSF Standard 61 certified ARI K-060 HF with a one-way, vacuum relief attachment, or equal. Materials: body, cover, and strainer protective cover – ASTM A48, Class 35, cast iron; float – SAE 316L stainless steel; orifice seat – SAE 304 stainless steel; orifice seal – E.P.D.M. 60; O-ring – NBR-70; screen – SAE 304 stainless

steel; bolts and domed nuts for screen protective covers and cover bolts and nuts – ASTM A-307 GR-B Galvanized Steel, Chromate Plated; disc for NS model – SAE 316 stainless steel.

- D. Air Release Valve Vault as detailed in Drawings.

PART 3 EXECUTION

3.01 EARTHWORK

- A. Conform to applicable provisions of Section 02227 – Excavation and Backfill for Utilities.

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 City 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 aboveground vents for valve boxes as indicated on drawings.

3.03 DISINFECTION AND TESTING

- A. Disinfect valves and appurtenances as required by Section 02675 – Disinfection of Waterline and test as required by Section 02676 – Hydrostatic Testing of Pipelines.

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 City Engineer.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure reducing valves (PRV).

1.02 UNIT PRICES

- A. Measurement is on a lump sum basis for each valve installed.
- B. Payment includes valve boxes and necessary fittings and appurtenances necessary for complete installation of valve.
- C. 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 pressure reducing valves purchased for Work, were manufactured and tested in the United States, and conform to applicable requirements of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide Cla-Val Model 90-01, or equal, PRV with strainer in location and arrangement as shown on Drawings. Valve body: ASTM A48, cast iron or ASTM A126, Class B, cast iron with ANSI B16.1, Class 125, flanges. Valve cover: ASTM A48 cast iron. Valve internals: Type-303, stainless steel or B-62 bronze. Rubber parts: Buna-N. No leather parts shall be allowed. Resilient seat shall have rectangular cross section.
- B. Control Tubing: Contain shutoff cocks with "Y" strainer.
- C. PRV: Equip with valve position indicator. Initially set in field by authorized manufacturer's representative with 60-psi downstream pressure.
- D. Provide basket strainer upstream of PRV as shown on Drawings. Strainer body: quick-opening type, fabricated-steel construction with ANSI B16.1, Class 150, flanges. Basket: Type-304, stainless steel. Provide Hayward Model 90, or equal, for PRV 4-inch through 24-inch. Provide Hayward Model 510, or equal, for PRV 14 inches or greater when space limitations dictate the use of smaller strainer housing.
- E. Pilot Systems for PRV: Adjustable and pressure sustaining.
- F. Valve Box: Valve Box conforming to requirements of Section 02604 – Valves Boxes, Meter Boxes and Meter Vaults.

PART 3 E X E C U T I O N

3.01 EARTHWORK

- A. Conform to applicable provisions of Section 02227 – Excavation and Backfill for Utilities.

3.02 SETTING VALVES AND VALVE BOXES

- A. Provide services of technical representative of valve manufacturer available on site during installation of valves and to advise on aspects of installation.
- 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.

3.03 DISINFECTION AND TESTING

- A. Disinfect valves and appurtenances as required by Section 02675 – Disinfection of Waterlines and test as required by Section 02676 – Hydrostatic Testing of Pipelines.

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 City Engineer.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire hydrants.

1.02 UNIT PRICES

- A. Measurement is on a lump sum basis for each fire hydrant assembly installed.
- B. 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 City of Victoria.
 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 PRODUCTS

2.01 HYDRANT MATERIALS

- A. Hydrants: AWWA C502; dry barrel design; tamper resistant; same manufacturer throughout project.
 1. "O" Ring Seal Packing: Prevent water leakage between barrel and lubrication chamber. Provide dynamic seals of Buna "N" or other oil resistant material and static seals of Buna "N" or other approved synthetic rubber.
 2. Bronze: Hydrant components in waterway to contain not more than 15 percent zinc and not more than 8 percent lead.
 3. Acceptable Manufacturer: Mueller Super Centurian 250, Clow Medallion, Kennedy K81A or approved equal.
- B. Operating Stems: Everdur, or other high-quality non-corrodible metal where threads are located in barrel or waterway. Bronze-to-bronze working parts in waterway; genuine wrought iron or steel where threads are not located in barrel or waterway, bronze bushed at penetration of stuffing box; seal threads against contact with water regardless of open or closed position of main valve. Connect operating stems with breakable coupling.
- C. Main Valve (shut-off valve): Circular; compression-type; closes with line pressure; minimum opening of 5-1/4 inches in diameter. Seal bottom end of stem threads from contact with water with cap nut.
- D. Valve Mechanism: Bronze valve seat ring threaded into bronze drain ring; seat ring and main valve assembly removable from above ground through upper barrel with lightweight seat removal wrench; breakable stem coupling opposite barrel breakaway; bronze or corrosion-resistant pins and locking devices; bronze valve stem sleeve, O-ring seals and travel stop; sealed lubricating reservoir at top and bottom which fully lubricates threads and bearing surfaces when opening or closing main valve; thrust bearing or lubricated thrust collar for operating assembly. Lubricants: Food Grade. Valve Seat: Molded "Natural" rubber; scale durometer rating of 90 ± 5 ; minimum thickness of 1/2 inch. Natural Rubbers: Resistant to microbiological attack.

- E. Lower Hydrant Barrel: Single piece coupled to upper barrel to allow 360-degree rotation of upper barrel. Bury Length: Distance from bottom of inlet to ground line as specified. Ground Line: Clearly marked on barrel. Indicate inside diameter and wall thickness (with tolerances) for upper barrel, lower barrel, and bonnet sections. Show dimensions at minimum sections to demonstrate compliance with Paragraph 3.2.6 of AWWA C502.
- F. Extensions: Permit use of one or more standard extensions available from manufacturer in lengths from 6 inches to 60 inches in 6-inch increments.
- G. Provide hydrants with automatic, positively operating, non-corrodible drain or drip valve to drain hydrant completely when main valve is shut. Bronze or corrosion resistant drain line. Tapping of drain holes is not required.
- H. Inlet Connection: Elbow with AWWA Standard bell designed for 6-inch mechanical joint. Joints: ANSI A21.11/ AWWA C111.
- I. Operating Nut and Hold-down Nuts: Stainless steel or cast or ductile iron with bronze inserts or, as an alternative, provide security device with bronze operating nut. Any such security devices shall not require special tools for normal off/on operation of hydrant. Fabricate hold-down assemblies of suitable metallic materials for service intended.
- J. Field-Replaceable Nozzles: NFPA No. 194, ANSI B26-1925; mechanically attached to hydrant body counterclockwise; sealed with "O" rings and mechanically located into place; provide two hose nozzles with 2-1/2 inch nominal inside diameter and one pumper nozzle with 4-1/2 inch nominal inside diameter; National Standard Threads; lock in place with security device.
- K. Pumper Nozzle: Allow a minimum unobstructed radius of 10 inches from threaded surface of nozzle throughout path of travel of wrench or other device used to fasten hose to nozzle.
- L. Nozzle Caps: Security chains to hydrant barrel, minimum 1/8-inch diameter; "Natural" rubber or neoprene gasket seals.
- M. Hydrant shoe with 6-inch cast or ductile iron pipe diameter inlet, swivel with harnessing lugs for restrained joints. Underground flanging shall incorporate minimum of six full 3/4-inch diameter electro-galvanized or cadmium coated steel bolts or four 5/8-inch diameter stainless or cadmium coated steel bolts.
- N. 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.
- O. Lubricate hydrants with food grade oil or with grease meeting requirements of FDA 21 CFR 178.3570 and manufactured with FDA approved oxidation inhibitors.
- P. Accomplish replenishment of lubricant for hydrant working parts without removing hydrant bonnet. Store lubricant system in reservoir. Lubricate bearing surfaces and working parts during normal operation of fire hydrant.
- Q. 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/alkyd/silicone alkyd system with a total dry film thickness (DFT) of 6 - 9 mils as follows:
 - i. Prime Coat: Oil Modified Alkyd Primer, Sherwin Williams, Steel Primer, or approved equal; SSPC Paint Specification No. 25. Total dry film thickness (DFT): 2 - 3 mils.

- ii. Intermediate Coat: Heavy Duty Industrial Alkyd Enamel, Sherwin Williams brand or equivalent; SSPC Paint Specification No. 104; Federal Standard FF-E-489. Total dry film thickness (DFT): 2 - 3 mils.
 - iii. Finish Coat: Sherwin Williams KEM 400 Enamel or approved equal; SSPC Paint Specification No. CC-B26. Total dry film thickness (DFT): 2 - 3 mils. Exception: hydrant bonnet may be finish shop coated - only intermediate coated. Finish coating may be field applied and color-coded when installed.
 - iv. Colors: Primer: Manufacturers standard color. Finish coat of hydrant body: Silver (Sherwin Williams KEM 400 Enamel Silver Metallic or equivalent). Bonnet and base connection caps: Finish coated with Sherwin Williams Safety Green or equivalent;
- 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:
 - i. Primer and Intermediate Coat: Cal tar epoxy, Sherwin Williams Product, or approved equal; 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.
 - ii. Finish Coat: Water based vinyl acrylic mastic, Sherwin Williams Product, or approved equal. Apply one (1) coat with a dry film thickness (DFT) of 6 - 8 mils. Finish coat color: Same as finish coat for exterior above traffic flange, i.e. Silver Metallic (Sherwin Williams KEM 400 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 as suitable for contact with potable water as required by Chapter 290, Rules and Regulations for Public Water Systems, Texas Natural Resource Conservation Commission (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 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 1500 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 1500 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.
 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 degrees F $\pm$ 5 degrees 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 and Section 02620 - PVC Pipe.

PART 3 EXECUTION

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. Locate nozzle centerline minimum 18 inches above finish grade.
- C. Place black plastic wrapping entirely around fire hydrant on installed or new mains not in service. Remove indicators after new main is tested and approved by City Engineer.
- D. Do not cover drain ports when placing concrete thrust block.
- E. 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 City 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.
- F. City Engineer 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 The City of Victoria's expense, to verify compliance with The City of Victoria'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 The City of Victoria's requirements.
- G. Install branches (leads) in accordance with Section 02664 - Water Mains.

END OF SECTION

PART 1 G E N E R A L**1.01 SECTION INCLUDES**

- A. Installation of water mains by horizontal directional drilling (HDD).
- B. The contractor may install waterline by open cut in areas designated for HDD, if approved in advance by the Engineer or stated on the plans.

1.02 UNIT PRICES

- A. Measurement for water mains a linear foot basis for each size of pipe installed.
 - 1. Mains: Measure along axis of pipe and include fittings and valves.
 - 2. Branch Pipe: Measure from axis of main to end of branch.
- B. Approved open-cut construction shall be paid for at the Contract Unit Price for Horizontal Directional Drilling. Payment includes necessary surface restoration and pavement repair.
- C. Refer to Section 0125 – 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. Prior to commencement of work, furnish for the Engineer's approval a bore plan, showing finished grade, deflection and radii of pilot bore, all existing utilities with minimum vertical and horizontal clearances. The plan shall also address the location of the drill rig setups and for multiple bores, the lengths of each bore based on the soil conditions, equipment used, topography, etc. The proposed clearances between the bored pipe and any existing/proposed conflicting pipes, conduits or obstructions shall exceed the guidance system accuracy tolerance by a minimum of 100%. Approval of this plan will not relieve the Contractor from responsibility to obtain specified results.
- D. Submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment list shall include but not be limited to: drilling rig, mud system, mud motors (if applicable), downhole tools, guidance system, and 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 shall also be submitted.

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 02620 – Polyvinyl Chloride (PVC) Pipe

2. Products delivered under this specification shall be manufactured only for water distribution pipe and couplings conforming to AWWA C900. Restrained joint pipe shall also meet all performance requirements AWWA C900.
3. Restrained joint PVC pipe products used in directional drilling applications shall have been tested and approved by an independent third-party laboratory for continuous use at rated pressures. Copies of Agency approvals or product listings shall be provided to the Engineer. Products intended for contact with potable water shall be evaluated, tested and certified for conformance with NSF Standard 61 by an acceptable certifying organization, when required by the regulatory authority having jurisdiction.
4. PVC pipe and couplings shall be made from unplasticized PVC compounds having minimum cell classification of 12454-B, as defined in ASTM D1784. All compounds shall qualify for a Hydrostatic Design Basis (HDB) rating of 4000 psi for water at 73.4°F, in accordance with the requirements of ASTM D2837. Blue pipe shall be supplied for the potable water system.
5. Nominal outside diameters and wall thickness of thrust-restrained pipe shall conform to the requirements of AWWA C900. Restrained pipe shall be furnished in sizes 4": (Class 200, DR-18) and 6", 8" and 12" (Class 150, DR-18) in right-of-way. Restrained pipe installed under roadway pavement in sizes 6", 8" and 12" shall be Class 200, DR-18. Pipe shall be furnished in standard laying lengths of 20 ft. + 1 in. All restrained couplings (4", 6", 8" and 12") shall be furnished in DR 18.
6. Restrained Joint Couplings.
 - a. Pipe shall be joined using nonmetallic restrained type couplings. Pipe and couplings shall be designed as an integral system and shall be provided by a single manufacturer for maximum reliability and interchangeability. Pipe and couplings shall be joined using high-strength flexible plastic splines inserted into mating precision-machined grooves, which align when the pipe is fully inserted providing a full 360° restraint with evenly distributed loading. No external pipe-to-pipe restraining devices that clamp onto or otherwise damage the pipe surface as a result of point-loading shall be permitted.
 - b. Couplings shall be designed as minimum for use at the rated pressures of the pipe with which they are utilized and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Assembled joints shall meet the leakage test requirements of ASTM D3139.
 - c. Allowable axial jacking loads shall be supplied by the manufacturer. The Engineer and Contractor shall utilize appropriate instrumentation to insure that these loads are never exceeded. Only experienced personnel shall be used to install pipe. Coupling edges shall bevel to reduce drag force when pipe is installed by micro tunneling. Assembly of joints shall be accordance with the manufacturer's instructions.
 - d. Acceptable Manufacturers
 1. CertainTeed Certa-Lok C-900/RJ PVC Pipe.
 2. Approved Equal
7. Restrained Joints
 - a. Restrained joints that may be used at valves, tees, bends, and other fittings for Certa-Lok C-900/RJ pipe.

- b. Manufacturer: CertainTeed
- c. Materials
 - 1. Spline: High strength Polyamide Thermoplastic.
 - 2. Gaskets: Vulcanized SBR in accordance with AWWA C111/A21.11.
 - 3. Tee Bolts: Shall meet requirements as described in AWWA C111/A21.11.
- B. HDPE Pipe
 - 1. Refer to Section 02619 – High Density Polyethylene (HDPE) Solid Wall Pipe, for additional requirements pertaining to HDPE pipe.

PART 3 EXECUTION

3.01 GENERAL

- A. Conform to applicable specification sections for types of pipe used.
- B. Employ workmen who are skilled and experienced in installing pipe by HDD of type and joint configuration being installed. Provide watertight pipe and pipe joints.
- C. PVC pipe installed by directional drilling methods shall meet all the requirements of AWWA C-900, with a minimum dimension ratio of DR-18. The diameter of the carrier pipe shall be as shown on the drawings. Pipe shall be Polyvinyl Chloride (PVC) pipe. Pipe joints shall be Certa-Lok as manufactured by CertainTeed, or an approved equal.
- D. Install pipe to lines and grades shown on Drawings. Use adequate methods and equipment and employ personnel competent in use of this equipment to measure and record “as-built” horizontal alignment and vertical grade at maximum of every 10 feet on-site record Drawings. Readings shall be recorded after advancement of each successive drill pipe. Access to all recorded readings and plan and profile information shall be made available to the Engineer, or his representative and the Owner at all times. At no time shall the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe as specified herein.
- E. 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.
- F. Where above clearance cannot be attained and a special design has not been provided on Drawings, obtain direction from Engineer before proceeding with construction.
- G. The City, at no cost to the Contractor, will perform all operations involving opening and closing of valves on the City’s existing water mains.

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 damaged of any kind thereto. Handle and transport pipe with equipment designed, constructed and arranged to prevent damaged 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. Pipe rollers shall be used for assembly during final product pull back.
 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 the Engineer, at no additional cost to Owner.
 6. Permit no visible cracks longer than 6 inches, measured within 15 degrees of a line parallel to pipe longitudinal axis in the cores of finished pipe with the following exceptions:
 - a. In the surface laitance of centrifugally cast concrete.
 - b. In sections of pipe with steel reinforcing collars or wrappers.
 - c. Within 12 inches of pipe ends.
 7. Reject pipe with visible cracks (not meeting exceptions above) 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 DIRECTIONAL DRILLING

- A. The Contractor shall provide all material, equipment and facilities required for directional drilling. Proper alignment and elevation of the borehole shall be consistently maintained throughout the directional drilling operation. The method used to complete the directional drill shall conform to the requirements of all applicable permits. The Engineer will supply copies of all permits to the Contractor.
- B. The entire drill path shall be accurately surveyed by the Contractor with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If Contractor is

using a magnetic guidance system, drill path shall be surveyed for any surface geo-magnetic variations or anomalies.

- C. Contractor shall place silt fence between all drilling operations and any drainage, well-fields, wetland, waterway or other area designated for such protection if required by 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. A complete list of all drilling fluid additives and mixtures to be used in the directional operation will be submitted to the Engineer, along with their respective Material Safety Data Sheets. All drilling fluids and loose cuttings shall be contained in pits or holding tanks for recycling or disposal, no fluids shall be allowed to enter any unapproved areas or natural waterways. Upon completion of the directional drill project, the drilling mud and cuttings shall be disposed of by the Contractor at an approved dumpsite.
- E. The pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over the length of the bore unless previously agreed to by the Engineer. In the event that pilot does deviate from the bore path more than 5% of depth over the length of the bore, Contractor will notify Engineer may require Contractor to pull-back and re-drill from the location along bore path before deviation. In the event of a drilling fluid fracture, inadvertent returns, or returns loss 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 March funnel and wait another 30 minutes. If mud fracture or returns loss continues, Contractor will discuss additional options with the Engineer and work will then proceed as agreed.
- F. Upon completion of pilot hole phase of the operation, a complete set of "as-built" records shall be submitted in duplicate to the Engineer. These records shall include copies of the pilot bore path plan and profile record drawing, as well as directional survey reports as recorded during the drilling operations.
- G. Upon approval of the pilot hole location by the Engineer, the hole opening or enlarging phase of the installation shall begin. The bore hole diameter shall be increased to accommodate the pullback operation of the required size of carrier pipe. The type of hole opener or back reamer to be utilized in this phase shall be determined by the types of subsurface soil conditions that have been encountered during the pilot hole drilling operation. The Contractor shall select the proper reamer type with the final hole opening being a maximum of 1.5 times the largest outside diameter pipe system component to be installed in the bore hole.
- H. The open bore hole shall be stabilized by means of bentonite drilling slurry pumped through the inside diameter of the drill rod and through openings in the reamer. The drilling slurry must be in a homogenous/flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the borehole. The volume of bentonite mud required for each pullback shall be calculated based on soil conditions, largest diameter of the pipe system component, capacity of the bentonite mud pump and the speed of pullback as recommended by the bentonite drilling fluid manufacturer. The bentonite slurry is to be contained at the exit or entry side of the directional bore in pits or holding tanks. The slurry may be recycled at this time for reuse in the hole opening operation or shall be hauled by the Contractor to an approved dumpsite for proper disposal.
- I. The pipe section shall be joined together according to manufacturer's specifications. The gaskets and the ends of pipe must be inspected and cleaned with a wet cloth prior to each

joint assembly so they are free of any dirt or sand. The pipe must be free of any ships, scratches or scrapes. A pulling eye will be attached to the Certa-Lok C900/RJ pulling head on the lead stick of pipe which in turn will be attached to a swivel on the end of the drill pipe. Tracer wire (#8) solid coated copper wire shall be attached to the pulling eye and the crown of PVC pipe with duct tape @ 24" O.C. and a minimum of two full wraps around the pipe. This will allow for a straight, smooth pull of the product pipe as it enters and passes through the borehole toward the drill rig and original entrance hole of the directional bore. The product pipe shall be elevated to the approximate angle of entry and supported by means of a sideboom with roller arm or similar equipment to allow for the "free stress" situation as the pipe is pulled into the exit hole toward the drill rig. The product pullback phase of the directional operation shall be carried out in a continuous manner until the pipe reached the original entry side of the bore.

3.04 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 section not exceeding 2000 feet per crew, chlorinate and pressure test. 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.

3.05 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.

3.06 DISINFECTION OF WATERLINES

- A. Conform to requirements of Section 02675 – Disinfection of Waterlines.

3.07 FIELD HYDROSTATIC TESTS

- A. Conform to requirements of Section 02676 – Hydrostatic Testing of Pipelines.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Installation of water mains.

1.02 UNIT PRICES

- A. Measurement for water mains open cut or augered with or without casing is on a linear foot basis for each size of pipe installed.
 - 1. Mains: Measure along axis of pipe and include fittings and valves.
 - 2. Branch Pipe: Measure from axis of main to end of branch.
- 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. Conform to submittal requirements of applicable specification section for type of pipe used.
- C. Submit preconstruction and post construction photographs if required by Section 01010 – Summary of Work.

PART 2 PRODUCTS**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 02620 - Polyvinyl Chloride (PVC) Pipe.
- B. Type of pipe materials used is identified on Drawings.

PART 3 EXECUTION**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. Measure and record "as-built" horizontal alignment and vertical grade at maximum of every 100 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 and City Engineer before proceeding with construction.

- F. If any un-metered sprinkler or fire line connections exist, which are not shown on Drawings, the Contractor shall notify the Engineer and City Engineer. The Contractor shall make the connection only after approval by City 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 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. The City of Victoria will coordinate with the Contractor the isolation and closing of existing valves on the City's existing water mains. The Contractor shall notify the Utilities Department 48 hours prior to the proposed closing of the valves and shall notify all property owners that there will be a water outage. If the expected water outage is more extensive than a few blocks or it involves a large diameter main the Contractor shall be required to do a test closure of the valves to accurately determine the overall outage area and how the outage will effect the City's water system.

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 City Engineer at no additional cost to Owner.
 - 6. Permit no visible cracks longer than 6 inches, measured within 15 degrees of a line parallel to pipe longitudinal axis in the cores of finished pipe with the following exceptions:
 - a. In the surface laitance of centrifugally cast concrete.
 - b. In sections of pipe with steel reinforcing collars or wrappers.
 - c. Within 12 inches of pipe ends.
 - 7. Reject pipe with visible cracks (not meeting exceptions above) 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 Backfilling for Utilities and Section 02317 - Augering Pipe for Water Lines.
- B. Bedding: Use bedding materials in conformance with Section 02229 - Utility Backfill Materials and detail 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 detail in Drawings.
- 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 or City Engineer's discretion.

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 City 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. 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. Do not install pipe at greater depth than its design allows.
- C. 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.

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 12" diameter or greater pipe due to thrust is necessary, provide the following restrained joints, or equal:
 - a. Ductile-Iron Pipe:
 - i. Super-Lock Joint by Clow Corporation.
 - ii. Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.
 - iii. TR-Flex or Field-Lok Joint by U.S. Pipe and Foundry Company.
 - b. PVC Pipe:
 - i. Fittings: Series 200 by Ebba Industries, Inc., Series 1500 by Ford Industries or approved equal.

- ii. Bell and Spigot: JCM 620 or 621 Sur-Grip Bell Joint Restrainer by JCM Industries, Inc. or Series 1500 or Series 1100HV Joint Restrainer by Ebba Iron, Inc., Series 1300 by Ford Industries or approved equal.

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 neoprene 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. Draw bolts tight to ensure proper seating of gaskets.

C. Make curves and bends by deflecting joints or other method as approved by manufacturer, Engineer and City Engineer.

1. Deflection of pipe joints shall not exceed 1/2 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 Engineer or City Engineer 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 City 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.

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. 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. Water line thrust restraint shall be accomplished using a combination of concrete thrust collars, concrete thrust blocks and restrained joint pipes and fittings in accordance with the general notes and details shown on the plans.
- B. Concrete thrust blocks and collars will only be allowed where specifically called for on the plans.

3.09 POLYETHYLENE WRAP

- A. Wrap all ductile iron pipe and ductile iron fittings with 8-mil polyethylene film.

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 section not exceeding 2000 feet per crew, chlorinate and pressure test. 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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tapping existing mains and furnishing and installing new service lines for water.

1.02 UNIT PRICES

- A. Measurement for water taps and copper service lines is on a lump sum basis for each installation. Separate measurements will be made for "Short Side" and "Long Side" connections of various sizes as defined in Part 1.03 below.
- B. Payment for "Short Side" and "Long Side" includes locating water main, tap installation and connection to meter and restoring site.
- C. No additional payment will be made for bedding, backfill, compaction, push-unders, etc.
- D. 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 main on same side of street.
- B. Long Side Connection: Service line connecting proposed curb stop, located inside water meter box, to water main on opposite side of street or from center of streets where supply main is located in street center such as boulevards and streets with esplanades.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Copper Tubing: In accordance with Section 02612.
- B. HDPE Tubing (C.T.S.): In accordance with Section 02619.
- C. Corporation Stops: AWWA C800 as modified herein:
 - 1. Inlet End: AWWA standard iron pipe thread inlet/pack joint outlet.
 - 2. Valve Body: Tapered plug type, O-ring seat ball type, or rubber seat ball type.
 - 3. Outlet End: Compression type fitting for use with type-K, soft copper.
- D. Taps for Steel Pipe: Not allowed, unless specifically approved by City Engineer. Use saddle only if tap is approved on steel pipe.
- E. Provide taps for various water main types and sizes with a Double Strap Stainless Steel Epoxy Coated Saddle, Smith Blair 317, Ford FC 202 or approved equal.
- F. Curb Stops and Brass Fittings: AWWA C800 as modified herein.
 - 1. Inlet End: Compression-type fitting.
 - 2. Valve Body: Straight-through or angled, meter-stop design equipped with the following:
 - a. O-Ring seal straight plug type.
 - b. Rubber seat ball type.
 - 3. Outlet End: Female, iron-pipe thread or swivel-nut, meter-spud thread on 3/4-inch and 1-inch stops and 2-hole flange on 1-1/2 and 2-inch sizes.
 - 4. Fittings: Ford or approved equal; use same size open-end wrenches and tapping machines as used with respective Ford fittings.

5. Factory Testing of Brass Fittings:
 - a. Submerge in water for 10 seconds at 85 psi with stop in both closed and open positions.
 - b. Reject any fitting that shows air leakage. Engineer or City Engineer may confirm tests locally. Entire lot from which samples were taken will be rejected when random sampling discloses unsatisfactory fittings.
- G. Angle Stops: In accordance with AWWA C800; angle or straight ball valve, stop type with bronze lock-wing head stop cap; inlet and outlet threads conform to application tables of AWWA C800; and inlets compression connection.
 1. Outlet for 3/4-inch and 1-inch size: Meter swivel nut with saddle support.
 2. Outlet for 1-1/2-inch through 2-inch size: O-ring sealed meter flange, iron pipe threads.
- H. Fittings: In accordance with AWWA C800 and:
 1. Castings: Smooth, free from burrs, scales, blisters, sand holes, and defects which would make them unfit for intended use.
 2. Nuts: Smooth cast and have symmetrical hexagonal wrench flats.
 3. Thread fittings, of all types, shall have N.P.T. or AWWA threads, and male threaded ends shall be protected in shipment by plastic coating or other equally satisfactory means.
 4. Compression tube fittings shall have Buna-N beveled gasket.
 5. Stamp of manufacturer's name or trademark and size on body.
- I. Provide stainless steel inserts for HDPE tubing and PEX Tubing
- J. PEX Tubing (C.T.S.: In accordance with Section 02624 – Pex Tubing.

PART 3 EXECUTION

3.01 GENERAL

- A. Set service taps at right angles to proposed meter location and locate taps in upper pipe segment within 45 degrees of pipe springline unless otherwise approved by City Engineer.
- B. For service lines and lateral connections larger than those allowed in Part 2.01C, branch connections and multiple taps may be used. Corporation stops: spaced minimum 2 feet apart.
- C. Tapped collars of appropriate sizes: Approved in new construction only provided they are set at right angles to proposed meter location.
- D. All 2-inch and smaller service taps on pressurized water mains: Use tapping machine manufactured for pressure tapping purposes.
- E. Install service lines in open-cut trench in accordance with Section 02227 – Excavation and Backfill for Utilities except that service lines under all paved roadways, if so indicated on Drawings, shall be installed in bored hole in accordance with paragraph 3.01G.
- F. Unless otherwise approved by City Engineer, lay service lines with minimum of 36 inches of cover as measured from top of curb or, in absence of curbs, from centerline elevation of crowned streets or roads. Provide minimum of 18 inches of cover below flow line of all ditches to service lines, unless otherwise approved by City Engineer.
- G. Service lines across existing street (push-unders): Pull service line through prepared hole under paving. Only full lengths of tubing will be used. Take care not to damage copper tubing when pulling it through hole. A compression-type union is only permitted if Contractor

cannot span underneath pavement with a full length of tubing. Contractor is allowed one compression-type union for each full length of tubing, provided it is not under the pavement.

- H. Maintain service lines free of dirt and foreign matter at all times.
- I. Install service lines so that top of meter will be 4 to 6 inches below finished grade and located within meter box cut outs.
- J. Locate water meters between the sidewalk and the curb, if applicable. Otherwise locate meters as directed by the Engineer and City Engineer. Contact Engineer and City Engineer when major landscaping or trees conflict with service line and meter box location. No additional payment will be made for work on customer side of meter.

3.02 CURB STOP INSTALLATION

- A. Set curb stops or angle stops at outer end of service line inside of meter box. Secure opening in curb stop to prevent unwanted material from entering. In close quarters, make an "S" curve in the field. No flattening of tube. In all 3/4-inch and 1-inch services, install meter coupling, swivel-nut, or curb stop ahead of meter. Install straight meter coupling on outlet end of meter.

3.03 SEQUENCE OF OPERATIONS

- A. Open trench for proposed service line in accordance with Section 02227 – Excavation and Backfill for Utilities.
- B. Install curb stop on meter end of service line.
- C. With curb stop open and prior to connecting service line to meter in slack position, open corporation stop and flush service line thoroughly. Close curb stop, leaving corporation stop in full-open position.
- D. Check service line for apparent leaks. Repair any leaks before proceeding.
- E. Call to schedule inspection prior to backfilling. After inspection, backfill in accordance with Section 02227 – Excavation and Backfill for Utilities.
- F. Install meter box centered over meter with top of lid flush with finished grade. Meter box: Refer to Section 02604 – Valve Boxes, Meter Boxes and Meter Vaults.

END OF SECTION

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. Measurement for wet connections shown on drawings is on lump sum basis for each connection. Separate payment will be made for each size of water main.
- B. No extra compensation for damages or extra work resulting from an incomplete shutoff.
- C. 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.

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 – Ductile Iron Pipe and Fittings through 02630 – Polyethylene Wrap.
- B. Corporation stops and saddles shall conform to requirements of Section 02665 – Water Tap and Service Line Installation.
- C. Valves shall conform to requirements of Section 02640 – Gate Valves.
- 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 and City Engineer at least 48 hours in advance of making connections.
- B. Do not operate valves on mains in use by City of Victoria. City of Victoria 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.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Cut, plug and abandonment of water mains.

1.02 UNIT PRICES

- A. Measurement for cut, plug and abandonment of mains is on lump sum basis for each main. Separate payment will be made for each size of water main.
- 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 product data for proposed plugs and clamps for approval.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Concrete for reaction blocks: Class B conforming to requirements of Section 03305 – Concrete for Utility Construction and Minor Paving.
- B. Plugs and clamps shall be suitable for type of pipe to be plugged.

PART 3 EXECUTION**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 and City Engineer immediately. Cut and plug abandoned main at point of other feed as directed by Engineer and City Engineer.
- E. Plug or cap all ends or openings in abandoned main in an acceptable manner approved by Engineer and City Engineer.
- F. Remove and dispose of all surface identifications such as valve boxes and fire hydrants.
- G. Backfill all excavations in accordance with Section 02227 – Excavation and Backfill for Utilities.
- H. Repair all street surfaces in accordance with Section 02570 – Pavement Repair and Resurfacing.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Disinfection of potable waterlines.

1.02 UNIT PRICES

- A. No payment will be made for disinfection of waterlines. Include cost in unit price of waterlines being disinfected.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 GENERAL

- A. All waterlines constructed shall be promptly disinfected before any tests are conducted on waterlines and before waterlines 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 waterlines up to and including 6-inch diameter.
- B. Fire hydrants shall be used as blow-offs to flush newly constructed waterlines 6-inch diameter and above. Where fire hydrants are not available on waterlines, locations and designs for blow-offs shall be as indicated on Drawings. Install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.
- C. Slowly fill each section of pipe with water in a manner approved by City 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 waterlines 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 City Engineer.

3.04 BACTERIOLOGICAL TESTING

SECTION 02675

CITY OF VICTORIA
STANDARD SPECIFICATIONS

DISINFECTION OF WATERLINES

- A. After disinfecting and flushing waterlines, bacteriological tests will be performed as directed by the City Engineer in accordance with Section 01410 - Testing Laboratory Services. If test results indicate need for additional disinfection of waterlines based upon Texas Department of Health requirements, Contractor shall perform additional disinfection operations at no additional cost to the Owner.

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

PART 1 GENERAL

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 PRODUCTS - Not Used.

PART 3 EXECUTION

3.01 GENERAL

- A. Hydrostatically test all new water pipelines for liquids 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 City Engineer.
- C. Conduct hydrostatic tests in presence of City Engineer in accordance with requirements of this Section.

3.02 PREPARATION

- A. Disinfect water system pipelines prior to hydrostatic testing.

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 City 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 for water mains with rubber gasketed joints: 11.65 gallons per inch nominal diameter per mile of pipe per 24 hours while testing at the required pressure.

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 or City 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 Waterlines.
- 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.

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section covers all valves, except where specific requirements are given in other sections.

1.02 SUBMITTALS

- A. Complete specifications, data and detailed drawings covering the items furnished under this specification shall be submitted for approval in accordance with Section 01300 – Submittals. Catalog cuts, showing sufficient detail as determined by the Engineer, will be acceptable in lieu of detailed drawings for valves smaller than 4 inch in size and for other miscellaneous small items for which detailed drawings are not readily available.
- B. Drawings and data submitted shall include complete connection and schematic wiring diagrams for all electric motor operators, equipment, devices and controls.

1.03 GENERAL REQUIREMENTS

- A. Pipe and valve purchase orders shall be coordinated to insure proper installation of the valves and piping in conformance with the specified requirements.
- B. All valves, except those which are equipped with power actuated operators or are designed for automatic operation shall be provided with manual operators.
 - 1. All valves which are located 6'-0" or more above the floor and are not required to be equipped with other types of operators shall be provided with suitable chainwheels and operating chains. Each chainwheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Operating chains shall be heavily plated with zinc and cadmium and shall be looped to extend to within 4 feet of the floor below the valve.
 - 2. Wrench nuts shall be provided on all buried valves, on all valves which are to be operated through floor boxes and where shown on the plans. All wrench nuts shall comply with Section 3.16 of AWWA C500. Not less than two operating keys shall be furnished for operation of the wrench nut operated valves.
 - 3. All buried valves shall be equipped with extension stems, valve boxes and covers. Extension stems shall extend to within 12 inches of the ground surface and be fabricated of solid, cold rolled steel not smaller in diameter than the stem of the valve to which it is connected.

Extension stems shall be secured to the valve or operator shaft by means of a universal type joint or collar, keyed or pinned type connection (pipe couplings shall not be acceptable). Each extension stem shall be provided with spacers which will center the stem in a valve box having an inside diameter of 5 1/4-inches and shall be equipped with a standard AWWA wrench nut as described in Section 20 of AWWA C500.
- C. The direction of rotation of the wheel, wrench nut, or lever to open each valve shall be to the left (counter clockwise). Each valve body or operator shall have cast thereon the word OPEN and an arrow indicating the direction to open.
- D. Actual length of valves shall be within 1/16 inch (plus or minus) of the specified or theoretical length.

PART 2 PRODUCTS

2.01 GATE VALVES, 3 INCHES AND LARGER

- A. The CONTRACTOR has the option of furnishing double disc gate valves per AWWA C500 or resilient seat gate valves per AWWA C509.
- B. If double disc gate valves are furnished, the following additional features shall be furnished:
 - 1. Solid wedges shall be furnished on gate valves 6 inches and smaller in vertical lines.
 - 2. Square bottom gate valves shall be furnished in 8 inches and larger valves in vertical lines. Square bottom valves shall be of such design that full gate support is provided and rubbing contact between the discs and gate seat is prevented, at all positions of the gate except where the gate wedges are in contact when seating the discs.
 - 3. Valves 16 inches and larger shall be equipped with a bypass. Bypass valves shall conform to AWWA C500.
 - 4. Valve 16 inches and larger installed in the horizontal position shall be equipped with rollers, tracks and scrappers.
- C. Gate valves installed in structures or above grade shall be of the rising stem, outside screw and yoke type.
- D. Gate valves for buried service shall be of the non-rising stem type.
- E. Gate valves 16 inches and larger shall be furnished with spur or beveled gears enclosed in a seal grease case. The torque required to operate the valves shall comply with AWWA C500 or C509 as applicable.
- F. Valves with rising stems (OS&Y) shall have stem seals of the stuffing box design.
- G. Valves with non-rising stems (NRS) shall have stem seals of the double o-ring or three Chevron ring design.
- H. Gate valve end connections shall be mechanical joint or flanged as shown on the Plans. Flanges shall conform to the dimensions and drillings per ANSI B16.1 Class 125.
- I. All gate valves 16" and smaller shall be rated for a working pressure of 25 psi. All gate valves 18" and larger shall be rated for 150 psi and hydrostatic pressure tested at the factory to 300 psig. A certificate of compliance for the above shall be furnished by the manufacturer for each valve. All gate valves will be pressure tested in the field along with the associated piping to 200 psig.
- J. All gate valves shall be leak tested at the factory per AWWA C-500 or AWWA c-509 as applicable, and a certificate of compliance furnished by the manufacturer for each valve.
- K. The interior of all gate valves and the exterior of buried gate valve shall be coated per AWWA C-500 or AWWA C-509 as applicable. The exterior of non-buried gate valves shall be cleaned and primed at the factory. The primer shall be compatible with field applied finish coat specified in Section 09902 – Mechanical Painting.

2.02 GATE VALVES, SMALLER THAN 3 INCH

- A. Gate valves smaller than 3 inch in size shall be 125 pound brass body, rising stem, solid wedge valves capable of being repacked under pressure when the valve is fully open. Threaded end gate valves shall be Crane 428UB, Grinnel 3030 or equal.

2.03 GLOBE AND ANGLE VALVES

- A. Water service, two (2) inches and smaller shall meet the following requirements:
 - 1. Valve shall be 125 lb. bronze globe valve designed for 200 psi nonshock cold water service.
 - 2. Comply with Federal Specification: WW-Y-51d Class A, Type 1 for straight globe valves, or Type II for angle globe valves, or Type II for angle globe valves.
 - 3. Valve shall have screwed bonnet, integral seat, threaded end and renewable Teflon disc seats.
 - 4. Straight globe valve shall be Crane Figure 1240, ITT Grinnell Figure 3210 or equal. Angle globe valve shall be Crane Figure 2, ITT Grinnell Figure 3220 or equal.

2.04 AIR RELEASE VALVE

- A. Air release valves shall be of the combination air and vacuum release design.
- B. Valve body shall be cast iron and of the single body, double orifice design and have 1" NPT inlet and outlet.
- C. The large orifice shall be 1" in diameter and the small 5/64", and the entire valve shall be rated for a working pressure of 300 psig.
- D. The combination air release valve shall be APCO Model 143C or approved equal by Golden Anderson or Val-Matic.

2.05 BALL VALVES

- A. Ball valves, 2 ½" and smaller
 - 1. Ball valves shall be of bronze and stainless steel construction and comply with 400 WOG pressure rating.
 - 2. Ball valves shall be of two piece construction with a chrome plated stainless steel ball and NPT end connections.
 - 3. The ball valves shall be model B-6000 as manufactured by Watts or approved equal by Jamesbury, Nibco or Stockham.

2.06 SWING CHECK VALVES

- A. Swing Check Valves, 2 ½" and smaller:
 - 1. Swing check valves shall be of bronze and stainless steel construction having NPT end connections.
 - 2. The disc shall be constructed of bronze and the seat re-grindable.

3. The check valves shall be Class 300 and be a Model B5030 as manufactured by Watts or approved equal by Crane, Grinnel or NIBCO.

2.07 PUMP CONTROL VALVE

- A. The valve body and lid shall be constructed of ductile iron per ASTM A536.
- B. The valve shall be rated for a working pressure of 250 psig and be equipped flanges complying with AWWA C110.
- C. The interior metallic parts shall be constructed of bronze per ASTM B61 or B62 or 1808 stainless steel.
- D. All ductile iron surfaces (interior and exterior) shall be coated with factory applied fusion bonded epoxy that is approved per NSF Standard 61.
- E. All interior surfaces shall have easily renewable resilient seats and replaceable seals.
- F. External pilots, strainer, solenoid valves and interconnecting piping shall be bronze stainless steel or copper.
- G. The valve shall be equipped with open and closed position limit switches. The limit switch housings, actuating arms, rollers and support brackets shall be corrosion resistant.
- H. The solenoid valves shall operate on 120/60/1 electrical power and all the electrical enclosures shall comply with NEMA 4X.
- I. The pump control valve shall be equipped with a dual chamber and have hydraulic check capabilities.
- J. The pump control valve shall be equipped with the accessories that will allow the valve to operate as follows:
 1. Open at a controlled rate on pump start-up (adjustable). The anticipated opening time is 5 minutes.
 2. Closes on a controlled rate upon deactivation (pump stops when valve reaches closed position). The anticipated closing time is 5 minutes, but shall be independently adjustable from the opening time.
 3. In the event of a power failure, the valve shall automatically close.
 4. In event of flow reversal, the pump control valve shall automatically close.
- K. The valve shall have a minimum C_v of 770 gpm.
- L. The pump control valve shall be a Model 60-31 as manufactured by Cla-Val or approved equal by Ames, Watts or Golden Anderson.

PART 3 EXECUTION

3.01 SETTING OUTSIDE VALVES

- A. Buried gate valve may be set vertical providing that depth is sufficient such that there is adequate cover over the valve to allow a valve box, then be installed flush with the final

grade. In the event that the above is not possible, the valve shall be placed in the horizontal position. The valve shall be equipped for horizontal installation as described in the preceding specifications.

- B. Buried valves shall be supported with concrete foundation as shown on the Plans.
- C. Each valve which is installed in direct contact with earth backfill shall be provided with a valve box of such type and design that surface loads, impact or shock will not be transmitted through the box to the valve.
- D. Valves and valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After being placed in proper position, earth shall be filled in around each valve box and thoroughly tamped for a distance on each side of the box of 4 feet at the top of the pipe and 2 feet measured at the top of the trench.
- E. Each valve shall be inspected before installation to insure that all foreign substances have been removed from within the valve body, and shall be opened and closed to see that all parts are in first-class working condition. Geared valves shall be inspected to see that the gears are properly lubricated.

3.02 SETTING INTERIOR VALVES

- A. Valves shall be supported as shown on the Plans.
- B. Valve shall be positioned for easy access to the operating wheel or lever. Preferably valves are to be mounted with the valve stem vertical with the lever or wheel on top; however, other positions will be considered if it provides better access and safer conditions for personnel operating the valves.
- C. Drains from valves (such as pump control valves) shall be piped to the nearest floor drains.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Storm sewers and appurtenances.

1.02 UNIT PRICES

- A. Measurement for storm sewers is on a linear foot basis for each type and size of pipe installed. Measurement will be taken along the centerline of the pipe from inside faces of manholes, junction boxes, and inlets or from end to end of culverts. Storm sewers shall not be measured through manholes, junction boxes or inlets.
- B. No separate payment will be made for earthwork, connections to existing manholes and pipe, accessories, equipment and execution required or incidental to storm sewer work. Include payment in unit price for pipe.
- C. 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.

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 PRODUCTS**2.01 PIPE**

- A. Piping materials for storm sewers shall be of the sizes and types indicated on the Drawings.

2.02 PIPE MATERIAL SCHEDULE

- A. Reinforced Concrete Pipe: Conform to requirement of Section 02615 - Reinforced Concrete Pipe.

2.03 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

- A. Bedding and Backfill Material: Conform to requirements of Sections 02227 - Excavation and Backfill for Utilities and 02229 - Utility Backfill Materials.
- B. Topsoil: Conform to requirements of Section 02920 - Topsoil.

PART 3 EXECUTION**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 City Engineer and agency for any repairs or relocations, either temporary or permanent.
- E. 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 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 laser beam equipment to establish and maintain proper line and grade of the work is recommended.

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 and City 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 tongue or 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 backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Engineer and City 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 BACKFILL AND SITE CLEANUP

- A. Backfill the trench only after pipe installation is approved by the Engineer and City Engineer.
- B. Bed pipes with materials conforming to requirements of Section 02229 - Utility Backfill Materials and as indicated on Drawings.
- C. Backfill and compact soil in accordance with Section 02227 - Excavation, Trenching, Fill and Backfill for Utilities.
- D. Repair and replace removed or damaged pavement and sidewalks in accordance with the details shown on the plans.
- E. 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 and seed according to requirements of Section 02932 - Hydromulch Seeding.
- F. Conform to requirements of Section 01564 - Waste Material Disposal.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Gravity sanitary sewers and appurtenances, including cleanouts, stacks, and service connections.

1.02 UNIT PRICES

- A. Measurement for payment of pipe is on a unit price per linear foot basis. Measurement will be taken along the centerline of the pipe from centerline to centerline of manholes. Payment will be made for each linear foot installed, complete in place including sewer pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes and pipe, stacks, cleanouts, accessories, inspection and testing.
- 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 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 and City 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 PRODUCTS**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 Section:

Section 02620 - PVC Pipe.

- 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 EXECUTION**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 five feet deep.

- D. Immediately notify the agency or company owning any utility line which is damaged, broken or disturbed. Obtain approval from the City Engineer and agency or utility company for any repairs or relocations, either temporary or permanent.
- E. Install and operate dewatering and surface water control measures in accordance with Section 01563 - Control of Ground Water and Surface Water.
- F. 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 and City 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 and City Engineer so that required reporting can be made to the Texas Natural Resources Conservation Commission and the Environmental Protection Agency by the Engineer and City 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 City 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 and City 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 and City Engineer before proceeding.
- K. Where the length of stubs is not indicated, install a 12-inch length and seal the free end with an approved plug.

3.05 PIPE INSTALLATION OTHER THAN OPEN CUT

- A. For installation of pipe by augering, or jacking conform to requirements of specification sections on augering or jacking work as appropriate.

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 02762 - Sanitary Sewer Service Stubs or Reconnections.
- C. Construct manholes to conform to requirements of Section 02600 - Cast-in-Place Manholes, Section 02601 - Precast Concrete Manholes, and Section 02608 - Fiberglass Manholes, as applicable. Install frames, rings and covers to conform to requirements of Section 02603 - Frames, Grates, Rings and Covers.

3.07 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. The City of Victoria may elect to perform television inspection of the completed sewer before acceptance. The Contractor will assist with traffic control.

SECTION 02730

3.08 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 City Engineer.
- C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks in accordance with the details shown on the plans.
- 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 - Waster Material Disposal.

END OF SECTION

SECTION 02730

CITY OF VICTORIA
STANDARD SPECIFICATIONS

GRAVITY SANITARY SEWERS

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Paragraph 3.04.J - Design sewer/water line conflicts in accordance with TCEQ "Design Criteria for Sewerage Systems", TAC Chapter 317 and indicate special treatment on the Drawings.

END OF NOTE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Sanitary sewage force mains.

1.02 UNIT PRICES

- A. Measurement for payment for pipe is on a unit price per linear foot basis. Measurement will be taken along the centerline of the pipe from end to end. Payment will be made per foot of force main installed, complete in place including pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, accessories, inspection and testing.
- B. 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 DUCTILE IRON FITTINGS

- A. Conform to requirements of Section 02610 - Ductile Iron Pipe and Fittings.

2.02 PVC PIPE

- A. Conform to requirements of Section 02620 - PVC Pipe.
- B. Provide lined ductile iron fittings conforming to Section 02610 - Ductile Iron Pipe and Fittings.

2.03 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 Class 'B' 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 Professional Engineer licensed 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 EXECUTION**3.01 PIPE INSTALLATION BY OPEN-CUT**

- A. Perform excavation, bedding, and backfill in accordance with Section 02227 - Excavation and Backfill for Utilities.
- B. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in the following paragraphs.
- C. 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 City Engineer.
- D. 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.
- E. 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.
- 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 and City Engineer.
- H. Keep excavations free of water during construction and until final inspection.

SECTION 02731

CITY OF VICTORIA

STANDARD SPECIFICATIONS

SANITARY SEWAGE FORCE MAINS

- 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. Where sanitary sewer force main is to be installed under an existing waterline with a separation distance of less than 2 feet, install one full joint length of pipe centered on the waterline and maintain a minimum 6-inch separation distance.
- K. Wrap ductile iron fittings with 8-mil polyethylene film.

3.02 PIPE INSTALLATION OTHER THAN OPEN-CUT

- A. For installation of pipe by augering or jacking, conform to requirements of specification sections for augering or jacking work.

3.03 HYDROSTATIC TESTING

- A. After the pipe and appurtenance have been installed, test line and drain. Prevent damage to the Work or adjacent areas. Use clean water to perform tests.
- B. The Engineer or City 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 City Engineer.
- D. Test pipe at 150 psig or 1.5 times 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 2 hours according to requirements of UNI-B-3.
- F. Maximum allowable leakage shall be as calculated by the following formula:

$$L = (S) (D) (P^{0.5}) / 133,200$$

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.

- G. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by the City 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.

END OF SECTION

SECTION 02731

CITY OF VICTORIA
STANDARD SPECIFICATIONS

SANITARY SEWAGE FORCE MAINS

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Confirm that all pipe materials listed in Part 2 are acceptable for the project conditions and operating requirements.
- B. Paragraph 3.03D. The minimum test pressure is 150 psig. Increase the specified hydrostatic test pressure if needed to include the expected maximum surge pressure at peak flow conditions. The minimum test pressure shall be 1.5 times the maximum design pressure. [Ref: 30 TAC 317.3)(d) 5 and 6] Verify that pipe material specifications require a pressure rating consistent with the specified test pressure.

END OF NOTES

PART 1 GENERAL**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.

1.02 UNIT PRICES

- A. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
- B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

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 are met.
- D. Perform air testing in accordance with requirements of this Section and the Texas Natural Resources Conservation Commission 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 and City Engineer. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from 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 and City Engineer. Perform testing under observation of the City 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 packages" 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 shall not have adjustable or collapsible legs which would allow a reduction in 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 1/2 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 City 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 degree 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:
 - a. Air supply.
 - b. Pneumatic plugs.
 - c. Sealed line for pressuring.
 - d. Sealed line for monitoring internal pressure.
- 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.

PART 3 EXECUTION

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 1/2-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 degree 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 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.
 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 slip-lined 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 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 slip-lining, 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 Natural Resources and Conservation Commission (TCEQ) Design Criteria 317.2(a)(4)(B).

$$T = 0.0850(D)(K)/(Q)$$

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./sq.ft. 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.

Notes:

1. When two sizes of pipe are involved, the time shall be computed by the ratio of lengths involved.
2. Lines with a 27-inch average inside diameter and larger may be air tested at each joint.
3. Lines with an average inside diameter greater than 36 inches must be air tested for leakage at each joint.
4. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing.
5. 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. Testing procedures may be waived or modified by the Engineer for manhole adjustments when manholes are lowered for street rehabilitation and consequently raised to meet the final grade of the street.

- 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 for proper seal on cast-iron frame of manhole. Testing of manholes shall include the adjustment grade rings. Following manufacturer's instructions and safety precautions.
 2. All lift holes and exterior joints shall be plugged with a non-shrink grout. Grout shall be placed in horizontal joints prior to testing. All pipes entering the manhole shall be plugged. Stubouts, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn. A minimum 60-inch/lb torque wrench shall be used to tighten the external clamps that secure the test cover to the top of the manhole. The test head shall be placed at the inside of the top of the cone section, and the seal inflated in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn, and the vacuum pump shut off. With all valves closed, the time for the vacuum to drop to 9 inches of mercury shall not be less than two (2) minutes. If vacuum tests are used in lieu of hydrostatic tests, the test shall be done both before and after backfilling of the manhole. If the manhole fails the test, necessary repairs shall be made with a non-shrink grout while the vacuum is being drawn. The test shall be repeated.
 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 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.

SECTION 02732

*CITY OF VICTORIA
STANDARD SPECIFICATIONS*

**ACCEPTANCE TESTING
FOR SANITARY SEWERS**

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	12	0.0066
3	7.0686	.0306	13	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 mle 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)	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

SECTION 02732

CITY OF VICTORIA
STANDARD SPECIFICATIONS

**ACCEPTANCE TESTING
FOR SANITARY SEWERS**

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)

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installation of plastic liners for concrete interceptor sewers and structures. Only plastic liners manufactured with integral locking ribs spaced at approximately 2-1/2 inches on center over the entire liner is acceptable. Liners relying on mechanically fastened batten strips as the primary means of anchorage are unacceptable.

1.02 UNIT PRICES

- A. No separate payment will be made for Work performed under this Section. The cost shall be incidental to the work of precast concrete manholes, or cast-in-place, wastewater-containing structures.

1.03 SUBMITTALS

- A. Submit shop drawings according to Section 01300 - Submittals.
- B. Prior to submittal of shop drawings, the manufacturer shall approve the proposed panel layout and proposed details. The Contractor shall then submit shop drawings showing the proposed panel layout to cover the area to be lined. Shop drawings shall also show the proposed details for installation of liner at seams, terminations, corners, openings, pipe penetrations, etc., and the type of factory and field welds and attachments.
- C. Provide sufficient details to permit placement of liner without use of design drawings. Reproduction of design Drawings for use as shop drawings will not be allowed. Do not begin fabrication of the liner until after shop drawings and submitted materials have been reviewed and accepted by the Engineer and City Engineer.

1.04 INSTALLER QUALIFICATIONS

- A. Applicators. The application of plastic liner to forms and other surfaces, liner finishing, repair, and testing is considered highly specialized work and shall be performed only by firms and individuals recommended and approved by the lining manufacturer. Personnel performing such work shall be trained in methods of installation and shall demonstrate their ability to the Engineer and City Engineer.

B. Welders.

Each welder shall pass a qualification-welding test before doing any welding. Requalification may be required at any time deemed necessary by the Engineer or City Engineer. Provide at least 24 hours notice to the Engineer and City Engineer to schedule a qualification-welding test.

All test welds shall be made in the presence of the City Engineer and shall consist of the following:

Begin with two pieces of liner, at least 15 inches long and 9 inches wide. Hold pieces in a vertical position, lapped 1-1/2 inches.

Position a weld strip over the edge of the lap and weld to both pieces of liner. Extend each end of the weld strip at least 2 inches beyond the liner to provide tabs.

The weld specimen will be tested as follows:

Each weld strip tab, tested separately, shall be subjected to 10-pound pull normal to the face of the liner with the liner secured firmly in place. The weld is acceptable if there is no separation between the weld strip and liner.

Three test specimens shall be cut from the welded sample and tested in tension across the welds. Tensile strength measured across welded joints shall be at least 2000 psi

when tested in accordance with ASTM D 412. If none of these specimens fails when tested as indicated above, the weld will be considered satisfactory.

If one specimen fails to pass the tension test, a retest will be permitted. The retest shall consist of testing three additional specimens cut from the original welded sample. If the three retest specimens pass the test, the weld will be considered satisfactory.

A disqualified welder may submit a new weld sample when the welder has had sufficient off-the-job training or experience to warrant re-examination.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Plastic liner shall be as manufactured by Ameron Protective Linings Division; Poly-Tee, Inc.; or approved equal.

2.02 MATERIALS

- A. Manufacturing.

Plastic liner sheet, joint, corner and weld strips shall be manufactured from a high molecular weight thermoplastic polymer compounded to make a permanently flexible material suitable for use as protective liner in concrete pipe or other concrete structures. Polyvinyl chloride resin shall constitute not less than 99 percent by weight of the resin used in the formulation. Copolymer resins shall not be permitted.

At any time during the manufacture or prior to the final acceptance of the Work, the Engineer or City Engineer may sample specimens taken from sheets, strips or welded joints for testing.

Changes in formulation will be permitted only after prior notice is given to the Engineer and City Engineer and the manufacturer demonstrates that the new plastic liner will meet or exceed requirements for chemical resistance and physical properties.

- B. Properties.

Plastic liner sheets including locking extensions, joints, corners, and welding strips shall be free of cracks, cleavages or other defects adversely affecting the protective characteristics of the material.

Except at shop welds, plastic liner sheets, joint, corner and weld strips shall have the following properties when tested at 77 degrees F plus or minus 5 degrees F.

PROPERTY	ASTM TEST METHOD	CHEMICAL RESISTANCE TEST	
		INITIAL	AFTER CHEMICAL EXPOSURE (Note 1)
Tensile strength, min.	D 412, Die B	2200 psi	2100 psi
Elongation at break, min.	D 412, Die B	200 percent	200 percent
Shore durometer, Type D	D 2240, Within 1 sec.	50-60	±5 (Note 2)
	D 2240, 10 sec.	35-50	±5 (Note 2)
Weight change	(Note 3)	-----	±1.5 % (Note 2)

Notes:

- For 112 days in chemical solutions
- With respect to initial test results

3. Specimen shall be 1 inch x 3-inch sample sheet thickness, taken from sheet or strip at any time prior to final acceptance of the work.

2.03 MATERIAL TESTS

- A. **Material Properties.** Samples taken from sheets, joints or weld strips shall be tested to determine material properties. Determination of PVC tensile strength and elongation shall be in accordance with ASTM D 412 using Die B. Determination of indentation hardness shall be in accordance with ASTM D 2240 using a Type D durometer, except that a single thickness of material will be used. Determination of change of weight and indentation hardness shall be made of 1-inch by 3-inch specimens. Thickness of specimens shall be the thickness of the sheet or strip.
- B. **Measurement of Initial Physical Properties.** Determine the initial values for tensile strength, weight, elongation and indentation hardness prior to chemical resistance tests.
- C. **Chemical Resistance Tests.**
Determine the physical properties of the specimens after exposure to chemical solutions. Test specimens shall be conditioned to constant weight at 110 degrees F before and after submersion in the following solutions for a period of 112 days at 77 degrees F plus or minus 5 degrees F.

<u>Chemical Solution</u>	<u>Concentration</u>
Sulfuric acid	20%*
Sodium hydroxide	5%
Ammonium hydroxide	5%*
Nitric acid	1%*
Ferric chloride	1 %
Soap	0.1 %
Detergent (linear alkyl benzyl sulfonate or LAS)	0.1%
Bacteriological	BOD not less than 700 ppm

* Volumetric percentages of concentrated C.P. grade reagents.

At 28-day intervals, remove specimens from each chemical solution and test. If any specimen fails to meet the 112-day property requirements specified in Section 2.02B before completion of the 112-day exposure, the material will be rejected.

- D. **Pull Test for Locking Extensions.** Liner locking extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch, applied perpendicularly to the concrete surface for a period of 1 minute, without rupture of the locking extensions or withdrawal from embedment. This test shall be made at a temperature between 70 degrees F and 80 degrees F, inclusive.
- E. **Shop-Welded Joints.** Shop-welded joints used to fuse individual sections of liner together, shall meet the minimum requirements of the liner for thickness, corrosion resistance and impermeability. Welds shall show no cracks or separations and shall be tested for tensile strength. Tensile strength, measured across the welded joint in accordance with ASTM D 412 using Die B, shall be at least 2000 psi. Test temperature shall be 77 degrees F plus or minus 5 degrees F and the measured minimum width and thickness of the reduced test specimen section shall be used.
- F. **Spark Test.** Liners shall be shop and field tested for holidays or flaws using an approved spark tester set to provide a minimum of 20,000 volts (Tinker and Razor Model AP-W with power pack, or approved equal). Sheets having holes shall be satisfactorily repaired in the

shop prior to shipment from the manufacturer's plant. Repairs shall be made by welders qualified in accordance with these specifications.

2.04 MATERIAL DETAILS AND DIMENSIONS

- A. Approval of Details. Liner sheet, strip and other accessory pieces shall conform to the requirements of these Specifications.
- B. Thickness of Material. The minimum thickness of PVC sheet and strip shall be as follows:

<u>Material</u>	<u>Thickness in Inches</u>
Sheet, integral locking extensions	0.065
Sheet, plain	0.094
Joint strip	0.094
Weld strip	0.125

- C. Material Sizes. Sheets of PVC liner used for pipe shall be pipe-size sheets to provide the coverage required by the Drawings. Structural sheets shall be standard 48-inches by 96-inches, with any special size noted on the shop drawings. Lengths specified shall include tolerance at a ratio of plus or minus 1/4-inch for each 100 inches, or 0.25 percent. Joint strips shall be 4 inches plus or minus 0.25 inch in width and shall have each edge beveled prior to application. Weld strips shall be 1 inch plus or minus 0.125 inch in width. Weld strips shall have edges beveled at time of manufacture.
- D. Locking Extensions.
 - No polygrip-type holding or locking extension will be permitted.
 - PVC liner to be embedded in concrete shall have integral locking extensions. Liner may not be bonded to concrete surfaces with adhesives except as specifically acceptable to the Engineer and City Engineer.
 - PVC locking extensions shall be the same material as the liner, shall be integrally molded or extruded with the sheets, and shall have an approved cross section with a minimum height of 0.375 inch and a minimum web thickness of 0.085 inch. They shall be approximately 2.5 inches apart and shall be such that when the extensions are embedded in concrete, the liner will be held permanently in place.
 - PVC locking extensions shall be parallel and continuous except where interrupted for joint flaps, weep channels, strap channels and for other purposes shown on Drawings or permitted by the Engineer and City Engineer.
 - The liner sheet edge which will be the lower terminal edge in the structure shall not extend beyond the base of the final locking extension more than 0.375 inch.
- E. Provisions for Strap Channels. Unless alternate methods are acceptable to the Engineer and City Engineer, the liner required to be secured to the inner form with straps shall have strap channels at not more than 20 inches on center perpendicular to the locking extensions. Strap channels shall be a maximum of 1-inch wide and formed by removing the locking extensions so that a maximum of 3/16-inch remains. The channels shall not be provided in the final two locking extensions adjacent to the terminal edge of the liner coverage.
- F. Flaps. When transverse flaps are specified or required, they shall be fabricated by removing locking extensions so that no more than 1/32 inch of the base of the locking extensions remains on the sheet.
- G. Adhesive Products. Adhesive products and application procedures used in the installation of the liner shall be according to the manufacturer's recommendations. Adhesive products intended for use inside cast-in-place structures shall be non-flammable.

- H. Cleaners. Cleaners used in the installation of the liner shall be reviewed by the Engineer and City Engineer prior to use. Cleaners shall be nonflammable and shall be water-soluble or water dispersible and shall not be detrimental to the plastic liner.
- I. Caulking Products. Caulking products and application procedures used in the installation of liner and appurtenances shall be as recommended by the manufacturer.
- J. Mechanical Anchors. When approved for use with plain sheet liner, provide anchors and washers of Type 316 stainless steel, and as recommended by the liner manufacturer.

PART 3 EXECUTION

3.01 NOTIFICATION

- A. Notify the Engineer and City Engineer at least 24 hours before reinforcing steel placement so that the lining may be inspected and errors corrected without delaying the Work.

3.02 PLACING LINER

- A. Location. Liner shall be placed throughout the entire length of the interceptor sewer along the top 300 degrees of the pipe circumference, and inside all structures as indicated on the Drawings. Liner shall be applied and secured to the forms and inspected by the City Engineer prior to the placement of reinforcing steel.
- B. Coverage.

In cast-in-place structures, no offset of the lower terminal edge is permitted. Unless otherwise shown on the Drawings, the lower terminal edge shall be one foot below the low water level "all pumps off" level for lift stations), or 6 inches below the top of the grout or concrete fillet, whichever is higher.

At any station where there is a difference in the pipe's circumferential liner coverage, as shown on the Drawings, and the longitudinal terminal edges of liner downstream from that station are lower than those upstream, the terminal edges of the liner installed in the section of pipe or structure immediately upstream from the station shall be sloped uniformly for the entire length of the section of pipe or structure from the limits of the smaller coverage to those of the greater coverage. Wherever the longitudinal terminal edges of the liner downstream from the station are higher than those upstream, the slope shall be accomplished uniformly throughout the length of the section of pipe or structure immediately downstream from the station. An approved locking extension shall be provided along all sloping lower terminal edges of liner plate.
- C. Positioning Liner.

Position PVC liner installed in pipe so that locking extensions are parallel to the longitudinal axis of the pipe.

Position PVC liner installed in cast-in-place structures so that the locking extensions are parallel to the direction of concrete placement, which is normally vertically for vertical walls.

Liner shall be closely fitted to inner forms. Sheets shall be cut to fit curved and warped surfaces using a minimum number of separate pieces.

The Engineer or City Engineer may require the use of patterns or the marking of sheet layouts directly on the forms where complicated warped surfaces are involved.

At transverse joints between sheets of liner used in cast-in-place structures and pipe joints, the space between ends of locking extensions, measured longitudinally, shall not exceed 4 inches. Where sheets are cut and joined for the purpose of fitting irregular surfaces, this space shall not exceed 2 inches.
- D. Securing Liner in Place.

Liner shall be held snugly in place against inner forms. For pipes and similar circular sections, light steel banding straps or other approved means shall be used. Prefabricated pipe-size tubular sheets which do not require strap channels may also be used.

Banding straps, when used, shall be placed in strap channels, as specified under provision for strap channels, at a spacing not to exceed 20 inches.

Any method of banding, other than in strap channels, shall be reviewed by the Engineer and City Engineer prior to use.

On vertical surfaces where form ties or form stabilizing rods pass through liner, provisions shall be made to maintain the liner in close contact with the forms during concrete placement.

Concrete shall be prevented from flowing around the edges of sheets at joints by sealing the joint or seam with waterproof tape recommended by the manufacturer.

Forms in contact with plastic liner need not be oiled.

E. Weep Channels.

At each pipe joint and at transverse joints in cast-in-place structures, a gap not less than 2-inches nor greater than 4 inches shall be left in all locking extensions to provide a transverse weep channel. If locking extensions are removed to provide a weep channel at joints, the base of the extension left on the sheet shall not exceed 3/16 inch.

Intermediate weep channels shall be provided as required to maintain a maximum spacing of 8 feet. Intermediate weep channels shall not be less than 2.0 inches nor greater than 4.0 inches in width. If locking extensions are removed to provide intermediate weep channels, the base of the extension left on the sheet shall not exceed 3/16 inch.

Any area behind liner, which is not properly served by regular weep channels, shall have additional weep channels 2 inches wide provided by cutting away locking extensions.

A transverse weep channel shall be provided approximately 12 inches away from each liner return where surfaces lined with plastic liner join surfaces which are not so lined.

As a part of the Work of installing liner, outlets of all weep channels shall be cleared of obstructions which would interfere with their proper functions.

Weep channels shall be designed for external hydrostatic pressures of a water column equal in height to the greater of 50 feet (22 psi) or 1.1 times the depth of burial.

F. Liner Returns.

A liner return shall be installed where shown on the approved shop drawings and wherever surfaces lined with plastic liner join surfaces which are not so lined.

Unless otherwise indicated by the Drawings or the approved shop drawings showing liner installation methods, returns shall be made as follows:

The liner shall be returned at least 3 inches at the surfaces of contact between the concrete structure and items not concrete (including access frames, gate guides and pipe penetrations).

The same procedure shall be followed at joints where the type of protective lining is changed, or the new work is built to join existing unlined concrete.

Locking extensions shall be provided on returns to lock the returns to the concrete of plastic-lined, cast-in-place structures.

Each liner return shall be sealed to adjacent construction with which it is in contact by means of an adhesive system recommended by the manufacturer and acceptable to the Engineer and City Engineer. If the joint space is too wide or the joint surfaces too rough to permit the use of the compound, the joint space shall be filled with 2 inches of densely caulked cement mortar, lead wool, or other caulking material and finished with a minimum of 1 inch depth of an approved corrosion resistant sealant material.

3.03 CONCRETING OPERATIONS

A. Concrete Placement.

Concrete placed against liner shall be carefully vibrated so as to avoid damage to the liner and to produce dense concrete securely anchoring the locking extensions into the concrete. External vibrators shall be used in addition to internal vibrators, particularly along the lower terminal edge of the liner.

Stiffeners, when used along locking extensions of liner installed in forms for pipe, shall be withdrawn completely during the placement of concrete in the forms. The concrete shall be revibrated to consolidate the concrete in the void spaces caused by the withdrawal of the stiffeners.

B. Removing Forms.

In removing forms, care shall be taken to protect liner from damage. Sharp instruments shall not be used to pry forms from lined surfaces. When forms are removed, any nails that remain in the liner plate shall be pulled without tearing the liner and the resulting holes clearly marked. Form tie holes shall be marked before ties are broken off and all areas of abrasion of the liner shall be marked.

Following completion of form removal, liner in pipe and structures shall be cleaned for inspection.

Banding straps used in securing liner to forms for pipe and cast-in-place structures shall be removed within the limits of the unlined invert.

3.04 FIELD JOINTING OF LINER

A. Installation Requirements.

No field joint shall be made in the liner until the lined pipe or structure has been backfilled and seven days have elapsed after the flooding or jetting has been completed. Where ground water is encountered, the joint shall not be made until pumping of ground water has been discontinued for at least 7 days and no visible leakage is evident at the joint. Liner at joints shall be free of all mortar and other foreign material and shall be clean and dry before joints are made.

Hot joint compound shall not be brought in contact with liner.

No coating of any kind shall be applied over any joint, corner or welding strip, except where nonskid coating is applied to liner surfaces.

B. Field Joints in Pipe Installation.

Field joints in the lining at pipe joints shall be one of the following types:

Type P-1. The joint shall be made with a separate 4-inch joint strip and two welding strips. The 4-inch joint strip shall be centered over the joint, heat-sealed to the lining, then welded along each edge to adjacent liner sheets with a 1-inch weld strip. The 4-inch joint strip shall lap over each sheet a minimum of 1/2 inch.

Type P-2.

1. The joint shall be made with a joint flap with locking extensions removed as described in Section 2.04 above, and extending approximately 4 inches beyond the pipe end. The joint flap shall overlap the lining in the adjacent pipe section a minimum of 1/2 inch and be heat-sealed in place prior to welding. The field joint shall be completed by welding the flap to the lining of the adjacent pipe using 1-inch weld strip.

2. Care shall be taken to protect the flap from damage. Excessive tension and distortion in bending back the flap to expose the pipe joint during laying and joint mortaring shall be avoided. At temperatures below 50 degrees F heating of the liner may be required to avoid damage.

Field joints in liner at pipe joints shall not be made until the mortar in the pipe joint, if used, has been allowed to cure for at least 48 hours.

Joints between lined pipe and lined structures shall be either Type C-1 joint or Type C-2 joint as described below.

- C. Field Joints in Concrete Structures. Field joints in liner on concrete structures shall be one of the following types:
- Type C-1. The joint shall be made with a separate 4-inch joint strip and two welding strips. The 4-inch joint strip shall be centered over the joint, heat-sealed to the liner, then welded along each edge to adjacent sheets with a 1-inch wide weld strip. The width of the space between adjacent sheets shall not exceed 2 inches. The 4-inch joint strip shall lap over each sheet a minimum of 1/2 inch. It may be used at any transverse or longitudinal joint.
 - Type C-2. The joint shall be made by lapping sheets not less than 1/2 inch. One 1-inch weld strip is required. The upstream sheet shall overlap the one downstream. The lap shall be heat-sealed into place prior to welding on the 1-inch weld strip.
 - Type C-3. The joint shall be made by applying 2-inch wide waterproof tape or 1-inch wide welding strip on the back of the maximum 1/4-inch gap butt joint or by some other method approved by the Engineer and City Engineer to prevent wet concrete from getting under the sheet. After the forms have been stripped, a 1-inch weld strip shall be applied over the face to the sheet.
- D. Installation of Welding Strips.
- All welding of joints is to be in strict conformance with the specifications and instructions of the lining manufacturer.
- Welding shall fuse both sheets and weld strip together to provide a continuous joint equal in corrosion resistance and impermeability to the liner plate.
- Hot-air welding tools shall provide effluent air to the sheets to be joined at a temperature between 500 degrees F and 600 degrees F. Welding tools shall be held approximately 1/2 inch from and moved back and forth over the junction of the two materials to be joined. The welding tool shall be moved slowly enough as the weld progresses to cause a small bead of molten material to be visible along both edges and in front of the weld strip.
- Adequate ventilation shall be maintained in confined spaces during welding operations. After repairs have been made, defective welds will be reinspected and re-tested.
- E. Joint Reinforcement. A 12-inch long welding strip shall be applied as a reinforcement across each transverse joint and weep channel which extends to the lower terminal edge of liner. These reinforcement strips shall be centered over the joint being reinforced and located as close to the lower edge of liner as practicable. They shall be welded in place after the transverse welding strips have been installed.
- F. Application of Liner to Concrete Surfaces with Adhesives. Application of liner plate to concrete surfaces by means of adhesive shall be allowed only where shown on the Drawings for existing structures, or where specifically acceptable to the Engineer and City Engineer and called out on approved shop drawings, and shall be accomplished by the following steps:
- The concrete surface shall be etched by abrasive blasting to develop a slightly granular surface.
- After abrasive blasting, the concrete surface shall be thoroughly cleaned of dust.
- Application of primer, adhesive and liner shall be in strict accordance with the manufacturer's recommendations, as approved by the Engineer and City Engineer.
- Mechanical anchors shall be placed at 12-inch centers each way after adherence of the liner to the concrete surface has been achieved. Anchors shall be placed after the adhesive system as cured for a minimum of 24 hours. The penetration of the liner by the anchor shall be sealed in accordance with the manufacturer's recommendations.
- G. Nonskid Surfaces. Surfaces of liner, shown on the Drawings to be nonskid, shall be treated as follows prior to installation:
- The liner shall be cleaned, dried, and spread with an adhesive coating recommended by the manufacturer of the liner plate.
- The surface shall then be liberally sprinkled with clean, dry, well-graded sand, all of which will pass a No. 30 sieve but be retained on a No. 70 sieve.

After the sanded surface has thoroughly dried, excess sand shall be brushed away and a seal coat of the adhesive coating shall be sprayed over the sand in sufficient quantity to coat and bond the sand to the liner plate.

The coated sand surface shall be allowed to dry thoroughly before handling.

H. Protection and Repair of Liner.

Necessary measures and precautions shall be taken to prevent damage to liner from equipment and materials used in or taken through the Work. Any damage to installed liner plate shall be repaired by the Contractor in accordance with the requirements for repair of the liner.

Nail and tie holes and cut, torn and seriously abraded areas in the liner plate shall be patched. Patches made entirely with welding strip shall be fused to the liner over the entire patch. The use of this method is limited to patches which can be made with a single welding strip. The use of parallel, overlapping or adjoining welding strips will not be permitted. Larger patches may consist of smooth liner over the damaged area, with edges covered with welding strips fused to the patch and to the liner adjoining the damaged area. The size of a single patch of the latter type shall be limited only as to its width, which shall not exceed 4 inches.

Whenever liner is not properly anchored to concrete, or whenever patches larger than those permitted above are necessary, the repair of the liner and the restoration of anchorage shall be accomplished by injecting epoxy grout behind the liner plate by a method approved by the Engineer and City Engineer. The use of adhesives will not be allowed to repair improperly anchored liner plate.

I. Field Tests.

Upon completion of the installation, the surface of liner shall be cleaned to permit visual inspection and spark testing by the City Engineer, using a spark-type detector complying with the requirements for Spark Test. Areas of liner failing to meet the field test shall be properly repaired and retested.

The Contractor shall assist in the inspection and spark testing by providing adequate ventilation, ladders for access, barricades or other traffic control devices, and shall be responsible for opening and closing entrances and exits.

Any spark testing of liner by the Contractor shall be done with a detector complying these Specifications.

END OF SECTION

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Indicate on the Drawings the liner coverage requirements. All exposed interior surfaces should be shown as covered with liner. As a minimum, show the location of the lower terminal edge for all cast-in-place structures. The lower terminal edge in lift station wet wells is normally 1' – 0" below the "all pumps off" elevation (normal low water level). The lower terminal edge in manholes and junction structures is normally a minimum of 6 inches below the top of the grout or concrete fill, fillet, or bench.

END OF NOTE

PART 1 PRODUCTS

1.01 POLY-TRIPLEX® LINER SYSTEM (PTLS-11600)

- A. Multiple structural fiberglass layers with a non-porous membrane bonded between the layers of fiberglass, with a total fabric weight of 116 oz. per square yard, saturated with 100% solids epoxy, cured-in-place and bonded to the existing structure.

1.02 POLY-TRIPLEX® LINER SYSTEM (PTLS-6800)

- A. Multiple structural fiberglass layers with a non-porous membrane bonded between the layers of fiberglass, with a total fabric weight of 68 oz. per square yard, saturated with 100% solids epoxy, cured-in-place and bonded to the existing structure

1.03 POLY-TRIPLEX® LINER SYSTEM (PTLS-5600)

- A. Multiple structural fiberglass layers with a non-porous membrane bonded between the layers of fiberglass, with a total fabric weight of 56 oz. per square yard, saturated with 100% solids epoxy, cured-in-place and bonded to the existing structure.

1.04 POLY-TRIPLEX® LINER SYSTEM (PTLS-4400)

- A. Multiple structural fiberglass layers with a non-porous membrane bonded between the layers of fiberglass, with a total fabric weight of 44 oz. per square yard, saturated with 100% solids epoxy, cured-in-place and bonded to the existing structure.

PART 2 SECTION INCLUDES

2.01 MANUFACTURER/DISTRIBUTOR/INSTALLER

- A. Poly-Triplex® Technologies, Inc.
- B. Corporate Headquarters: 1701 Wynkoop Street, Suite 250, Denver, CO 80111. Phone: (303) 893-3100 · Fax: (303)893-3102.
- C. Manufacturing: 495 St. Johns Road, Bonifay, Florida 32425. Phone: (850)547-9999 · (850) 547-9990.
- D. Website: www.poly-triplex.com · Email: info@poly-triplex.com
- E. Installer: Please contact the corporate office for local distributor/licensed installer in your area.

PART 3 PRODUCT DESCRIPTION

3.01 USAGE

- A. The Poly-Triplex® Liner System is designed for use as a non-porous, multi-layer structural system for rehabilitation for structures such as manholes, pump stations, wet wells vaults storage tanks, large diameter pipe and corrugated culvert pipe. It provides impervious water and sewer gas resistant membrane layered between layers of structural fiberglass or polyester fiber. Therefore, the liner system is ideal for correcting H²S gas deterioration, infiltration, infiltration and exfiltration problems in structures of most any shape or size.
- B. The waterproof liner system completely seals off infiltration and exfiltration. The epoxy resins used in conjunction with the fiberglass linear fabric are resistant to gases and chemicals

- typically encountered in domestic sewer systems. The linear permanently adheres to wet or dry surfaces of brick, concrete PVC and ductile iron; it prevents further deterioration, infiltration and exfiltration while providing structural reinforcement to the existing structure and provides a chemical and sewer gas resistant protective lining system. Other epoxy or vinyl-ester resins may also be used in conjunction with the Poly-Triplex Liner for special chemical and industrial applications.
- C. PTLS-11600 is designed for structures with serious deterioration, infiltration or exfiltration problems, culverts and stormwater pipes.
 - D. PTLS-6800 is designed for structures with serious deterioration, infiltration or exfiltration problems.
 - E. PTLS-5600 is designed for structures with moderate deterioration, infiltration or exfiltration problems.
 - F. PTLS-4400 is designed for structures with mild to moderate deterioration, preventive maintenance and new construction.
 - G. Each linear is a type that allows rehabilitation of concentric, eccentric or flat top vertical structures without removing the ring top section or corbel. All linear material and components are custom fabricated at the Poly-Triplex® Technologies, Inc., manufacturing facility to fit the size and shape of each individual structure. Structure measurements are taken and liners are manufactured prior to commencement of the liner installation to minimize the on-site field time required for the liner installation.

3.02 MATERIALS AND LINEAR INSTALLATION SYSTEM

- A. The PTLS-11600 series is a multi-layered composite system with a total pre-saturated fabric weight of 116-ozs. per square yard. Layer #1 is (2) 24-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is a 20-oz. non-porous membrane of special synthetic materials bonded to layer #1 and layer #3. Layer #3 consists of (2) 24-oz. structural fiberglass saturated with epoxy and bonded to the nonporous membrane, forming a smooth interior wall to the host structure.
- B. The PTLS-6800 series is a three-layered composite system with a total pre-saturated fabric weight of 68-ozs. per square yard. Layer #1 is 24-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is a 20-oz. non-porous membrane of special synthetic materials bonded to layer #1 and layer #3. Layer #3 consists of 24-oz. structural fiberglass saturated with epoxy and bonded to the nonporous membrane, forming a smooth interior wall to the host structure.
- C. The PTLS-5600 series is a three-layered composite system with a total pre-saturated fabric weight of 56-ozs. per square yard. Layer #1 is 18-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is a 20-oz non-porous membrane of special synthetic materials bonded to layer #1 and layer #3. Layer #3 consists of 18-oz. structural fiberglass saturated with epoxy and bonded to the nonporous membrane, forming a smooth interior wall to the host structure.
- D. The PTLS-4400 series is a three-layered composite system with a total pre-saturated fabric weight of 44-ozs. per square yard. Layer #1 is 12-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is a 20-oz. non-porous membrane of special synthetic materials bonded to layer #1 and layer #3. Layer #3 consists of 12-oz. structural fiberglass saturated with epoxy and bonded to the nonporous membrane, forming a smooth interior wall to the host structure.

- E. The standard impregnating resin for typical domestic wastewater sewer system liners is modified Polyamide Bisphenol "A" Epichlorodhydrin system that field applied. After the resin is applied, the liner is lowered into the manhole where, in most cases, it is cured in place with a temperature inversion system of air pressure and steam heat injection. Most liners are cured within two hours and become a structural monolithic wall bonded to the host structure.
- F. Other chemical and industrial applications may require alternate resin system depending on the site conditions and chemicals present in the structures. Owner shall supply analytical report of chemicals present to Poly-Triplex® Technologies, Inc. Resin system used in these cases is determined on a case-by-case basis.

3.03 SIZES

- A. Each liner is custom fabricated to fit each individual structure. There is no standard configuration in manholes and many other structures; therefore, exact measurements must be completed and submitted prior to manufacturing each liner. Poly-Triplex® Technologies, Inc. provides diagrams for location, configuration, measurements, site & structure conditions, notes and observations.

PART 4 INSTALLATION PROCESS

4.01 CLEANING

- A. All surfaces of the host structure are to be cleaned with a high-pressure hydro-jet sprayer with an operating pressure of at least 4,000-psi. After pressure cleaning, surface may be cleaned with degreaser or other solvents as needed in order to remove any film or residue on the surface. Structure shall then be pressure rinsed with water.

4.02 FINAL PREPARATION

- A. All incoming laterals and main trunk line openings shall be properly trimmed and grouted with hydraulic or Portland Type II Cement, forming a fillet between the structure wall and each pipe. All inlet and outlet pipes should be trimmed so they do not extend into the structure more than two inches. Such application of grout shall extend at least six inches from the outlet onto the wall area.
- B. Benches, walls and floors shall be repaired or refinished as appropriate using chemical grout, hydraulic cement or Portland Type II Cement. Bench areas and floors shall be lined with Poly-Triplex® Liner System materials saturated with the epoxy resin and placed in the bottom and extending approximately 6 inches up the wall section, so as to overlap with the linear wall section.

4.03 MANHOLE LINER INSTALLATION

- A. Once the liner is fully saturated with resin, at the job site, it shall be lowered into the structure to the pre-marked position at the cover seat of the structure entrance. The liner shall form a monolithic structure permanently connecting the ring & cover seat to the chimney, corbel, walls and benches. Unless otherwise required, the liner will end at, but include, the bench. In cases where invert channel lining is required, the sewage flow must be stopped for a minimum period of 3 hours and should be a separate cost item.
- B. Normal installation procedures do not require the restricting or bypassing of the main trunk line in manholes where the sewage flow is contained within the channels and channel lining is not required.
- C. In cases where channel is required to be lined, the same process may be used as on the bench area however, the sewage flow must be stopped. Channels may also be lined with a

hand lay-up method using RAM-Epoxy Fast Setting Mastic and Fiberglass. Using the hand lay-up method, the channel shall be dry and free of infiltration of groundwater. Channel will receive not less than 1 24-oz structural fiberglass layer along with structural fiber reinforced epoxy mastic. Once channel lining is cured, additional layers may be applied as needed. If channel lining is required, it shall be specifically noted in the liner Proposal or the client's quotation request.

- D. The Poly-Triplex® Liner for manholes shall be pressurized with air or water and cured with steam, ambient or heated air, or ambient or heated water. Most typical Poly-Triplex® manhole liner installations will be pressurized at 750-1,000 lbs. per square foot, depending on the condition of the structure and the amount of hydrostatic pressure from incoming infiltration.

4.04 PUMP STATION, WET WELL AND VAULT INSTALLATION

- A. All pumps, pipes and switches shall be removed from the structure, providing the Poly-Triplex® Liner installer an empty structure. Unless otherwise specified by the owner, the liner will include walls, floor and underside of top slab. The underside of the top slab may be lined in conjunction with the walls and floor or it may be coated with RAM-750 Epoxy Mastic. The underside of the top slab may also be lined by removing the top slab for installation of the liner and applying Poly-Triplex® materials or RAM-750 Epoxy Mastic, then allowing cure at ambient temperature. Removal of the top slab method allows ability for the top slab to be removed in the future.
- B. Once the liner is fully saturated with resin, at the job site, it shall be lowered into the structure to the appropriate pre-marked position at structure entrance. In the case of large or non-cylindrical structures, the liner may be installed in sections with multiple cure times. The liner shall form a monolithic structure permanently connecting the walls and floor of the structure (and top slab where applicable).
- C. Pump stations and larger structures are typically pressurized at a minimum 300 lbs. per square foot, with major infiltration stopped prior to installation, due to the limited weight of the deck slab restricting the amount of internal lifting pressure applied from the installation process. The liner may also be pressurized and cured-in-place at ambient temperature by filling the structure with water to approximately one foot above the surface area to be lined. Depending upon specific site conditions, the water method is preferred for structures such as square or rectangular manholes or vaults and large pump stations.

4.05 CULVERT/STORMWATER PIPELINE INSTALLATIONS

- A. Designed form pipes from 12" – 96" in diameter – once saturated with resins the Poly-Triplex® Liner shall be lowered into and pulled through the section to be lined. A dual inflation canister system will be attached to the liner on each end. Air pressure and steam heat will be injected from one end and the other end will be equipped with an exhaust valve to control the amount of pressure within the structure. The liner may also be cured under air pressure at ambient temperature. Curing times will vary according to temperature applied in the curing process. Liner will cover the entire circumference of the pipe or the section of pipe or may be installed, more or less, from waterline-to-waterline.
- B. Point repairs may be necessary to provide a smooth surface to receive the insertion of the liner through the pipe. Flow control will be required during the installation process. Bypass pumping or coffer dam will be required for pipes to receive liner to entire circumference of the structure. In the case of waterline-to-waterline installation, the sewage may continue to flow during the process, but shall be controlled to provide Poly-Triplex® installer a consistent flow-line.

4.06 CURING PROCESS

- A. Once the liner is in position, it is pressurized and cured-in-place. The structure is pressurized with air or water and cured with steam, ambient or heated air, or ambient or heated water. Most typical installations are heated by a temperature inversion system of pressurization with steam injection into the high velocity hot air column, creating a steam/convection oven atmosphere to create a liner temperature of approximately 150°-190° F. The liner is heated for an estimated one to three hours curing time according to the size and temperature of the structure. Either curing process receives the same Poly-Triplex warranty.
- B. Upon completion of the liner curing process, the inflation bladder shall be removed, all lines reopened and the excess liner cut off at the manhole cover seat or structure opening.

PART 5 AVAILABILITY AND COST

5.01 AVAILABILITY

- A. Available in all major marketing areas in the United States, Canada, Australia, Mexico and Western Europe.

5.02 COST

- A. Due to the custom manufacture and installation requirements for each structure, a firm estimate needs to be accomplished for each unit. The Poly-Triplex® Liner System is a form of permanent rehabilitation.

PART 6 WARRANTY

- 6.01 Poly-Triplex® Technologies, Inc., and the Poly-Triplex® Authorized Licensed Installer, jointly provides a non-prorated warranty for the Poly-Triplex Liner Systems. Poly-Triplex® fabrics and resins are warranted to be free of defects in materials and workmanship, to prevent infiltration, prohibit root intrusion and provide a surface coating resistant to sewer gases and chemicals typically found in domestic sewer collection systems. This warranty is for the repair or replacement of the liner as needed. Labor and Materials Warranties are as follows:

- A. Poly-Triplex® Liner System (PTLS-11600) – Manholes – Ten-Year Materials, Five-Year Labor
- B. Poly-Triplex® Liner System (PTLS-6800) – Manholes – Ten-Year Materials, Five-Year Labor
- C. Poly-Triplex® Liner System (PTLS-5600) – Manholes – Ten-Year Materials, Five-Year Labor
- D. Poly-Triplex® Liner System (PTLS-4400) – Manholes – Ten-Year Materials, Five-Year Labor
- E. Sewage Pump Stations, Wet Wells & Culvert/Pipe (PTLS-6800 & PTLS-11600) – Five-Year Materials and Labor

- 6.02 Poly-Triplex® Technologies, Inc. does not certify the structural integrity of existing structure or substructure, but the liner system will eliminate further deterioration due to sewer gases and significantly increase the life of the existing structure. In the case of industrial or chemical applications, warranty will be provided on a case-by-case basis.

PART 7 MAINTENANCE

- 7.01 Although no maintenance is anticipated for decades, the Poly-Triplex® Liner System is easily repaired. Small holes or cracks can be repaired with RAM-750 Mastic. Larger areas may be

repaired using fiberglass material coated on both sides with RAM-750 Mastic for greater structural integrity. The liner may be core drilled through for the addition of incoming lateral lines. RAM-750 Mastic Grout is recommended for use as a seal between the new line and the liner wall.

PART 8 SOLE SOURCE SUPPLIER

8.01 US PATENT NUMBERS

- A. 5,265,981 issued November 30, 1993.
- B. 5,490,744 issued February 13, 1996.
- C. 5,915,886 dated June 29, 1999
- D. 6,368,025B1 dated April 9, 2002
- E. Other Foreign and U.S. Patents are issued or pending. Poly-Triplex® Technologies, Inc., et al, reserves all patents trademarks and copyrights.

PART 9 TECHNICAL SERVICE

9.01 CONTACT INFO

- A. Contact your local Poly-Triplex® Liner System licensed installer in your area or call, Fax or email to:
 - 1. Poly-Triplex® Technologies, Inc.
 - 2. 1701 Wynkoop Street, Suite 250, Denver, CO 80111
 - 3. Phone: 303-893-3100
 - 4. Fax: 303-893-3102
 - 5. Website: www.poly-triplex.com
 - 6. E-Mail: info@poly-triplex.com

END OF SECTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. All work required for disposal of waste from sewer cleaning operations required to complete the project.

1.02 UNIT PRICES

- A. Unless indicated otherwise in the proposal, this work shall be considered subsidiary to the project.

1.03 SUBMITTALS

- A. Submit to Owner disposal records.

1.04 METHODS

- A. Sewer grit, rubble, dislodged bricks and other such inorganic waste that is removed during cleaning shall not be allowed to continue downstream of the operation. Organic solids that remain in suspension would be allowed to continue downstream through the sanitary sewer system.
- B. A weir or other suitable trap shall be installed and maintained by the Contractor for the collection of such waste.
- C. This material shall be de-watered and delivered by the Contractor to a facility that is authorized to receive it. If this material is free of organic sludge and is sufficiently de-watered to pass the paint filter test, it would be acceptable for disposal at the Victoria Landfill subject to prior approval of the facility and the associated disposal fees.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Cleaning sewer lines to remove solids, roots, soil, sand, pieces of broken pipe, bricks, grease, grit from sewer lines and manholes and other debris, thus improving flow and facilitating television inspection for sewer evaluation. Cleaning includes initial manhole wall washing by high-pressure water jet.
- B. Television inspecting the line to obtain quality Digital Video Discs (DVDs) and Television Inspection Reports upon which the City Engineer can make decisions regarding needed sewer rehabilitation and repair. DVD shall be saved in a format such that they shall be able to be played on standard home DVD players.

1.02 MEASUREMENT AND PAYMENT**A. Unit Prices:**

- 1. Survey Normal Cleaning Equipment: Measurement for cleaning sanitary sewer mains with normal cleaning equipment is on a linear-foot basis. The Contract unit price for cleaning with normal equipment is full payment for sewer line actually cleaned and accepted. Cleaning using normal cleaning equipment includes:
 - a. Collection, removal, transportation and legal disposal of liquid wastes, soil, sand and other debris.
 - b. Locating, exposing and opening manholes on sewers to be cleaned.
 - c. Initial manhole wall washing with high-pressure water. Payment for additional cleaning and scrubbing of manhole walls which may be required for manholes rehabilitation is included in the unit price for manhole wall sealing as specified in Section 02768 – Corrosion Protection Liner and Rehabilitation of Manholes.
 - d. Reconstruction of manholes dismantled for cleaning equipment access, and repair of damage caused by dismantling or cleaning equipment.
- 2. Cleaning Using Mechanical Cleaning Equipment: Measurement for cleaning sanitary sewer mains with mechanical cleaning equipment is on a linear-foot basis for the quantity approved by the City Engineer. The Contract unit price for cleaning sanitary sewer mains with mechanical cleaning equipment is paid in addition to the unit price for cleaning using normal cleaning equipment. Mechanical cleaning is limited to locations approved by the City Engineer on a case-by-case basis after normal cleaning methods have failed to produce satisfactory results, as determined by viewing DVDs.
 - a. Mechanical cleaning prior to normal cleaning does not relieve the Contractor of the responsibility for fully cleaning the pipe with normal cleaning equipment.
 - b. Reconstruction of manholes dismantled for cleaning equipment access and repair of damage caused by dismantling or cleaning equipment.
 - c. Unit price for cleaning using mechanical equipment is compensation in full for all collection, removal, transportation and legal disposal of liquid wastes, soil, sand and debris regardless of quantity of material.
- 3. Survey Television Inspection: Measurement of survey television inspection for pipe segments selected by the City Engineer is on a linear-foot basis from centerline to

centerline of manholes. Payment for survey television inspection is made for the actual lengths of television inspection footage, as measured in the field at grade, as submitted for evaluation prior to final recommendations of sewer rehabilitation method. No separate payment will be made for the following:

- a. Poor or unacceptable-quality discs. Hazy, unclear pictures will not qualify for payment.
 - b. Re-taping any segment without prior approval of the City Engineer.
 - c. Portions of sanitary sewer not videoed. No payment will be made for length of sewer through which the camera could not pass.
 - d. Sewer flow control.
4. Survey Television Inspection by Floating Camera: Measurement of survey television inspection by floating camera for pipe segments selected by the City Engineer is on a linear-foot basis for actual footage taped from centerline to centerline of manholes. Such inspections may be required in 36-inch through 84-inch diameter sewer pipes, without any cleaning, for purely investigative studies. Payment for video inspection by floating camera shall be made based on a separate bid item for floating camera.
 5. Pre-Installation Cleaning: No separate payment will be made for pre-installation cleaning using normal cleaning equipment. Include cost for pre-installation cleaning in cost of line work for which the rehabilitation effort is performed. If a line is inspected and, in the opinion of the City Engineer, found to require no rehabilitation work, payment of cleaning will be made on the basis of survey normal cleaning.
 6. Pre-Installation Television Inspection: No separate payment will be made for pre-installation television inspection, except for lines inspected but not rehabilitated. Include cost for pre-installation television inspection in the cost of line work for which the rehabilitation effort is performed. If a line is inspected and found, in the opinion of the Engineer, to require no rehabilitation work, the Contractor will be paid for pre-installation television inspection on the basis of survey television inspection.
 7. Post Installation Television Inspection: No separate payment will be made for post-installation television inspection. Included cost for post-installation television inspection in the cost of line work for which the rehabilitation is performed. Post-installation television inspection tape policy allows payment for work based on the field-measured lengths indicated on the inspector's daily reports, but still requires the Contractor to submit a post-installation DVD within one calendar month after the segment completion. If no disc is received within that period, credit for the previously-paid line segment will automatically be deducted from pay estimates in following months until required disc is submitted.
 8. Footage paid for survey cleaning, under some circumstances, may exceed the footage paid for survey television inspection, as approved by the City Engineer.
 - a. Stipulated Price (Lump Sum): If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 DEFINITIONS

- A. Normal Cleaning Equipment. Cleaning devices such as rods, metal pigs, porcupines, root saws, snakes, scooters, sewer balls, kites, and other approved equipment in conjunction with

a hand-winch device and gas or electric rod-propelled devices. Variable pressure water nozzles (3,000 psi) are considered normal cleaning equipment.

- B. Mechanical Cleaning Equipment: Buckets, scrapers, scooters, porcupines, kites, heavy-duty brushes, metal pigs and other debris-removing equipment and accessories used in conjunction with approved power winching machines. High-to-very-high-pressure water nozzles (10,000 psi) are considered mechanical cleaning equipment.
- C. Survey Cleaning and Television Inspection. Video inspection of existing sanitary sewers to evaluate lines and determine whether conditions exist which will require line rehabilitation.
- D. Pre-Installation Television Inspection. Video inspection by the Contractor of sewer lines designated for rehabilitation to confirm cleaning, location of service connections, and constructability of line rehabilitation according to Drawings and Specifications.
- E. Post-Installation Television Inspection. Video inspection to determine whether rehabilitation of a sanitary sewer has been completed according to Drawings and Specifications.
- F. Television Inspection Report. A form that is filled out by each television operator for any television inspection effort that is submitted to the City, on a form provided by the City.

1.04 PERFORMANCE REQUIREMENTS

- A. Clean the designated sanitary sewers and manholes using mechanical, hydraulically propelled, or high-velocity sewer cleaning equipment. Select cleaning processes which will remove grease, soil, sand, silt, solids, rags, and debris from each sewer segment and associated manholes.
- B. The City Engineer may determine that no additional line rehabilitation work is required if the cleaning operation shows the sewer line to be free of damage or deterioration. The City Engineer may delete from the project any or all sanitary sewer lines which do not show a need for rehabilitation.

1.05 SUBMITTALS

- A. Make submittals in conformance with Section 01300 - Submittals.
- B. Submit the equipment manufacturer's operational manual and guidelines to the City Engineer for review. Strictly follow such instructions unless otherwise directed by the City Engineer.
- C. Submit a list of lawful disposal sites proposed for dumping debris from cleaning operations.
- D. Submit and maintain Liquid Waste Manifest conforming to City of Victoria requirements. Send the owner's regulator's copies of the completed manifests to the City Engineer within 24 hours after disposal of waste materials.
- E. Submit DVDs and Television Inspection Reports to the City Engineer for review.
 - 1. Provide digital video discs of a quality sufficient for the City Engineer to evaluate the condition of the sanitary sewer, locate the sewer service connections and verify cleaning. If quality is not sufficient, re-tape the sanitary sewer segment and provide a new disc and report at no additional cost to the City. Camera distortion, inadequate lighting, dirty lens, and blurred or hazy pictures will be causes for rejection of disc and associated line segment.

2. DVDs submitted become the property of the City and will be retained by the Maintenance Support Division.
3. Contractor shall maintain the master originals of all DVDs and TV Inspection Reports submitted, until final acceptance of Contract.
4. Transmit each TV Inspection Report Log to the Engineer. Copies of the TV Inspection Reports submitted, until final acceptance of the Contract.

1.06 QUALITY ASSURANCE

- A. Qualifications. Use experienced personnel to operate cleaning equipment and devices.
- B. Acceptance of sewer cleaning work is subject to successful completion of the television inspection. If video inspection shows debris, solids, sand, grease, or grit remaining in the line, the cleaning is considered unsatisfactory. Repeat cleaning, inspection, and videotaping of the sewer line until cleaning is acceptable by the City Engineer.
- C. For reporting overflow or spillage of wastewater, refer to Section 01500 - Temporary Facilities and Controls.

PART 2 PRODUCTS

2.01 CLEANING EQUIPMENT

- A. Select cleaning equipment and methods based on the condition of the sanitary sewer mains at the time work begins. More than one method or type of equipment may be required on a single project or at a single location.
- B. When requested by the City Engineer, demonstrate at the performance capabilities of cleaning equipment and methods proposed for use on the project. If results obtained by demonstration are not satisfactory, provide other equipment that will clean the sewer line.
- C. For high-velocity cleaning use a water jet capable of producing a minimum volume of 50 gpm with a pressure of 1500 psi at the pump. Install a gauge to indicate working pressure on the discharge of high-pressure water pumps. In addition to conventional nozzles, use a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18 inches and larger.
- D. When hydraulic or high-velocity cleaning equipment is used, install a suitable sand trap, weir, dam or suction device in the downstream manhole so that solids and debris are trapped for removal.

2.02 CLEANING ACCESSORIES

- A. When an additional quantity of water from the public water supply is needed to meet the cleaning requirements of the equipment and the sewer, obtain transient water meters from the City for installation on trucks or at fire hydrants.
- B. All cleaning equipment must be equipped with a backflow preventers (air gap or RPZ) to prevent contamination to the public water supply.

2.03 VIDEO EQUIPMENT

- A. Video Equipment: Select and use video equipment that will produce color digital video discs.

SECTION 02761

CITY OF VICTORIA STANDARD SPECIFICATIONS

CLEANING AND TELEVISION INSPECTION FOR CIPP LINING

- B. Digital Video Disc: Provide first generation digital video disc in a format that can be read by computer and by all DVD players. Permanently label each disc with the following information:

Project No.: _____ Contractor's Name: _____
Inspection Type: ☐ Survey ☐ Pre-Installation ☐ Post-Installation
Disc No.: _____ Date Taped: _____ Date Submitted: _____
Address: UPS: _____ DWN: _____
Pipe Diameter: _____ Pipe Length: _____
Manhole No.: From: _____ To: _____

- C. Pipe Inspection Camera. Produce a video using a pan-and-tilt, radial-viewing, pipe inspection camera that pans ± 275 degrees and rotates 360 degrees. Use a camera with an accurate footage counter which displays on the monitor the exact distance of the camera from the centerline of the starting manhole. Use a camera with camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe to be clearly seen. A reflector in front of the camera may be required to enhance lighting in dark or large-diameter pipe.
1. Two labels are required, one on the digital video disc case and the other on face of the disc.
 2. Disc shall show only one basin. Only line segments from the same basin shall be included on a single video disc.
 3. Up to 5 (maximum) line segments may be included on the same DVD if they are in the same basin.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin cleaning until both upstream and downstream manholes have been checked for flow monitors or other mechanical devices. Refer to Section 02768 – Corrosion Protection Liner and Rehabilitation of Manholes.

3.02 PREPARATION

- A. Cleaning.

1. Take precautions to protect sanitary sewer mains and manholes from damage that might be inflicted by the improper selection of cleaning processes or improper use of equipment. When using hydraulically-propelled devices, take precautions to ensure that the water pressure created does not cause damage to or flooding of public or private property. Do not surcharge any sanitary sewer to an elevation that could cause overflow of sewage into area waterways, homes, or buildings or onto the surface.
2. Do not use or obstruct a fire hydrant when there is a fire in the area. Remove water meters, fittings and piping from fire hydrants at the end of each working day.
3. Exercise care to prevent contamination of the potable water system. Use an appropriately sized backflow preventer as required by the City of Victoria Utilities Department when drawing water from a public hydrant.
4. Where possible, use the flow of wastewater present in the sanitary sewer main to provide fluid for hydraulic cleaning devices.

- B. Document results of video inspection using the Television Inspection Report form following this Section.

3.03 CLEANING

- A. Conserve Water. Do not waste water from the public water supply through poor connections, hydrants left open or any other cause.
- B. Collapsible Dams. Use collapsible dams for hydraulically propelled devices which require a head of water to operate. Dam shall be easily collapsible to prevent damage to the sewer, public and private property.
- C. High Velocity Cleaning: Operate high-velocity cleaning equipment so that the pressurized nozzle moves continuously. Turn off or reduce the flow to the nozzle to prevent damage to the line any time the nozzle becomes stationary.
- D. Mechanical Cleaning: In addition to normal cleaning equipment, perform mechanical cleaning when required and approved using equipment and accessories as defined in this Section.
- E. Debris Disposal. Remove sludge, soil, sand, rocks, grease, roots and other solid or semi-solid material resulting from the cleaning operation at the downstream manhole of the section being cleaned. Passing debris from any sewer section to any other sewer section is not allowed. Load debris from the manholes into an enclosed container permitted by the City of Victoria for liquid waste hauling. Remove solids and semi-solids resulting from cleaning operations from the site and dispose them lawfully at the end of each work day. Do not accumulate debris, liquid waste, or sludge on the site except in totally enclosed containers approved by the City Engineer. Contractor may choose to provide and store debris from the cleaning process in an enclosed container (roll-off container) as permitted by the City of Victoria for liquid waste hauling, or the Contractor may choose to leave the debris in the vacuum truck and haul directly to the disposal site.
- F. Disposal Sites. Dispose of waste at a lawfully-permitted disposal site using a transporter having a valid City Liquid Waste Transporter Permit.

3.04 TELEVISION

- A. Immediately after cleaning, video the sanitary sewer line to document the condition of the line and to locate existing service connections. Notify the City Engineer 24 hours in advance of any television inspection so that the City Engineer may observe inspection operations.
- B. Perform television inspection of sanitary sewers as follow:
 - 1. Perform a survey television inspection on sanitary sewers within the boundary of the project, as directed by the City Engineer. After reviewing survey digital video discs, the City Engineer will determine which sanitary sewers will be rehabilitated or need additional work.
 - 2. Perform pre-installation television inspection immediately after line cleaning and before line rehabilitation work. Pre-installation video is not required for sewer lines designated to be removed and replaced. Verify that the line is clean and ready to accept the line rehabilitation. Prepare Television Inspection Report forms. Maintain copies of discs and reports for reference by the City Engineer for the duration of the project.

3. Videos shall pan beginning and ending manholes to show that all debris has been removed. Camera operator shall slowly pan each service connection, clamped joint and pipe material transition from one material to another. Complete and submit a Television Inspection Report for every sewer segment video submitted to the City Engineer.
 4. Perform post-installation television inspection to confirm completion of rehabilitation work, including removal and replacement. Verify that rehabilitation work conforms to the requirements of the Drawings and Specifications. Provide a color digital video disc showing the completed work, including the condition of restored service connections. Prepare and submit Television Inspection Report forms providing location of service connections along with location of any discrepancies. Post-Installation video of completed manholes may be substituted for photographic documentation, as described in Section 02768 – Corrosion Protection Liner and Rehabilitation of Manholes. Manhole work, including benches, inverts and pipe penetrations into manhole, should be complete prior to post-installation video work.
- C. Survey television inspection discs shall be continuous for pipe segments between manholes. Do not leave gaps in the videotaping of a segment between manholes and do not show a single segment on more than one video, unless specifically allowed by the City Engineer.

3.05 FLOW CONTROL

- A. Perform survey TV inspection on one manhole section at a time. Adequately control the flow in the section being taped. Do not exceed the depth of wastewater flow shown below:

Pipe Diameter (inches)	Depth of Flow (percent of pipe diameter)
6–10	10
12–24	15
Over 24	20

1. If during survey television inspection of a manhole section, the wastewater flow depth exceeds the maximum allowable, reduce the flow depth to an acceptable level by performing the survey television inspection during minimum flow hours, by diversion pumping, or by pulling a camera with swab, high-velocity jet nozzle, or other acceptable dewatering device. Video made while floating the camera is not acceptable unless approved by the City Engineer.
- B. Minimize flow in the line while performing pre-installation television inspection. Diver the normal flow as specified in Section 01511 – Diversion Pumping, and clean the line to be inspected.
- C. No flow is allowed in the line while performing post-installation television inspection.

3.06 PASSAGE OF TV CAMERA

- A. Do not pull or propel the video camera through the line at a speed greater than 30 feet per minute.
- B. If during survey television inspection of a manhole section, the camera is unable to pass an obstruction even though flow is unobstructed, televise the manhole section from the other direction (reverse setup) in order to obtain a complete video of the line. Whenever such a condition arises, notify the City Engineer to determine whether an obstruction removal or

point repair is necessary. If a point repair is authorized, repair the pipe at the designated location and then re-televise the manhole section to verify completion of the point repair, unless waived by the City Engineer.

1. When the camera is being pulled from the other direction in order to survey on either side of an obstruction and a second obstruction or repair location is encountered away from the first obstruction, notify the City Engineer and request a review of the digital video disc. The City Engineer may direct the Contractor to make one or both point repairs. No downtime shall be allowed.
 2. If two point repairs are allowed and completed, re-tape 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 repair may be lamped or physically inspected to verify the condition of the sewer without further television inspection.
 3. The City makes no guarantee that the sanitary sewer designated for survey television after cleaning is clear for the passage of the camera set-up. Select the appropriate equipment, tools, and methods for securing safe passage of the camera.
- C. During pre-installation television inspection, camera passage should show the line is ready for rehabilitation. Report to the City Engineer any variations between previous reported (existing data) conditions and the actual conditions encountered.
- D. For post-installation television inspection, exercise the full capabilities of the camera equipment to document the completion of the rehabilitation work and the conformance of the work to the Drawings and Specifications. Provide a full 360-degree view of pipe, joints, and service connections.

3.07 TELEVISION INSPECTION REPORT

- A. For each television inspection video provide a completed Television Inspection Report, as attached at the end of this section. The Report is a written narrative log of pipe defects, sags, service connection locations and conditions, indexed to the footage counter. Fill out the Television Inspection Report as follows.
- B. HEADER SECTION
1. ADDRESS UPS/DWN: The upstream and downstream address of the line segment; an alpha-numeric field with 6 spaces available for the street number and 21 spaces available for the street name (e.g., UPS: 2150 Sunnyland DWN: 2110 Sunnyland).
 2. W. W. File NO.: The Wastewater File number; found on the Contract Documents; an alpha-numeric field with 10 spaces available (e.g., 4250-49).
 3. WORK ORDER NO.: Since this number will be provided by the City, this field shall be left blank. This is a numeric field with 10 spaced available.
 4. TAPING DATE: The date that the digital video disc was produced (same as the date shown on the display screen), a numeric field with 8 spaces available (e.g., 2/21/95).
 5. BASIN: The basin that the line segment is located in; an alpha-numeric field with 10 spaces available (e.g. IA010).
 6. VIDEO CONTRACTOR: The Video Contractor's name; an alpha-numeric field with 5 spaced available (e.g., KIN) (Kinsel), IGS (Insituform or Chief).

7. WEATHER: The existing weather conditions at the time that the video was made; an alpha-numeric field with 10 spaced available (e.g., Cloudy).
8. VTR FORMAT: An alpha-numeric field with 4 spaces available (e.g., DVD).
9. DISC NUMBER: Each digital video disc produced must have a disc number for identification, affixed to the disc label. This number must not be duplicated in the same project. This is an alpha-numeric field with 6 spaced available (e.g., IA0101).
10. VTR INDEX: The numeric location of the line segment on the disc; an alpha-numeric field with 6 spaces available for each number (e.g., 1336 to 2185).
11. SUMMARY:
 - a. Use for additional information about the line segment as follows:
 - 1) Type of video (e.g., Post, Survey, Pre-Rehabilitation)
 - 2) General Contractor (e.g., Cullum, Kinsel, Texas Sterline)
 - 3) Rehabilitation Method (e.g., FF, CPP, PB, SL, RR)
 - 4) Rehabilitation System Manufacturer or Trade Name when applicable (e.g., Insituform, Inliner II, PIM System, McConnell Pipe Crushing, U Liner).
 - 5) Pipe Trade Name for PVC, PEP or FRP pipe e.g., Hobas, Drisco 1000, Lamson Vylon, Quail).
 - b. Note information according to the following examples:
 - 1) Post/Cullum/FF/U Liner/Quail (a typical listing for a **Fold and Form** line segment).
 - 2) Post/Insituform/PP/Insituform (a typical listing for a **Cured-in-Place** line segment).
 - 3) Post/McLat/PB/McConnell Pipe Crushing/Drisco 1000 (a typical listing for a **Pipeburst** line segment).
 - 4) Post/Kinsel/SL/Hobas (a typical listing for a **Sliplined** line segment).
 - 5) Post/Texas Sterling/RR/Lamson Vylon (a typical listing for a **Removed and Replaced** line segment).
12. LOCATION: The physical location of the line segment (for the line segment, not the manholes). If the line segment covers more than one location, then state the location at the majority of line segment. Location codes are listed on the attached Television Inspection Codes list. This is an alpha-numeric field with 2 spaces available (e.g., C).
13. SURFACE COVER: The type of surface that covers the majority of the line segment. Codes for surface cover are listed on the attached Television Inspection Codes list. This is an alpha field with only 1 space available (e.g., F).
14. PIPE SIZE: The inside diameter of the liner or pipe in inches, based on new pipe size, material and SDR; a numeric field with 6 spaces available, including 2 spaces for decimals (e.g., 6.58 IN).
15. PIPE TYPE: The pipe of liner type installed; an alpha field with 3 spaces available (e.g., PEP, CPP, PVC).
16. LENGTH: The length of the line segment, in feet. The length shown on the Television Inspection Report must be the same as the length shown on the digital video disc. Also, the length on the top portion of the Television Inspection Report shall match that shown

on the bottom portion of the Television Inspection Report. This is a numeric field with 4 spaces available, with no decimals (e.g., 305 FT).

17. UPS DEPTH: The depth, measured from the top of the manhole frame of the upstream manhole to the invert of the upstream manhole, in feet and tenths of a foot; a numeric field with 3 spaces available, including one space for a decimal (e.g., 6.9 FT).
18. DWN DEPTH: The depth, measured from the top of the manhole frame of the downstream manhole to the invert of the downstream manhole, in feet and tenths of a foot; a numeric field with 3 spaces available, including one space for a decimal (e.g., 7.4 FT).
19. JOINT LENGTH: The pipe joint length, in inches. Show "O" joint length for CPP, FF and PEP line segments (since they have no joints). This is an alpha field with 2 spaces available (e.g., 40 IN).
20. FLOW DEPTH: The pipe or liner flow depth shall be placed in this field. The unit of measure is inches. This is a numeric field with 3 spaces available, which includes one decimal place, (e.g., 2.5 IN).
21. MASTER DISC NO.: Contractor's master disc number (if one exists).
22. REVERSE SET UP: When a reverse set up is done on a line segment, check "yes"; if not, check "no".
23. SKETCH: If a sketch of the line segment is included check "yes"; if not, check "no".
24. PRIOR HISTORY: If any prior information exists on this line segment check "yes"; if not, check "no".
25. EVALUATION VIDEO: If the Television Inspection Report is for line segment evaluation or survey purpose, check "yes"; if not, check "no".
26. PRE-REHAB VIDEO: If the Television Inspection Report is for pre-installation video inspection to document completion of the rehabilitation work, check "yes"; if not, check "no".
27. POST-REHAB VIDEO: If the Television Inspection Report is for post-rehab video inspection to document completion of the rehabilitation work, check "yes"; if not, check "no".
28. LINE DETERIORATION: Indicate here the existence and extent of pipe deterioration. If no deterioration, check "N"; if deterioration is light, check "L"; if medium, check "M"; if heavy, check "H".
29. DIRECTION OF FLOW: Indicate the direction of flow in the line segment. Typically, the larger number is the upstream manhole and the smaller number is the downstream manhole. Do not reverse the manhole designation; if a reverse set up is shown, check the "Reverse Setup" box.

C. CODE INPUT SECTION

1. TELEVISION INSPECTION CODES: Codes to be used in reports are specified and defined on the Television Inspection Codes sheet (attached following this Section and Sample Report form).

2. FOOTAGE READING U/D: Show the up/down designation under the section titles "Footage Reading" in the boxes marked "U" and "D". This will make it clear what direction footage is measured from.
 3. CLOCK POSITION: Show the clock position, with 12 o'clock straight up, of each defect (e.g., 12:00, 3:00). Also, show the clock positions of each service connection and state the condition of the connection. Include the distance the connection is protruding into the pipe, when appropriate, and the type of connection, such as "plumber service".
 4. CRACKS: List cracks in the pipe Television Inspection Codes. Report the size (length and width) of all cracks.
 5. JOINTS: List misaligned and broken joints using Television Inspection Codes.
 6. LATERALS: List all laterals using the Television Inspection Codes.
 7. ROOTS: List any root intrusions in the pipe using Television Inspection Codes.
 8. DEBRIS: List any debris in the pipe using Television Inspection Codes.
 9. INFLOW/INFILTRATION: Report any inflow and infiltration using Television Inspection Codes.
 10. ALIGNMENT: Report the existence of any sags in the field using Television Inspection Codes. Report the beginning of sags for one-quarter pipe, one-half pipe and underwater, as well as where the camera pulls out of the sag.
 11. STRUCTURAL: Report structural condition of the pipe using Television Inspection Codes.
 12. PICTURE NO.: Leave this field blank.
 13. COMMENTS: Place comments in this field. Comments must be accompanied by a corresponding footage reading. Items to report in this field: collapses in pipe, stabilized material, mineral deposits, changes in pipe material, reverse setup, drop stack, large voids, multiple cracks, when unable to continue video, etc.
 14. CLAMP/SPLICE LOCATION: The clamp/splice location shall be shown in the Comments field. Clamp/splice locations must be accompanied by a footage reading.
 15. START SURVEY AT M.H. XYZ: Note the depth of the line segment in the Comments field (e.g., "Start Survey at M.H. 021 – Line Depth 10.2 FT"). Measure depth from the top of the manhole frame to the invert of the pipe being televised in feet and tenths of a foot. (This depth may be different from the manhole depth).
 16. END OF SURVERY AT M.H. XYZ: Note the depth of the line segment in the Comments field (e.g., End Survery at M.H. 022 – Line Depth 10.8 FT). Measure depth from the top of the manhole frame to the invert of the pipe being videoed in feet and tenths of a foot. (This depth may be different from the manhole depth).
- 3.08 FIELD QUALITY CONTROL
- A. Do not under any circumstances, allow sewage or solids removed in the cleaning process to be released onto streets or into ditches, catch basins, cleanouts, storm drains, sanitary or storm sewer manholes.

- B. Acceptance of sewer cleaning work is subject to successful completion of the television inspection. If the television inspection shows solids, soil, sand, grease, grit, or other debris remaining in the line, cleaning will be considered unsatisfactory. Repeat cleaning, inspection, and televising of the sewer line until cleaning is satisfactory by the City Engineer.

3.09 MANHOLE REPAIR

- A. Repair manholes dismantled or damaged during the cleaning process, and replace manhole frames and covers damaged during the cleaning process.

END OF SECTION

ATTACHMENT TO 02761

TELEVISED INSPECTION REPORT LOG

DATE: _____ TIME: _____

PROJECT: _____

OPERATOR: _____

ENTRY POINT: _____ EXIT POINT: _____

EXISTING PIPE TYPE: _____ EXISTING PIPE SIZE: _____

MANHOLE DEPTH: _____

TAPE NUMBER: _____ STARTING COUNTER: _____

CAMERA STARTING FOOTAGE: _____

COMMENTS: _____

CAMERA FOOTAGE (DISTANCE FROM ENTRY POINT)	OBSERVATION/COMMENTS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Installation of service stubs on new sanitary sewers serving areas where sanitary sewer service did not previously exist.
- B. Reconnection of existing service connections along parallel, replacement, or rehabilitated sanitary sewers.

1.02 UNIT PRICES

- A. Measurement for sanitary sewer service lines from the sewer main to the property line is on a per each basis, complete in place. Augured pipe for service stubs will be paid as provided in Section 02316 - Pipe and Casing Augering.
- B. Pay estimates payments will be made as measured above according to the following schedule:
 - 1. Payment will be authorized when the reconnection is completely installed and backfilled, including pavement repair, if necessary.
 - 2. Payment will be authorized when the reconnection has been tested as specified in Section 02732 - Acceptance Testing for Sanitary Sewers.
- C. One or more connections discharging into a common point are considered one service connection. The Contractor shall not add service reconnections without approval of the City Engineer. The City Engineer may require reconnections to be moved or relocated to avoid having more than two houses per reconnection.

1.03 PERFORMANCE REQUIREMENTS

- A. Accurately locate in the field all proposed service stubs along the new sanitary sewer main.
- B. Accurately locate in the field existing service connections and proposed service stubs along the alignment of the new parallel or replacement sewer main.

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 manhole.

PART 2 PRODUCTS**2.01 PVC SERVICE CONNECTION**

- A. As stubouts, use PVC sewer pipe, 4-inch through 10-inch, conforming to ASTM D 1784 and ASTM D 3034, with a cell classification of 12454-B. The SDR (ratio of diameter to wall thickness) shall be 26 for pipe 10 inches in diameter or less.
- B. PVC pipe shall be gasket jointed with gasket conforming to ASTM D3212.

- C. Provide service connection pipe in sizes shown on the Drawings. For reconnection of existing services, select service connection pipe diameter to match existing service diameter.
- D. Provide a 6-inch service connection when more than one service discharges into a single pipe.
- E. 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.
- F. 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 service to the new sewer main.

2.02 PIPE SADDLES

- A. Use pipe saddles only on rehabilitated sanitary sewer mains. Comply with Paragraph 2.01E 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.

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., Series 1055 with shear ring SR-8;
 - 2. Band Seal by Mission Rubber Co., Inc.;
 - 3. Approved equal.
- B. For connection between new PVC pipe stubout and new service, use rubber-gasketed adapter coupling:
 - 1. GPK Products, Inc., IPS & Sewer Adapter.
 - 2. 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 and as shown on the Drawings.
- C. Provide stacks of the same nominal diameter at the sanitary service line.

2.05 CLEAN-OUTS

- A. Install clean-outs at property line on each service connection 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 equal.

PART 3 EXECUTION

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 City Engineer. Plug the service connection at the R.O.W. for vacant lots.
- E. Complete reconnection of service lines within 24 hours after disconnection.
- F. Reconnection shall include the stack and fittings 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. Where sewers are existing, field locate existing service connections, whether in service or not. Use existing service locations to reconnect service lines to new liner or new sanitary sewer main.
- 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.

3.04 EXCAVATION AND BACKFILL

- A. Excavate in accordance with Section 02227 - Excavation and Backfill for Utilities.
- B. 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.

- C. 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 RECONNECTION ON NEW SEWER

- A. Install the new service connection on the new sanitary sewer main for each service connection.
- B. Remove and replace cracked, offset or leaking service line for up to 5 feet, measured horizontally, from the centerline of the new sanitary sewer main.
- C. Make up the connection between the new main and the existing service line using PVC sewer pipe and approved couplings, as shown on the Drawings.
- D. Test service connections before backfilling.
- E. 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.

3.06 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.

3.07 TESTING

- A. Test service reconnections and service stubs. Follow applicable procedures given in Section 02732 - Acceptance Testing for Sanitary Sewers.

3.08 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 and Resurfacing. In unpaved areas, bring surface to grade and slope surrounding the excavation. Replace a minimum of 4 inches of topsoil and seed according to requirements of Section 02932 - Hydromulch Seeding.
- C. Conform to Section 01564 - Waste Material Disposal.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Repairs to existing sewer lines by replacing short lengths of failed pipe.
- B. Remove obstructions by excavation or remote device.

1.02 UNIT PRICES

A. Sewer Line Point Repairs

1. Measurement for point repairs is on a unit price basis for each repair performed on each diameter for all depths.
2. Measurement for extra length repair is on a linear foot basis in excess of replacement length specified in bid item.
3. The cost of the following items of work is included in the unit prices for sewer line point repairs:
 - a. Excavation, embedment and backfill.
 - b. Hauling excess excavation and debris.
 - c. Pipe, pipe fittings, adapters and concrete collars.
 - d. Restoration of site improvements, including Sodding.
 - e. Pre- and post-repair cleaning and television inspection.
 - f. Abandonment of point repair.
4. Obstruction Removal by Remote Device:
 - a. Obstruction removal of protruding taps by remote device will be paid per unit price for each removal. Obstruction removal can be submitted for payment when the obstruction has been cleared from the sewer line to be lined.
 - b. No payment will be made for obstruction removal of protruding tap if the service reconnection is performed by excavation.
 - c. Removal of other obstruction (fixed debris, stabilized material, hanging gaskets, heavy roots, hardened mineral deposits, etc.) will be paid per unit price for each setup. A setup consists of one manhole section where one or more removals are accomplished.
 - d. Pre- and post-obstruction removal cleaning and television inspection are included in the unit prices for obstruction removal by remote device.
 - e. Payment will not be made for obstruction removal if the existing sewer line, service line or tap is damaged by the Contractor and a point repair is required.
 - f. Removal of hard deposits, concrete, debris, pipes or any other material in the manhole or that is accessible from the manhole wall will be cleared under work items for rehabilitation of sanitary sewer pipes and manholes.

5. Obstruction Removal by Excavation:

- a. Obstruction removal by excavation will be paid per unit price for each removal. Obstruction removal can be submitted for payment when the obstruction has been cleared from the sewer line to be lined.
- b. Liner work must proceed a minimum of 6 feet before payment for removal of another obstruction by excavation will be considered.
- c. Depth shall be measured from natural ground level to the flow line at the point of obstruction removal.
- d. The cost of the following items of work is included in the unit prices for obstruction removal by excavation:
 - i. Excavation, embedment and backfill.
 - ii. Hauling excess excavation and debris.
 - iii. Restoration of site improvement, including Sodding.
 - iv. Post obstruction removal cleaning and television inspection.
- e. Payment will not be made for obstruction removal if the existing sewer line, service line or tap is damaged by the Contractor and a point repair is required.
- f. Removal of hard deposits, concrete, debris, pipes or any other material in the manhole or that is accessible from the manhole wall will be cleared under work items for rehabilitation of sanitary sewer pipes and manholes.

1.03 PERFORMANCE REQUIREMENTS

A. Sewer Line Point Repair

1. Locate and replace small lengths of one or more pipe sections where isolated line failure has occurred due to settlement, corrosion, crushing or separation of joints.
2. ENGINEER may identify potential locations for point repair, but Contractor is responsible for verifying locations.
3. Determine the location of point repairs by TV inspection of the manhole section in which the failed pipe is located. ENGINEER will authorize each point repair after failed points are located. Do not make point repairs without prior approval of ENGINEER.
4. Replace carrier pipe for all point repairs unless otherwise directed by ENGINEER.

B. Obstruction Removal

1. Remove obstructions by one of the following methods:
 - a. Obstruction removal by remote device:
 - i. Protruding taps service lines that protrude greater than 1 inch into the sewer.
 - ii. Other obstructions hanging gaskets, fixed debris, stabilized sand, hardened mineral deposits, roots, rust scale, tuberculation, etc.

- b. Obstruction removal by excavation. An obstruction encountered during liner insertion that is removed by digging and exposing the pipe.
- c. Obstruction removal could run entire length of sewer line depending on direction of the ENGINEER.

1.04 DEFINITIONS

- A. Point Repair. Repair of broken or collapsed gravity sanitary sewer lines on public property, including mains, collectors and service lines by replacing at the point of failure, the length of failed pipe with new pipe.
- B. Obstruction Removal. Clearing the sewer main of obstructions to allow for rehabilitation.
- C. Sewer Lines. Gravity flow pipelines in the easement or right-of-way, which collect sanitary sewer discharges from commercial or residential service lines and discharge into another sewer line (main or collector), lift station or treatment plant.

1.05 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 – Submittals.
- B. Submit product data for each pipe product, fittings and jointing material.
- C. Submit certified test results prepared by manufacturer for joining material integrity.

1.06 SEQUENCING

- A. Complete point repairs before rehabilitating sewer between adjacent manholes.
- B. Clean line and make closed-circuit television inspection for each point repair.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials for point repairs, other than those specified, may be considered for use in rehabilitation of existing sewers.
- B. For consideration of other materials, submit complete manufacturer's data including material, sizes, flow carrying capacity, installation procedures and history of similar installations to ENGINEER for pre-bid evaluation.

2.02 PVC PIPE

- A. PVC sewer pipe and joints: 6 inch through 18 inch pipe conforming requirements of Section 02620 – PVC Pipe.

2.03 DUCTILE IRON PIPE

- A. Ductile iron pipe: 4 inch through 48 inch, conforming to requirements of Section 02610 – Ductile Iron Pipe and Fittings.
- B. Fittings: Push-on end joint fittings with bell-and-spigot ends, with bell modified for push-on joint, conforming to requirements of Section 02610 – Ductile Iron Pipe and Fittings.

- C. Interior Coating: Conform to requirements of Section 02610 – Ductile Iron Pipe and Fittings for sanitary sewers.
- D. Exterior Coating: 8 mil polyethylene tubular material conforming to requirements of Section 02630 – Polyethylene Wrap.

PART 3 EXECUTION

3.01 PROTECTION

- A. Provide barricades and warning lights and signs for excavations created by point repairs. Conform to requirements of Section 01500 – Temporary Facilities and Controls.
- B. Do not allow sand, debris or runoff to enter sewer system.

3.02 EXCAVATION

- A. Excavation trenches in accordance with Section 02227 – Excavation and Backfill for Utilities.
- B. 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.

3.03 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 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 and OWNER so that required reporting can be made to the Texas Water Commission and the Environmental Protection Agency.

3.04 TYPICAL SEQUENCE OF POINT REPAIR

- A. Survey, clean and televise to verify the location of point repair.
- B. 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 ENGINEER and obtain approval before proceeding.
- D. Remove and replace failed pipe and connect to existing pipe using flexible adapters. If joints cannot be made watertight using flexible adapters, place water stop gaskets on each joint and encase in a reinforced concrete collar as indicated on the Drawings. Place concrete as specified in Section 03305 – Concrete for Utility Construction and Minor Paving.
- E. Establish proper grade for the pipe being replaced using methods acceptable to ENGINEER.

- F. After completion of point repair, but prior to backfill, perform a smoke test in the presence of ENGINEER. Testing as specified in Section 02732 – Acceptance Testing for Sanitary Sewers. Repair and retest sections that fail.
- G. Encase exposed pipe in cement stabilized sand conforming to Section 02252 – Cement Stabilized Sand as indicated on Drawings.
- H. Backfill the excavation as specified in Section 02227 – Excavation and Backfill for Utilities.
- I. Replace pavement or sidewalks removed or damaged by excavation in accordance with Section 02570 – Pavement Repair and Resurfacing. In unpaved areas, bring surface to grade and slope surrounding the excavation. Replace a minimum of 4 inches of topsoil and seed area in accordance with Section 02932 – Hydromulch Seeding.
- J. Perform a post-completion TV inspection. 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 work is rejected.

3.05 ABANDONMENT OF POINT REPAIR

- A. If a pipe is exposed and found in good condition, not requiring a point repair, notify ENGINEER who will record abandonment of point repair.
- B. Backfill the excavation, replace pavement or sidewalk and repair and seed or sod unpaved areas as specified in paragraph 3.04 – Typical Sequence of Point Repair.

3.06 OBSTRUCTION REMOVAL

- A. Remote Device. Remove obstructions identified on video tape of a sanitary line segment which could cause a non-uniform liner pipe installation or obstruction of the liner during installation. Obtain approval from the ENGINEER for obstruction removal with a remote device before proceeding.
 - 1. Use a power driven cutting device (Robotic cutter) to remove protruding taps. Cut the protruding tap so that the protrusion is no greater than 3/4 inch. If the cutting device cannot remove the protruding tap, then point repair may be performed at the direction of the ENGINEER.
 - 2. To remove other obstructions, use a remove device. Pull or drive the devices from manhole to manhole using a solid steel mandrel, porcupine, root saw, bucket, robotic cutter or similar devices to remove the obstruction. Select a device that is adequately sized to remove the obstruction.
- B. Excavation. Use excavation as the method of obstruction removal when installation of the liner in the sanitary sewer is in progress. 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 the linear, notify the ENGINEER for approval to make an excavation. Uncover and remove the obstruction in the following manner.
 - 1. Excavation at the point where there is an obstruction. Use a trench safety system, as required.
 - 2. Break out the existing sanitary sewer pipe (carrier pipe) as directed by the ENGINEER. Remove only that amount of material which is causing the obstruction. Remove the minimum amount of carrier pipe.

3. Under such conditions, replacement of the carrier pipe is not required. Do not disturb the existing sewer bedding during excavation. However, if embedment is disturbed during the obstruction removal procedure, place cement stabilized sand or crushed stone beneath the liner.
4. When the liner is completely in place, encase it with crushed stone or cement stabilized sand, as applicable.

END OF SECTION

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 MEASUREMENT AND PAYMENT

- A. Unit Prices.

1. Payment for grout fill and abandonment of existing gravity sewers and force mains is on a linear foot basis for each diameter of sewer being abandoned. Measurement will be along the centerline of the sewer from centerline to centerline of manholes.
2. Payment for grout fill and abandonment of sanitary sewer manholes is by each manhole abandoned in conformance with this Section.
3. Payment will be full compensation for all material, equipment, and labor required for complete abandonment grouting, including air venting, testing, temporary plugs, PVC pipes and all incidentals.
4. Refer to Section 01025 - Measurement and Payment for Unit Price Procedures.

- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for Work in this Section is included in the total Stipulated Price.

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 REFERENCE STANDARDS

- A. ASTM C 33 - Standard Specifications for Concrete Aggregates.
- B. ASTM C 138 - Standard Test Method for Unit Weight, Yield and Air Content (gravimetric) of Concrete.
- C. ASTM C 150 - Standard Specification for Portland Cement.
- D. ASTM C 494 - Standard Specification for Chemical Admixture for Concrete.

- E. ASTM C 618 - Standard Specification for Fly Ash and Raw or Calcinated Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
- F. ASTM C 937 - Standard Specification for Grout Fluidifier for Replaced Aggregate Concrete.
- G. ASTM C 940 - Standard Test Method for Expansion and Bleeding of Freshly Mixed Grout for Replaced Aggregate Concrete.
- H. ASTM C 942 - Standard Test Method for Compressive Strength of Grout for Replaced Aggregate Concrete into Laboratory.
- I. ASTM C 953 - Standard Test Method for Time of Setting of Grout for Replaced Aggregate Concrete in the Laboratory.
- J. ASTM C 1017 - Standard Specification for Chemical Admixture for use in Producing Flowing Concrete.
- K. ASTM C 1107 - Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)
- L. ASTM D 4823 - Standard Test Method for Preparation and Testing of Soil - Cement Slurry Test Cylinders.
- M. U.S. Army Corps of Engineers - Specification CRD C 621, Non-shrink Grout.

1.05 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 PRODUCTS

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 C 150 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 C 618 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 No. 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 plus or minus 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, add at least 30 percent of natural aggregate shall be added as necessary to provide workability.
 6. Admixtures: Use admixtures meeting ASTM C 494 and ASTM C 107 as needed to improve pumpability, to control time of set, and reduce bleeding.
 7. Fluidifier: Use a fluidifier meeting ASTM C 937 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 C 940.
 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 C 1107, 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 EXECUTION

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 01564 - Waste Material Disposal.
- 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 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 nearest City of Victoria for future use. If called for on the plans, and approved by the Engineer and City Engineer, salvaged castings may be used for construction 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
- 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 manufacture'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 01564 - Waste Material Disposal.

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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Approved methods and materials for the rehabilitation of deteriorated gravity sewer lines by the Cured-In-Place Pipe (CIPP) method.
- B. Refer to Section 10100 – Corrosion Protection Liner and Rehabilitation of Manholes for Existing Manhole Rehabilitation Requirements.

1.02 UNIT PRICES

- A. Measurement and payment for cured-in-place pipe is on a linear foot basis measured along the centerline of the pipe from centerline to centerline of manholes and shall be considered full compensation for all labor and materials required to install the liner to the specified requirements. The cost should also include rehabilitating existing manholes at either end and along CIPP installation (access points).
- B. No separate payment will be made for the following items of work. Include cost in the unit price for installing cured-in-place pipe:
 - 1. Diversion pumping as specified in Section 01511 – Diversion Pumping.
 - 2. Pre-Installation and post-installation cleaning and TV inspection as specified in Section 02761 – Cleaning and Television Inspection.
 - 3. Sealing the liner in manholes.
 - 4. Reworking invert and benches for manholes.
 - 5. Temporary meter and municipal water obtained from a City fire hydrant.
 - 6. Rehabilitating existing manholes at either end and along CIPP installation (access points).
- C. Where post-installation thickness measurements and/or physical property testing is performed, payment for installed cured-in-place pipe shall be made in accordance with:
 - 1. If thickness, flexural strength, and flexural modulus of elasticity of the installed CIPP are all 95% or better of the specified values, full payment shall be paid accordingly.
 - 2. If thickness, flexural strength, and flexural modulus of elasticity are between 90% and 95% of the specified values, payment shall be based on:

Adjusted Unit Price = Unit Price Bid x Value Factor, where:

Value Factor = $\frac{\text{actual thickness}}{\text{specified thickness}} \times \frac{\text{actual flexural strength}}{\text{specified flexural strength}} \times \frac{\text{actual flexural modulus of elasticity}}{\text{specified flexural modulus of elasticity}}$

*Insert actual measured or tested result expressed as a percentage of specified value. Maximum allowable percentage is 100%.

- D. Payment for Point Repairs and Obstruction Removals will be made according to Section 02763 – Point Repairs to Sanitary Sewers and Obstruction Removals.
- E. Payment for repair of sags in the line will be made either according to Section 02763 - Point Repairs to Sanitary Sewers and Obstruction Removals, or according to the diameter and depth of the pipe if “Remove and Replace” is the method of repair designated by the Engineer.
- F. Refer to Section 01025 – Measurement and Payment for unit price procedures.

1.03 REFERENCES

- A. AASHTO Standard Specifications for Highway Bridges.

- B. ASTM C581 – Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures, Intended for Liquid Service.
- C. ASTM D543 – Test Method for Resistance of Plastics to Chemical Reagents.
- D. ASTM D790 – Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- E. ASTM D5035 – Test Method for Breaking and Elongation of Textile Fabrics (Strip Method).
- F. ASTM D3567 – Standard Practice for Determining Dimensions of Reinforced Thermosetting Resin Pipe (RTRP) and Fittings.
- G. ASTM D3681 – Test Method for Chemical Resistance of Reinforced Thermosetting Resin Pipe in a Deflected Condition.
- H. ASTM D5813 – Standard Specification for Cured-In-Place Thermosetting Resin Sewer Pipe.
- I. ASTM E1251 – Standard Practice for General Techniques for Qualitative Infrared Analysis.
- J. ASTM F1216 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
- K. ASTM F1743 – Standard Practice for the Rehabilitation of Existing Pipelines and Conduits by the Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP).
- L. ASTM D5199 – Standard Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
- M. ASTM 2019 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled-in-Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP).

1.04 SYSTEM DESCRIPTION

- A. The process generally consists of inserting a resin-impregnated flexible tube into an existing sewer, expanding the tube against the existing sewer, and curing the tube to form a pip liner. Curing is accomplished by either exposing the liner to ultraviolet light or circulating heated water or steam or ambient temperature water or air to affect the desired cure throughout the tube from manhole to manhole.
- B. The CIPP cures into a hard, impermeable, corrosion resistant liner of the specified thickness and physical properties, with a uniformly smooth interior surface.
- C. The general guides for materials and installation of the CIPP are ASTM D5813, F1216, 2019 and F1743, as modified by this specification. The City reserves the right to approve any material or installation practice which may differ from these standards.

1.05 SUBMITTALS

- A. Make submittals in conformance with requirements of Section 01300 – Submittals.
- B. Resin
 - 1. Submit technical data sheet showing physical and chemical properties, as modified for the specified CIPP process.

2. Submit test results of chemical resistance testing performed by the resin manufacturer demonstrating compliance with requirements of Section 2.03 A.
3. Submit infrared spectrum analysis per ASTM E1251 (chemical fingerprint) of proposed resin system as modified for the CIPP process.

C. Flexible Tube

1. Submit technical data sheet showing physical properties, as per ASTM 5035.
2. Submit tabular summary by sewer segment noting required thickness, and certification that liner's "dry" thickness is greater than or equal to the required cured laminate thickness, as per section 2.04 B. Thickness measurements shall be in accordance with ASTM D5199. Should the liner be fiberglass CIPP, the minimum allowable wall thickness shall be 2.8 mm or greater as required by ASTM 1216 Design Formula, in 0.70-mm increments.

D. Cure-In-Place Pipe

1. Prepare and submit curing schedule.
2. Submit copies of curing log sheets with temperature reading prior to curing, during curing, and during cool down for each installation section. Must be submitted at least weekly.
3. Submit copies of all test results performed by the Contractor's Independent Testing Laboratory for test listed in 2.03 of this specification.
4. Submit Contractor's Quality Control Plan and/or Procedures showing control conditions used during impregnation of the resin to ensure proper materials and proper dispersion is achieved in the wet out process.
5. Submit pre- and post-installation TV inspection tapes as specified in Section 02761 – Cleaning and Television Inspection.

E. Corrosion Protection Liner

1. Refer to Section 10100 - Corrosion Protection Liner and Rehabilitation of Manholes, for submittal requirements for corrosion protection liners for manholes.

1.06 QUALITY ASSURANCE

- A. Though the process may be licensed, no change of material, design values, or procedures may be made during the course of the Work without the prior written approval of the Engineer.

PART 2 PRODUCTS

2.01 SUPPLIERS

- A. Manufactures shall be approved by the City and Engineer as acceptable manufacturers of this product.

2.02 MATERIALS

A. Flexible Tube

1. Provide a flexible tube manufactured and fabricated under quality controlled conditions set by the process manufacturer. Use a tube sized so that, when installed, the tube will snugly fit the internal circumference of the sewer pipe and produce the specified thickness and physical properties when the resin cures.
2. Use a tube length necessary to fully span the distance between manholes. Include sufficient amount of material for sealing at manholes and product sampling (when required).
3. Fabric tube shall have a minimum tensile strength of 750 psi in both the longitudinal and transverse directions when tested in accordance to ASTM D5035.
4. The tube may consist of one or more layers of flexible needled felt or an equivalent non-woven or woven material or a combination of non-woven and woven materials that are compatible with the resin system used and are capable of supporting and carrying resin, and capable of withstanding installation pressures and curing temperatures. The tube should be

capable of withstanding installation procedures and curing temperatures. Longitudinal and circumferential joints between multiple layers of a tube should be staggered to not overlap. The tube shall be fabricated to fit its final in-place position in the existing pipe, with allowance for stretch as recommended by the tube manufacturer. The elongation or expansion of the flexible tube during installation, both longitudinally and circumferentially, should be limited to 5 to 10% minimize reduction of the finished wall thickness.

5. The tube may consist of a seamless, spirally wound glass fiber that is flexible and has strain values (expandable) between five (5) and ten (10) percent. The fiberglass liner shall not have a longitudinal seam. The impregnated liner shall have a uniform thickness that, when compressed at installation pressures, will meet or exceed the design thickness. Fiberglass materials must be "direct sized" to enhance the fiberglass/resin bond.

B. Resin

1. Provide a liquid thermosetting resin to saturate the tube and produce a properly cured liner which is resistant to abrasion due to soils, grit, and sand.
2. Use virgin polyester, vinyl ester, or epoxy resin complying with the following requirements. All recycled polyethylene terephthalate (PET) resins are prohibited.
 - A. Polyester Resin. A resin created by reaction products between isophthalic/tetrathalic 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 cross-linked copolymer matrices.
 - B. Vinyl Ester Resin. A resin created 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 cross linked copolymer matrices.
 - C. Epoxy Resin. A resin created by reaction products of biphenyl A and epichlorohydrin producing glycidyl ether reactive sites in the terminal position of the molecular chain. This resin is cross-linked with the reactive equivalent of a curing agent suitable for the cured-in-place process.

C. Corrosion Protection Liners for Manholes

1. Refer to Section 10100 – Corrosion Protection Liner and Rehabilitation of Manholes for material requirements for corrosion protection manhole liners.

2.03 TESTING REQUIREMENTS

- A. Chemical Resistance: The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. The test specimens shall be capable of exposure for a minimum of one month at a temperature of 73.4 degrees Fahrenheit. During this period, the CIPP test specimens should lose no more than 20% of their initial flexural strength and flexural modulus when tested in accordance with Section 8 of ASTM F1216. Appendix X2, Table X2.1 presents a list of chemical solutions that serve as a recommended minimum requirement for the chemical-resistant properties of CIPP in standard domestic sanitary sewer applications. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.
- B. Leakage Testing: The water leakage testing of the CIPP should be tested using an exfiltration test method where the CIPP is plugged at both ends and filled with water. This test shall be in accordance with ASTM F1216, paragraph 8.2.
- C. Wall Thickness Test: This thickness shall be measured in accordance with ASTM D2122.
- D. Samples:
 1. Per Paragraph 8.1 of ASTM F1216, the preparation of two CIPP samples is required for each insertion segment. One sample from each of the following two methods:

- A. The sample should be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been inverted or pull-in through a like-diameter pipe that has been held in place by a suitable heat sink, such as sandbags.
 - B. The sample should be fabricated from material taken from the tube and the resin/catalyst system used and cured in a clamped mold placed in the downtube when circulating heated water is used and in the silencer when steam is used.
 - C. Samples of each of these cases should be large enough to provide a minimum of three specimens and a recommended five specimens for flexural testing and also for tensile testing, if applicable. The Short-term Flexural (Bending) Properties testing should be in accordance with Test Methods ASTM (D790 and should meet the requirements of the standard listed in Paragraph 2.04 of this specification.
 - D. Samples taken for the measurement of the liner thickness shall be as described in Paragraph 2.04 of this specification.
- E. Corrosion Protection Liners for manholes shall meet testing requirements outlined in Section 10100 – Corrosion Protection Liner and Rehabilitation of Manholes, included in these specifications.

2.04 PHYSICAL PROPERTIES

- A. CIPP Properties. The installed CIPP, after curing, shall meet the minimum flexural properties listed below:

PROPERTY	REFERENCE	MINIMUM
Flexural Strength (Modulus of Rupture)	ASTM D790	4,500 psi
Tangent Modulus of Elasticity	ASTM D790	250,000 psi

- B. CIPP Thickness. The CIPP thickness, after curing shall meet the minimum thickness specified below. Provide the required CIPP thickness based on the maximum depth to sewer invert for the segment being rehabilitated.

Minimum CIPP Thickness (mm)

Nominal Sewer Diameter (inches)	Maximum Pipe Segment Invert Depth							
	Up to 10 ft		10 to 15 ft		15 to 20 ft		20 to 25 ft	
	Felt	Fiberglass	Felt	Fiberglass	Felt	Fiberglass	Felt	Fiberglass
6.0	4.5	2.8	4.5	2.8	4.5	2.8	6.0	2.8
8.0	6.0	2.8	6.0	2.8	6.0	2.8	7.0	3.5
10.0	6.0	2.8	6.0	3.5	7.5	3.5	9.0	4.2
12.0	6.0	3.5	7.5	3.5	9.0	4.2	10.5	4.9
15.0	7.5	4.2	9.0	4.9	10.5	4.9	12.0	5.6
18.0	9.0	4.9	12.0	5.6	13.5	6.3	15.0	7.0
21.0	10.5	5.6	13.5	6.3	15.0	7.0	16.5	7.7
24.0	12.0	6.3	15.0	7.0	16.5	8.4	19.5	9.1
30.0	15.0	7.7	18.0	9.1	21.0	9.8	24.0	11.2
36.0	16.5	9.1	21.0	10.5	24.0	11.9	28.5	13.3
42.0	19.5	10.5	24.0	12.6	28.5	14.0	33.0	15.4
48.0	22.5	11.9	28.5	14.0	33.0	16.1	36.0	17.5
54.0	25.5	13.3	30.0	16.1	36.0	18.2	42.0	19.6
60.0	28.5	14.7	34.5	17.5	39.0	19.6	45.0	21.7

- C. Corrosion protection liners for manholes shall meet physical properties per Section 10100 - Corrosion Protection Liner and Rehabilitation of Manholes, included in these specifications.

PART 3 EXECUTION**3.01 PRE-INSTALLATION CLEANING AND TV INSPECTION**

- A. Perform a pre-installation television inspection in accordance with Section 02761 - Cleaning and Television Inspection. Verify that sewer is clean and pipe conditions are suitable for installation of the CIPP. Notify Engineer if conditions exist which will impact the installation.

3.02 OBSTRUCTION REMOVAL, POINT REPAIR AND SAG ELIMINATION

- A. If pre-installation video inspection reveals an obstruction in the line segment (such as heavy solids, dropped joints, protruding service connections or collapsed pipe) that cannot be removed by conventional sewer cleaning equipment and the obstruction will prevent completion of the insertion process, perform point repairs or obstruction removal prior to CIPP installation. Obtain approval of Engineer prior to performing work. Follow requirements in Section 02763 – Point Repairs to Sanitary Sewers and Obstruction Removals.
- B. If pre-installation video inspection reveals a sag in the sewer that has a vertical displacement greater than one-half the pipe diameter, eliminate the sag by performing a point repair as specified in Section 02763 - Point Repairs to Sanitary Sewers and Obstruction Removals or by removal and replacement of the sewer segment. Obtain approval of Engineer prior to performing work.

3.03 OUT OF SERVICE

- A. In the event that a service will be temporarily out of service, the maximum amount of time of no service shall be 8 hours for any property served by the sewer. If it is anticipated that disruption of service will be required, the Contractor shall schedule the disruption during minimal flow periods, i.e., early hours of the morning. Such notification shall be provided to the Utility Department at least one week prior to service disconnection.

3.04 PUBLIC NOTIFICATION

- A. A public notification program shall be implemented and shall, as a minimum, require the Contractor to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be conducted, and when the sewer will be off-line. The Contractor shall also provide the following:
 - 1. Written notice to be delivered to each home or business 1 week prior describing the work, schedule, how it affects them, and a local telephone number of the Contractor that they can contact to discuss the project or any problems that could arise.
 - 2. Personal contact and attempted written notice the day prior to the beginning of work being conducted on the section relative to the residents affected.
 - 3. Personal contact with any home or business that cannot be reconnected with the time stated in the written notice.
 - 4. Records of contacting summary.

3.05 DIVERSION PUMPING

- A. Maintain commercial and residential sanitary sewer service during the installation process.

- B. Install and operate diversion pumping equipment to maintain sewage flow around the segment of pipe being rehabilitated and to prevent backup or overflow as specified in Section 01511 – Diversion Pumping.

3.06 INSTALLATION PROCEDURES

A. Felt Liner/Thermal Cured CIPP

1. Notification: Inform the Engineer of work schedules for CIPP installation:
 - A. Provide 24-hour notice for the Engineer to witness the “wet-out” procedure.
 - B. Provide 24-hour notice to Engineer prior to inversion and curing of liner.
2. 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. Wet-Out: Designate a location where the flexible tube will be impregnated with resin. Thoroughly saturate flexible tube prior to installation. A catalyst system or additive, compatible with the resin and flexible tube, shall be used in accordance with manufacturer's recommendations. Handle the resin-impregnated flexible tube to retard or prevent resin setting until it is ready for insertion.
4. Insertion: Insert flexible tube through an existing manhole or access structure by means of inversion, pull-in or other approved procedure.
5. Curing
 - A. Follow manufacturer's recommended cure schedule in curing on liner.
 - B. After insertion is completed, apply a suitable recirculation system capable of delivering steam or water uniformly throughout the section to achieve a consistent cure of the resin. Maintain the curing temperature as recommended by the resin/catalyst system manufacturer.
 - C. Provide suitable monitors near the heat source to gauge the temperature of incoming and outgoing water or steam supply. Place additional temperature sensors between the impregnated tube and invert of the original pipe at each manhole to monitor the outside temperature of the liner while curing.
 - D. Continue uninterrupted heating until the required curing temperature is achieved. Accurately measure temperatures at both ends of the CIPP. Initial cure is considered complete when exposed portions of the flexible tube pipe appear to be cured and the remote temperature sensors have achieved the external temperature recommended by the resin/catalyst system manufacturer.
6. Cool Down: Initiate a controlled cool-down of the hardened pipe to a temperature below 100 degrees Fahrenheit, in accordance with the cure schedule. Take care in release of the water column so that a vacuum will not develop that could damage the newly installed pipe. Do not discharge water in excess of 100 degrees Fahrenheit into the sanitary sewer system.
7. Finished Pipe: Provide a finished CIPP which is continuous and free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, lifts and delamination, and areas which have not cured sufficiently.
8. If a point repair is required after the liner has cured, use a tube segment to splice across the point repair. The overlap on each end shall be twice the diameter, or 12 inches, whichever is greater. Cure the segment using the same process as used for the original liner.

B. Fiberglass/UV Cure CIPP

1. Installation
 - A. Installation of the impregnated liner shall be by insertion as specified by the manufacturer. All equipment, labor, materials, and processes that are required to complete the work must be ready on-site before installation begins.
 - B. The first segment shall be lined, completed and accepted to become the "job standard" against which all-subsequent work is judged.
2. Pre-Installation
 - A. Prior to installation of the liner, the following activities are required:
 - i. Receipt and approval of pre-installation submittals.
 - ii. Verification of line condition and any obstructions by video inspection.
 - iii. Verification of existing taps in service by flowing water, dye test, or visually with a pan and tilt head camera or other means.
 - iv. Cleaning of line (recorded on videotape).
 - v. Construct and complete any and all point repairs deemed necessary shall receive Owner approval before reworking the lines and liner is installed.
3. Set-up
 - A. Prior to installation all necessary traffic control measures shall be put into place and the diversion pumping system, including back-up pumps, shall be tested and running. Every effort should be made to protect the environment from any contamination from the sewer. Provide 24-hour notice for the Engineer to witness set-up.
4. Outer Film
 - A. To control resin loss, liner thickness and contamination of the resin by water or other contaminants an outer film material shall be manufactured on the exterior surface of the liner. This outer film material shall be fabricated from a styrene barrier material, which is specified by the manufacturer. This outer film shall remain in-place after UV curing of the liner has been completed. The installation must be witnessed by the City Engineer.
5. Slip Sheet Insertion
 - A. A plastic slip-sheet shall be installed in the bottom half of the pipe prior to liner insertion. The slip-sheet is used to protect the outer film from damage during insertion from offset joints, broken pipe, or slightly protruding taps. In addition, it will increase flow characteristics and reduce friction during the pull-in process.
 - B. A double capstan, constant tension winch should be used to pull the glass fiber liner into position in the pipe. Once inserted, end plugs or packers shall be used to cap each end of the fiberglass liner to prepare for pressurizing the liner. The packers should be secured with straps to prevent them from being expelled due to pressure.
 - C. The spiral wound fiberglass liner shall be cured with UV light sources at a constant inner pressure. When inserting the curing equipment in the liner, care should be taken to not damage the inner film material.
 - i. The UV light sources should be assembled according to the manufacturer's specifications for the liner diameter. For the liner to achieve the required water tightness and specified mechanical properties, the following parameters must be controlled during the entire curing process, giving the Engineer a record of the curing parameters over every segment of the entire length of the liner. This demonstrates that the entire liner is cured properly. The recording will include:
 - a. Curing Speed
 - b. Light source working & wattage
 - c. Inner air pressure
 - d. Exothermic (curing) temperatures
 - e. Date and time
 - f. Length of liner
 - ii. This will be accomplished using a computer and database that are tamper proof. During the curing process, infrared sensors will be used to record curing data that will be submitted to the Engineer with a post CCTV inspection on DVD.

- iii. The parameters for curing speed, inner air pressure and wattage are defined in the Quality Tracker UV curing protocol issued by the manufacturer. The optimal curing speed, or travel speed of the energized UV light sources, is determined for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature.
- iv. The UV light train shall be capable of curing the fiberglass liner at a curing rate of up to 10 LF (liner feet) per minute.
- D. The inner film material should be removed and discarded after curing to provide optimal quality of the final product.

3.07 SERVICE RECONNECTIONS

- A. After the CIPP has been cured in place, the Contractor shall reopen the service connections. This shall generally be done without excavation, and in the case of non-man entry pipe, from the interior of the pipeline by means of a television camera and a cutting device that re-establishes the service connection to not less than 100% capacity. Cutting devices that use high pressure water shall not be used since they may cause wicking at lateral openings, the lateral opening edges must be sealed with a resin mixture compatible with the tube resin. The Contractor shall certify he has a minimum of 2 complete working cutter units plus spare key components on the site before each inversion. No additional payment will be made for excavation for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

3.08 SEALING AT MANHOLES

- A. Form a tight seal between the CIPP and the manhole wall at the pipe penetration. Do not leave any annular gaps. Seal the annular space with a ¼-inch-diameter activated Oakum band soaked in chemical sealant. Seal any annular spaces greater than ¼-inch with manhole wall repair material. Finish off the seal with a non-shrink grout or cementitious liner material placed around the pipe opening from inside the manhole in a band at least 4 inches wide. Complete the sealing procedure for each liner segment immediately after the liner is cured.
- B. Reshape and smooth the manhole invert as specified in Section 02601 – Precast Concrete Manholes.

3.09 CORROSION PROTECTION LINER

- A. Refer to Section 10100 – Corrosion Protection Liner and Rehabilitation of Manholes of these specifications for installation requirements for corrosion protection liners for manholes.

3.10 POST-INSTALLATION TV INSPECTION

- A. Provide video tape showing completed work, including condition of restored connections. Refer to Section 02761 – Cleaning and Television Inspection.

3.11 FINAL CLEANUP

- A. Upon completion of rehabilitation work and testing, clean and restore project area affected by the Work.

3.12 NON-CONFORMING WORK

- A. If either, the thickness, flexural strength, or flexural modulus of elasticity of the installed CIPP is less than 90% of the specified values, the product is considered unacceptable. A method of repair or replacement shall be submitted for review and approval by the Engineer. All work required to remedy non-conforming work shall be at the sole cost of the contractor.

SECTION 02766

CITY OF VICTORIA

STANDARD SPECIFICATIONS

CURED-IN-PLACE PIPE

- B. For all instances, as described in this specification section, other than thickness, flexural strength, and flexural modulus of elastic, where the CIPP is deemed unacceptable, the Contractor shall submit a method of repair or replacement for review and approval by the Engineer. All work required to remedy non-conforming work shall be at the sole cost of the contractor.

END OF SECTION

SECTION 02767

CITY OF VICTORIA
STANDARD SPECIFICATIONS

PIPE BURSTING/
CRUSHING SANITARY SEWER

PART 1: GENERAL

Pipe Bursting/Crushing of Sanitary Sewers is not required in the proposed project, but the Contractor is allowed the option of utilizing this method at equal cost of construction methods included in the base bid pricing.

1.01 SECTION INCLUDES

- A. Pipe Bursting/Crushing existing sanitary sewers.

1.02 UNIT PRICES

No additional payment will be made for pipe bursting/crushing of sanitary sewer. Payment will be made according to construction methods included in base bid pricing.

1.03 REFERENCES

- A. ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials.
- B. ASTM D2122 - Dimensions of Thermoplastic Pipe and Fittings, Determining.
- C. ASTM D2412 - Determination of external Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- D. ASTM D2992 - Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting) Resin Pipe and Fittings.
- E. ASTM 03262 - "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
- F. ASTM D3350 - Polyethylene Plastics Pipe and Fittings Materials.
- G. ASTM D3681 - Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition.
- H. ASTM D4161 - "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

1.04 DEFINITIONS

- A. Pipe bursting/crushing: The pipe bursting/crushing process is defined as the reconstruction of existing sanitary sewers by the simultaneous insertion of a pipe within the bore of the existing pipe, by breaking and expanding the existing pipe.

1.05 SYSTEM DESCRIPTION

- A. The pipe bursting/crushing process 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

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PIPE BURSTING/ CRUSHING SANITARY SEWER

“mole” or the “knife” may be aided by hydraulic equipment or other apparatus. Replacement pipe is either pulled or pushed into the bore.

1.06 QUALITY ASSURANCE

- A. Acceptance: Provide pipe material which is homogeneous without defects and manufactured to the standards and dimensions specified. Cause for rejection includes physical defects of the pipe, such as concentrated ridges, discoloration, excessive spot roughness, pitting, visible cracks, foreign inclusions, and varying wall thickness.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prevent injury or abrasion to pipe during loading, transportation, and unloading. Do not drop pipe from cars or trucks, 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.

1.08 PERFORMANCE REQUIREMENTS

- A. Maintain flow of sewage by diversion pumping as specified in Section 01511 – Diversion Pumping or other method approved by the Engineer.
- B. Clear existing sewer of debris, obstructions or other material and make point repairs to existing sewers as specified in Section 02763 - Point Repairs to Sanitary Sewers and Obstruction Removals.
- C. Shape manhole invert as specified in Section 02601 – Precast Concrete Manholes.
- D. Test lines as specified in Section 02732 - Acceptance Testing of Sanitary Sewers.
- E. Televiser lines as specified in Section 02761 - Cleaning and Television Inspection for Sanitary Sewers.

1.09 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 polyester (FRP) pipe conforms to requirements of ASTM D2992 and ASTM D3681, as applicable.

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PIPE BURSTING/ CRUSHING SANITARY SEWER

- D. Submit manufacturer's product data on clamps.
- E. Submit video tapes as specified in Section 02761 - Cleaning and Television Inspection.

1.10 TESTING

- A. The City may run tests on field samples following applicable ASTM specifications at an independent laboratory to verify the required physical properties and characteristics of supplied materials. Provide product samples as requested by Engineer.
- B. The City will pay for tests on pipe material which meets specification requirements. Contractor shall pay for failed tests and retesting of failed materials.

PART 2: PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers and pipe bursting installation crews shall be approved by the City and Engineer as acceptable for pipe bursting.
- B. Replacement pipe systems shall be polyethylene or fiberglass reinforced polyester (FRP) products approved by the City.

2.02 POLYETHYLENE PIPE (PEP) AND FITTINGS

- A. Provide polyethylene pipe, manufactured of solid wall, high density, high molecular weight, polyethylene compound conforming to ASTM D1248, Type III, Class C, Grade P-34, Category 5, with a PPI rating of PE 3408. Use polyethylene material with a minimum cell classification in accordance with 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. High Density Polyethylene Solid Wall pipe shall be in accordance with Section 02619 – High Density Polyethylene (HDPE) Solid Wall Pipe. 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)	Proposed Outside Diameter (inches)	Minimum Wall Thickness (inches)		
		≤15' Deep	>15' ≤20' Deep	>20' Deep
		SDR19	SDR 17	SDR 11
6-8	8.625	0.454	0.507	0.784
10	12.75	0.671	0.750	1.159
12	14.0	0.737	0.824	1.273
15	18.0	0.947	1.059	1.636

2.03 FRP AND FITTINGS

- A. Provide pipe manufactured in conformance to the requirements of ASTM D3262, Type 1, Liner 2, Grade 3. Pipe shall be fiberglass polyester reinforced pipe manufactured by the centrifugal casting process resulting in a dense, nonporous, corrosion resistant, consistent, composite

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PIPE BURSTING/ CRUSHING SANITARY SEWER

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 City 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.
 - 2. 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.
 - 3. Fabricate pipe ends square to pipe axis plus 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 joined by glass fiber reinforced overlays.

2.04 PIPE SEAL AT MANHOLE

- A. Manhole wall penetration, for replacement pipe, shall be reshaped with approved mortar/grout.
- B. The replacement pipe shall be installed with a tight fitting seal with the existing or new manhole using oakum strips soaked in Scotchseal 5600 as manufactured by 3M Corporation or equal.

2.05 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 pipe. Use minimum clamp (length) as specified in the following table:

Replacement Pipe O.D. (inches')	Minimum (Length) of Clamp (inches)
8.625	18
10.750 or greater	30

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CITY OF VICTORIA STANDARD SPECIFICATIONS

PIPE BURSTING/ CRUSHING SANITARY SEWER

2.06 BEDDING MATERIAL

- A. Provide bedding conforming to requirements of Section 02229 - Utility Backfill Material and Section 02252 - Cement Stabilized Sand.

PART 3: EXECUTION

3.01 OBSTRUCTION REMOVAL

- A. Remove obstructions such as roots, rocks or other debris, prior to installing pipe. Debris shall be removed and disposed of in accordance with Section 01500 - Temporary Facilities and Controls or Section 01564 - Waste Material Disposal.
- B. Refer to Section 02763 - Point Repairs to Sanitary Sewers and Obstruction Removals for requirement and procedures for obstruction removals.

3.02 DIVERSION PUMPING

- A. Refer to Section 01511 - Diversion Pumping.

3.03 INSERTION OR ACCESS PITS

- A. Locate pits so that the total number is minimized and footage of replacement pipe installed in a single pull is maximized. Use excavations at point repair locations for insertion pits, where possible.
- B. Before excavating, check with various utility companies 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 - Excavation and Backfill for Utilities.
- D. Perform work in accordance with OSHA standards. Follow requirements specified in Section 01526 - Trench Safety System for excavations requiring trench safety.
- 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.

3.04 POLYETHYLENE PIPE INSTALLATION

- A. Joints:
 - 1. Assemble and join sections of polyethylene pipe on site above the ground. Make joints by heating and butt-fusion method in strict conformance with manufacturer's instructions.
 - 2. Use operators who are experienced with the butt-fusion method for pipe jointing in the field. Operators should be trained in fusing polyethylene pipe with similar equipment using proper jigs and tools per standard procedures outlined by pipe manufacturer.

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3. Form joints with a smooth, uniform double rolled back bead made while applying the proper melt, pressure, and alignment. Joints will be inspected by City Engineer before insertion.
- B. 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 polyethylene pipe by use of a suitable pulling head equal to or greater than the outside diameter of pipe. Secure pulling head to pipe and attach to Pipe Bursting/Crushing system so that pipe can be satisfactorily fed and pulled through sanitary sewer main. Prevent ragged edges of existing pipe from scarring pipe. Refer to insertion procedures given in ASTM F585. Do not allow sand or other debris to enter the PEP.
- C. Pulling PEP:
 1. The maximum length of continuous PEP 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 so that the forces indicated below for the various diameter of polyethylene pipe are not exceeded. Provided a suitable measuring device connected to the winch or pulling mechanism.

Polyethylene Pipe 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

3.05 FRP PIPE INSTALLATION

- A. FRP pipes may be pushed or 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 instructions. 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

3.06 CLAMP AND GASKET INSTALLATION

- A. Where excavations for replacement pipe insertion are made between two manholes, cut ends of the pipe smooth, square to its axis. Join pipes with appropriately sized stainless steel universal

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clamp couplings. Gap between ends of pipe shall be butted together with space between ends not exceeding ½ inch.

- B. Bedding shall be stabilized cement sand conforming to requirements of Section 02252 - Cement Stabilized Sand. Bedding shall extend 12" above the clamp/replacement pipe.

3.07 FRP COLLAR/CLOSURE

- A. FRP collar closure pieces shall be installed in accordance with manufactures recommendations.

3.08 FIELD QUALITY CONTROL

- A. After pipe installation, perform the following tests:
 - 1. Low pressure air test before replacement pipe 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 replacement pipe has not been damaged by inserting it into sanitary sewer.
 - 2. Service lateral connection test after all service laterals have been completed for a particular sewer section. Verify integrity of reconnections at points where they join the replacement pipe and existing service lines by performing smoke test.
 - 3. Refer to Section 02732 - Acceptance Testing for Sanitary Sewers for applicable test procedures.

3.09 SEALING PIPE AT MANHOLE

- A. Allow replacement 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 replacement pipe so that it extends 4 inches into manhole. Make a smooth, vertical cut and slope area over top of exposed replacement pipe using non-shrink grout.
- C. Seal space between replacement pipe and manhole wall with a chemical seal and non-shrink grout. Place strips of oakum soaked in sealer in a band to form an effective water-tight gasket in the annular space between replacement pipe 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 02601 – Precast Concrete Manholes. Use approved manhole rehabilitation material to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of replacement pipe, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new replacement pipe.

3.10 POST-INSTALLATION TELEVISION OF COMPLETED WORK

- A. Provide City Engineer with a video tape showing completed Work including condition of restored connections. Refer to Section 02732 - Acceptance Testing for Sanitary Sewers and Section 02761 - Cleaning and Television Inspection.

3.11 FINAL CLEANUP

- A. Upon completion of installation work and testing, clean and restore project area affected by the Work.

END OF SECTION

PART 1 GENERAL**1.01 DESCRIPTION**

- A. This specification shall cover all work, materials equipment and procedures for application required for protecting and/or rehabilitating concrete manholes and other underground concrete structures by spray applied calcium aluminate cementitious structural rehabilitation system and by cured-in-place installation of a non-porous, multilayer structural system to eliminate infiltration, provide corrosion, protection, repair voids, enhance structural integrity, shaping of channel-inverts on existing manholes and pipe connections and stubs to existing manholes.

1.02 UNIT PRICES

- A. Installation of corrosion protection spray applied system and liner and rehabilitation of manholes shall be paid per each unless otherwise noted as being subsidiary to other items of the contract.

1.03 RELATED SECTIONS

- A. Section 02601 – Precast Concrete Manholes
- B. Section 03310 – Structural Concrete
- C. Section 03345 – Concrete Finishing
- D. Section 03700 – Concrete Repair and Rehabilitation

1.04 REFERENCES

- A. ASTM D-16 Type V SolventlessElastomeric Polyurethane Aromatic Chemical Cure
- B. ASTM D543 Resistance of Plastics to Chemical Reagents
- C. ASTM D638 Tensile Properties of Plastics
- D. ASTM D695 Compressive Properties of Rigid Plastics
- E. ASTM D790 Flexural Properties of Unreinforced and Reinforced Plastics
- F. ASTM D2240 Durometer Hardness
- G. ASTM D2584 Volatile Matter Content
- H. ASTM D4541 Pull-off Strength of Coatings Using a Portable Adhesion Tester
- I. ASTM The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
- J. NACE The published standards of National Association of Corrosion Engineers, Houston, TX.

1.05 SUBMITTALS

- A. Make submittals in conformance with requirements of Section 01300 – Submittals.

- B. Technical data sheet(s) for each product to be used.
- C. Material Safety Data Sheets.
- D. Materials to be used for pipe connections at manhole walls.
- E. Materials and procedures for corrosion-resistant liner and coatings.
- F. Manufacturer's data for premix concrete for channel inverts and benches.

1.06 STORAGE AND HANDLING

- A. Products should be kept dry, protected from weather and stored in a secure location.
- B. Products should be stored and handled according to their material safety data sheets.

1.07 QUALITY ASSURANCE

- A. Quality control procedures should be enforced according to corrosion protection liner manufacturer's recommendations. A certified inspector shall observe interior surface preparation, liner application and material handling procedures to ensure adherence to this specification.

1.08 WARRANTY

- A. Poly-Triplex Technologies, Inc. and the Poly-Triplex Authorized Licensed Installer, jointly provides a non-prorated warranty for the Poly-Triplex Liner Systems. Poly-Triplex fabrics and resins are warranted to be free of defects in materials and workmanship, to prevent infiltration, prohibit root intrusion and provide a surface coating resistant to sewer gases and chemicals typically found in domestic sewer collection systems. This warranty is for the installation/application of the liner in existing structures. Labor and Materials Warranties are as follows:
 - 1. Poly-Triplex Liner System (PTLS-6800) Manholes – Ten Year Materials, Five Year Labor
- B. Poly-Triplex Technologies, Inc. does not certify the structural integrity of existing structure or substructure, but the liner system will eliminate further deterioration due to sewer gases and will significantly increase the life of the existing structure.
- C. The warranty extends to the OWNER of the structure to which SewperCoat is applied, effective as of the OWNER'S acceptance of the work: Kerneos warrants to the OWNER that SewperCoat PG and SewperCoat 2000HS products, when installed in compliance with the recommended installation guidelines published by Kerneos, will protect sanitary wastewater structures from biogenic corrosion caused by exposure to sanitary sewerage environment. To be honored, claims must be filed by the OWNER within 10 years of acceptance of the work by OWNER. Kerneos obligations hereunder extend only to providing labor and material to replace the defective material.

PART 2 PRODUCTS

2.01 CORROSION RESISTANT LINER

- A. Poly-Triplex Liner System (PTLS-6800), Poly-Triplex Technologies, Inc. or Engineer – approved equal. Local Contact:
Poly-Triplex of Texas
P.O. Box 1023

Waskom, TX 75692
Telephone: 1-888-277-5485

- B. Repair Materials: All voids or cracks in concrete surfaces shall be repaired with a high strength, rapid cure, zero shrinkage resurfacing product. Repair materials must be compatible with the specific corrosion protection coating and shall be applied in accordance with the manufacturer's recommendations.
- C. Materials and Liner System: The PTL-6800 series is a three-layered composite system with a total pre-saturated fabric weight of 68 oz. per square yard. Layer #1 is 24-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is a 20-oz. non-porous membrane of special synthetic materials bonded to layer #1 and layer #3. Layer #3 consists of 24-oz. structural fiberglass saturated with epoxy and bonded to the nonporous membrane, forming a smooth interior wall to the host structure.
- D. Liner Application Equipment: Corrosion protection liner shall be applied with manufacturer approved equipment.

2.02 CORROSION RESISTANT SPRAY APPLIED CALCIUM ALUMINATE CEMENTITIOUS STRUCTURAL REHABILITATION SYSTEM

- A. SewperCoat PG
Kerneos Inc.
1316 Priority Lane
Chesapeake, Virginia 23324
Telephone: 1-757-284-3200
- B. Lining material furnished under this section shall be a prepackaged mortar mix, including all cement, aggregates, and any required additives. It is the intent of this specification that the Contractor only be required to add the proper amount of potable water so as to produce concrete suitable for spray application. Do not add Portland cement, other aggregates, or any admixtures whatsoever to lining material. Typical package weights shall not be less than 50 lbs and shall be identical for all material furnished on this project.
- C. The mortar mix shall be either "SewperCoat PG" or "SewperCoat 2000HS Regular", both as manufactured by Kerneos, Inc.
- D. Mortar mix must have at least ten (10) years of successful performance in similar applications and be supplied by an ISO 9001 certified manufacturer. Manufacturer's ISO 9001 certificate shall be submitted to engineer and owner.
- E. Mortar mix manufacturer shall offer to the Owner a labor and materials replacement limited warranty for a period of no less than 10 years from the date of the Owner's acceptance of the installation.
- F. In addition the mortar mix shall be designed to withstand long-term exposure to a bacterially corrosive hydrogen sulfide environment that may be expected to produce a pH of 1 on normal Portland cement based concrete or typical brick and mortar surfaces.

2.03 MANHOLE INVERTS

- A. 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.

2.04 PIPE CONNECTIONS FOR SANITARY SEWERS

- A. Use resilient connectors conforming to ASTM C923 requirements. Metallic mechanical devices as defined in ASTM C923 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 C213.

PART 3 EXECUTION

3.01 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 ½ inch per foot maximum
 - 2. Depth of bench to invert:
 - a. Pipes smaller than 15 inches: ½ largest pipe diameter.
 - b. Pipes 15 to 24 inches: ¾ the largest pipe diameter.
 - c. Pipes larger than 24 inches: equal to the largest pipe diameter.
- 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.

3.02 PIPE CONNECTIONS AT MANHOLES

- A. Install approved resilient connectors at each pipe entering and existing 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. Test connection for watertight seal before backfilling.

3.03 CORROSION RESISTANT LINERS

- A. Acceptable applicators

1. Repair material applicators shall be trained to properly apply the product according to manufacturer's recommendations.
2. Corrosion protection liner must be applied by a Certified Applicator of the approved liner manufacturer and according to manufacturer specifications.

B. Examination

1. All structures to be coated shall be readily accessible to Applicator.
2. Appropriate actions must be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.

C. Cleaning

1. All surfaces of the host structure are to be cleaned with a high-pressure hydro-jet sprayer with an operating pressure of at least 4,000 psi. After pressure cleaning, surface may be cleaned with degreaser or other solvents as needed in order to remove any film or residue on the surface. Structure shall then be pressure rinsed with water.

D. Final Preparation

1. All incoming laterals and main trunk line openings shall be properly trimmed and grouted with hydraulic or Portland Type II Cement, forming a fillet between the structure wall and each pipe. All inlet and outlet pipes should be trimmed so they do not extend into the structure more than two inches. Such application of grout shall extend at least 6 inches from the outlet onto the wall area.
2. Benches, walls and floors shall be repaired or refinished as appropriated using chemical grout, hydraulic cement or Portland Type II cement. Bench areas and floors shall be lined with Poly-Triplex Liner System materials saturated with the epoxy resin and placed in the bottom and extending approximately 6 inches up the wall section, so as to overlap with the liner wall section.

E. Manhole Liner Installation

1. Once the liner is fully saturated with resin, at the job site, it shall be lowered into the structure to the pre-marked position at the cover seat of the structure entrance. The liner shall form a monolithic structure permanently connecting the ring & cover seat to the chimney, corbel, walls and benches. For invert channel lining, the sewage flow must be stopped for a minimum period of 3 hours.
2. To line manhole invert channel, the sewage flow must be stopped. Channels may also be lined with a hand lay-up method using RAM-Epoxy Fast Setting Mastic and Fiberglass. Using the hand lay-up method, the channel shall be dry and free of infiltration of groundwater. Channel will receive not less than one 24-oz structural fiberglass layer along with structural fiber reinforced epoxy mastic. Once channel lining is cured, additional layers may be applied as needed.
3. The Poly-Triplex Liner for manholes shall be pressurized with air or water and cured with steam, ambient or heated air, or ambient or heater water. Most typical Poly-Triplex manhole liner installations will be pressurized at 750-1,000 lbs. per square foot, depending on the condition of the structure and the amount of hydrostatic pressure from incoming infiltration.

F. Curing Process

1. Once the liner is in position, it shall be pressurized and cured in place. The structure shall be pressurized with air or water and cured with steam, ambient or heated air, or ambient or heated water. Heat by a temperature inversion system of pressurization with steam injection into the high-velocity hot air column, creating a steam/convection oven atmosphere to create a liner temperature of approximately 150 to 190 degrees Fahrenheit. The liner shall be heated for an estimated 1 to 3 hours curing time according to the size and temperature of the structure.
2. Upon completion of the liner curing process, the inflation bladder shall be removed, all lines reopened and the excess liner cut off at the manhole cover seat or structure opening.

G. Testing and Inspection

1. Physical properties of the cured resin system after seven (7) days curing at 75 degrees Fahrenheit shall meet or exceed the table below.

Test	Results	Hardness
Hardness	82 Shore D	ASTM-D-2240-75
Tensile Strength	12,957 psi	ASTM-D63860
Compression Strength	18,652 psi	ASTM-D699554
Flexural Strength	17,494 psi	ASTM-D-79058T
Ultimate Elongation	6.0%	ASTM-D63860
Test	Condition	Separate Pressure
Bonding Strength	Butt to Butt Resin Bond 6" Diameter, 10,000 psi Concrete Test Cylinder	7,130 lbs

2. A final visual inspection shall be made by the Inspector and Applicator. Any deficiencies in the finished liner shall be marked and repaired by Applicator according to the procedures set forth herein.
3. The wastewater collection system may be put into operation service upon final inspection.

3.04 CORROSION RESISTANT SPRAY APPLIED CALCIUM ALUMINATE CEMENTITIOUS STRUCTURAL REHABILITATION SYSTEM

A. Acceptable applicators

1. Repair material applicators shall be trained to properly apply the product according to manufacturer's recommendations.
2. Corrosion protection liner must be applied by a Certified Applicator of the approved manufacturer and according to manufacturer specifications.

B. Surface Preparation

1. Ensure all surfaces are clean and free of laitance, loose material, residue and all existing coating and lining materials. For detailed explanation of the required surface preparation see ACI RAP-3 "Spall Repair by Low Pressure Spraying" page 2. ACI 546R "Concrete Repair Guide", chapter 2 also provides a good reference for important considerations for repairing concrete surfaces using mortar.

2. Sub-surfaces shall be thoroughly saturated with water prior to the application of the lining materials. In no instance shall shotcrete be applied in an area where running water exists. It is the intent of this specification that the existing surface be saturated and free of any running water just prior to installation or SSD, "saturated surface dry condition". To achieve this condition it may be necessary to presoak the subsurface for at least 24 hours.
3. Contractor shall provide all equipment necessary to individually gauge, control, and monitor the actual amounts of all component materials necessary to complete the lining installation. The type of equipment and methods used to gauge, control, and monitor component materials shall be subject to approval by the Engineer and Manufacturer.
4. All lining materials shall be thoroughly mixed by mechanical means to ensure all agglomerated particles are reduced to original size or removed prior to placement into the application equipment (ie hopper). Each batch of materials should be entirely discharged before recharging with fresh material. Mixing equipment shall be cleaned at regular intervals to remove all adherent materials.
5. For inflow and infiltration repairs, use Preco Plug, Octocrete, Burke Plug or Engineer approved equal rapid setting crystalline enhanced hydraulic cement product.

C. Application of Materials

1. Lining materials shall not be applied to a frozen surface or to a surface that may freeze within 24 hours of application. Frozen conditions shall be defined as ambient temperatures of 32 degrees F or below.
2. Sequence of application may be from bottom to top or vice versa if rebound is properly removed.
3. Application shall be from an angle as nearly perpendicular to the surface as practicable with the nozzle held at least 1 foot from the working subsurface. If the flow of material at the nozzle is not uniform and slugs, sand spots, or wet sloughs result, the nozzleman shall direct the nozzle away from the work until the faulty conditions are corrected. Such defects shall be replaced as the work progresses.
4. Application shall be suspended if the air velocity separates the cement from the aggregate at the nozzle or the ambient temperature approaches freezing and the newly placed SewperCoat cannot be protected and insulated.
5. The time interval between successive layers of material application must be sufficient to allow tackiness to develop but not final set. If final set does occur, this surface shall be prepared in section 3.04.B.1.
6. Construction joints within a manhole shall be avoided. In the event a construction joint is necessary and approved by the Engineer, it shall be sloped off to a thin, clean regular edge at a 45 degree angle. Prior to placement of the adjoining materials, the sloped portion and adjacent applied material shall be thoroughly cleaned as necessary then moistened and scoured with an air jet.
7. Nozzleman shall bring the material to an even plane and to well-formed corners.
8. After the body coat has been placed, the surface shall be trued with a thin edge screed to remove high areas and expose low areas. Low areas shall be properly filled with additional material to insure a true, flat surface.
9. For manhole applications the minimum thickness of SewperCoat shall be a ½-inch cover over all surfaces. For larger structures the minimum thickness of SewperCoat shall be 1-inch cover over all surfaces.

D. Curing

1. If the material has been applied and furnished in accordance to the specifications, and it has been determined that the environment is not moist enough for natural curing, the contractor will be required to apply a curing compound to all coated surfaces. Curing compound shall meet the requirements of ASTM C309 and have the approval of the lining material Manufacturer and the engineer prior to use.
2. Moist curing may also be used in lieu of curing compound. If moist curing is selected it should be implemented just after the notice of uniform heat generation of the installed

lining. Moist curing can consist of the use of soaker hoses, water sprinklers, or vapor/misting machines. Regardless of delivery method, moist curing should continue for a minimum of 18 hours.

END OF SECTION

PART 1 GENERAL**1.01 SUMMARY**

- A. This section describes the requirements for a submersible pump lift station.

1.02 RELATED SECTIONS

- A. Section 01526 – Trench Safety Systems
- B. Section 02227 – Excavation and Backfill for Utilities
- C. Section 02229 – Utility Backfill Materials
- D. Section 16010 – Electrical – General Requirements

1.03 MEASUREMENT AND PAYMENT

- A. Measurement and payment will be on a lump sum basis. The payment made according to the Bidder's proposal shall be full compensation for all materials, tools, equipment, labor, superintendence, fees, permits and incidentals for a complete operational facility.

1.04 SYSTEM DESCRIPTION

- A. The lift station includes the wetwell (basin), pumps, discharge piping and valves to a point ten (10) feet from valve vault, electrical service entrance, electrical starting equipment, electrical controls including alarm and driveway base material as shown on plans, site grading and incidentals for a complete operational facility.

1.05 SUBMITTALS

- A. Shop Drawings and Pump Performance Curves
 - 1. Contractor shall submit to Engineer for approval six (6) copies of data on equipment proposed to be used, including pump performance curves. Performance curves shall include efficiency curves and horsepower requirements.
- B. Operation and Maintenance Manuals
 - 1. The Contractor shall furnish the Owner with five (5) copies of operation and maintenance instructions for the equipment furnished under this specification.

1.06 QUALITY ASSURANCE

- A. Testing and Materials
 - 1. Only materials specified and approved shall be used in construction of the facility. All components of the pump station shall be given an operations test of all equipment at the factory to check for excessive vibration, for leaks in all piping or seals and for correct operation of the control system and all auxiliary equipment.
 - 2. The pump suction and discharge lines shall be coupled to a reservoir and the pump shall recirculate water under simulated service connections.
- B. Pump Warranty

1. The pump shall be guaranteed to be free from defects in materials and workmanship for a period of one year from the date of final acceptance.

1.07 DELIVERY, STORAGE AND HANDLING

- A. All equipment and materials to be incorporated into construction of the facility shall be delivered, stored and handled in accordance with the recommendation of the manufacturer for each piece of equipment and or material.

1.08 PROJECT SITE CONDITIONS

- A. The Contractor shall visit the site to become familiar with the site conditions. Contractor is responsible for performing any testing he deems necessary to satisfy himself of site conditions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The lift station pumps shall be manufactured by Flygt.

2.02 MATERIALS AND/OR EQUIPMENT

- A. Wetwell – Reinforced concrete pipe meeting ASTM C76, Class III; inside diameter and depth as shown on the plans. The interior shall be coated with in accordance with Section 09880 – Coating of Concrete Walls, or Engineer approved equal.

B. Pumps and Motors

1. Capacity

- a. Lift Station – Two submersible non-clog sewage pumps (min.) shall be installed in the wetwell. Each pump shall have a capacity as shown in the Plans. Pump motors shall be of the phase, voltage and minimum horsepower shown on the plans. The actual horsepower of the pump used may be more than that shown on the plans depending on the manufacturer of the actual pump used.
- b. Pump motors shall be of the phase, voltage and minimum horsepower shown on the plans. The actual horsepower of the pump used may be more than that shown on the plans depending on the manufacturer of the actual pump used.

2. The pumps shall be capable of handling raw, unscreened sewage. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. Anchor bolts for the discharge connection elbow shall be Type 316 stainless steel. The pumps shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. There shall be no need for personnel to enter wet well to either disconnect or reconnect the pump. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided to and pressed tightly against the discharge connection elbow. No portion of the pump shall bear directly on the floor of the wet well.

- C. Lift System: A lift system shall be supplied that shall consist of a ¼" Type 316 stainless steel cable. The cable shall be attached to the pump and shall be long enough to reach the station

- top. The cable shall be attached so that it can be pulled by the use of lifting equipment. All miscellaneous metal associated with the lift system shall be stainless steel.
- D. Casting: Each pump casting shall be constructed of fine-grained cast iron. The casting shall be designed for a minimum working pressure of 50 psig and hydrostatically tested to 1-1/2 times the working pressure.
- E. Pump Shaft: The pump shaft shall be of carbon steel, C1036, completely isolated from the pump medium or stainless steel when exposed to the pump medium. The pump shaft shall rotate on two permanently lubricated ball or roller bearings. The shaft shall be of sufficient diameter to assure rigid support of the impeller and to prevent excessive vibration at all operating speeds.
- F. Mechanical Seal: Each pump shall be provided with a mechanical seal system running in an oil reservoir having separate, constantly hydrodynamically lubricated lapped seal faces. The lower seal unit shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper seal shall contain one stationary tungsten-carbide ring and one positively driven carbon ring. The seal systems shall not rely upon the pumped media for lubrication.
- G. Impeller: The pump impellers shall be one-piece cast iron, fully-encased, design with wide passages to prevent clogging when pumping solids, trash, rags and string material entrained in sewage. The impeller shall be statically and dynamically balanced. The impeller hub shall be accurately fitted and mechanically secured to the impeller shaft. Impeller and casing shall be designed to pass the minimum 2-1/2-inch diameter test sphere.
- H. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase). These shall be used in conjunction with, and supplemental to, external motor overload protection and wired to the control panel.
- I. Motor: Pump motor shall be of NEMA Design B, squirrel-cage, induction, shell-type design, housed in an air-filled watertight chamber. The stator winding and stator leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155°C (311°F). The stator shall be dipped and baked three times in Class F varnish.
- The motor shall be designed for continuous duty, capable of sustaining a minimum of 10 starts per hour. The rotor bars and short circuit rings shall be made of aluminum.
- J. Leak Detection: Manufacturers requiring moisture detection devices for warranty shall supply a lockout device with a manual reset in the control panel.
- K. Exposed Surfaces: All fasteners and hardware inside wet well nuts and bolts shall be Type 316 stainless steel.
- L. Discharge Elbow: The discharge elbow shall have a foot for anchoring to the wet well floor and a means for firmly supporting the guide rails. The design and mass of the discharge elbow shall be sufficient for rigidly supporting the eccentric load for the pump unit and discharge piping. The discharge elbow inlet flange face shall be perpendicular and make a metal-to-metal contact with the pump discharge nozzle flange face. Sealing of the discharge interface by means of a diaphragm, o-ring or other device is not acceptable. The discharge 125-pound flange dimensions and drilling.
- M. Pump Guides: The pumps shall be capable of being lowered into position in the pump chamber and automatically connected to the discharge connection elbow by the use of a

sliding bracket and positioning devices. The sliding bracket shall be part of the pump assembly. The sliding bracket and positioning device shall be constructed of stainless steel.

1. The upper guide rail bracket and the guide rails shall be constructed of stainless steel, sized as shown on the drawings.
 2. Intermediate guide rail brackets shall be constructed of stainless steel and be positioned a maximum of 20 feet apart.
- N. Discharge Piping and Valves: A check valve and a plug or a gate valve (as noted on the plans) shall be installed on the discharge pipe from each pump. The valves shall be installed as shown on the plans. Plug valves shall be Cam Centric as manufactured by Val-Matic or Engineer approved equal.
- O. Electric Service Entrance: An electrical service entrance is required for electrical power to the lift station.
- P. Electrical Service Equipment, Breakers, Controls and Wiring
1. Control Panel – shall have a NEMA 4X stainless steel enclosure with a stainless steel hinged deadfront door on a continuous piano hinge and removable subpanel. The inner door shall be stainless steel or aluminum mounted on a continuous hinge and shall be furnished for protection against exposed wiring. Inner door shall be equipped with cutouts for access to the circuit breakers. A lock hasp shall be provided on door. A circuit breaker shall be provided for each pump with mechanical through-the-door operators mounted on the inner door and shall be Square D Mag-Guard or preapproved equal. A magnetic starter with three (3) leg overload protection for three-phase operation or one (1) leg overload protection for single-phase operation shall be supplied for each pump. The control circuit shall be protected by a single-pole 10-Ampere circuit breaker. An alternating relay shall be provided to alternate pumps on each successive cycle of operation. Starters shall have auxiliary contacts to operate all pumps on override condition. An interlock relay shall be provided to automatically reconnect the control circuit in case of circuit breaker trip on one (1) pump. H-O-A switches and run lights shall be supplied for each pump. Pump control switches and pilot devices will be oil-tight units mounted on inner door. Toggle switches will not be acceptable. Hand-off-auto switches shall be Square D 9001 K Series or approved equal. Pilot lights shall be Idec APD series or approved equal. LED pilot lights are not acceptable. Detection and display on the inner door of seal failure and overtemperature failure within each pump shall be required. The overtemperature and seal failure alarm circuit shall be self-latching and shall require resetting by means of a pushbutton on the inner door. The overtemperature alarm shall lock out each individual pump. Alternator relay shall be Diversified ARB-120-AEA or equal, with switch to allow choice of either pump as lead pump or automatic alternation. Motor starters must be NEMA-rated for horsepower. No size 00 starters and no IEC-rated starters will be allowed in the panel. Starter coils shall be 120-volt. Starters will be Square D 8536 or approved equal. All starters, breakers and relays must be enclosed.

Open-frame components shall not be used. IEC rated components are not acceptable. A power monitor relay shall be used to protect the pumps against damage from being directly switched by the power monitor relay. Activation time of the relay shall be adjustable, but not be longer than 250 milliseconds with an adjustable release time of up to 30 seconds. Relay shall be PBD series by Diversified or approved equal. There shall be no penetrations of the top of the panel enclosure, in order to prevent moisture from damaging panel components. Panel shall include four single-pole circuit breakers and a ground-fault protected 120-volt receptacle for service use. Individual control relays for 120V 3-pole service shall be Idec RR3BUL120V AC or approved equal and for 24V 2-pole service shall be RR2PUL24V AC or approved equal. Time delay relays shall be

Idec RTEB 11-120V AC or approved equal. All relays and time delay relays shall have contact rated at 10 amperes. Lightning Protection shall be provided to protect against lightning strikes. Unit shall be Delta Lighting Arrestors Model LA603. Unit must be mounted on exterior of control panel. Non-resettable elapsed time meters shall be provided for each pump. They shall be Cramer 635G or approved equal. A copy of the schematic drawings with a bill of material shall be placed inside the control panel. One additional copy shall be provided to the operating entity.

2. Wetwell (Sump) Level Controls – Level controls are provided by existing ultrasonic devices. Level control device shall be connected to the new lift station control panels.
 3. Wiring: The pump station shall be completely wired at the factory except for the power feeder lines. All wiring in the pump station shall be color coded as indicated on the wiring diagram. Wiring diagram matching the unit wiring shall be provided. All backplane wiring shall be enclosed in snap-open wireway by Panduit or approved equal. All control wiring shall be #14 AWG THHN/THWN or approved equal. Each wire shall have slide on wiring markers to identify each end of the wire. Wire markers shall be Wieland Z-type markers or approved equal. Fork terminals shall be used in each termination. Fork terminals shall be 3M Scotchlock MVU14-6FBK or approved equal. All power wiring shall be sized per the full load amps of the pumps and be THWN or MTW. Terminal connections shall be black phenolic, 300 volt rated and numbered for each position. Terminals shall be Buchanan 525 or approved equal.
- Q. Access Covers and Frames with Safety Net System: The pump supplier shall provide aluminum access covers and frames with a safety net system. Fasteners, hinges and other hardware shall be Type 316 stainless steel. The access cover shall be as specified on the drawings as manufactured by Usemco or approved equal. Door panels shall be ¼" aluminum diamond plate, reinforced to withstand a live load of 300 psf. Doors shall open 90 degrees and automatically lock with a stainless steel hold open arm with an aluminum release handle and shall include a stainless steel spring assist. When closed, doors shall be flush with the frame and equipped for padlocking. Padlock assembly shall be recessed and sized to restrict access by bolt cutters. Access Cover shall meet the required live load as a stand-alone unit only. No grating system will be acceptable if the hatch door rests on the grating frame to achieve the load rating.

Each access hatch shall be fitted with a permanently installed fall through prevention grate system that is easily retractable for access to the opening below as manufactured by Safe Approach. The fall prevention system shall consist of the following components:

1. A safety shall be certified to meet the current OSHA standard drop test.
2. All Type 316 stainless steel hardware, hooks and anchors.
3. A permanently attached metal tag with the following information: name of manufacturer; date of manufacture; and serial number.

PART 3 EXECUTION

3.01 PREPARATION

- A. Location of Existing Utilities: Contractor shall verify the existence and location of all existing underground utilities in the area of the work.
- B. Protection of Existing Utilities: Contractor shall take the necessary precautions to protect all existing utilities from damage due to his operations. Any damage to the existing utilities shall be repaired at the Contractor's expense by qualified personnel. In order to protect existing

utilities that are required to be exposed, Contractor's operation shall be such that a sufficient distance back from the edge of the excavation is maintained to avoid overloading and to prevent slides or caving. No unnecessary excavation or exposing of existing underground utilities will be allowed.

- C. Convenience to Public: All trenching and excavating shall be performed in a manner that will cause as little inconvenience to the public as possible. All excavation material shall be kept trimmed such that minimum inconvenience is caused to the public or adjoining property owners.
- D. Erosion Control: Employ measures and construction practices to prevent erosion at, or adjacent to, the project site. "The Contractor is solely responsible for providing stormwater pollution prevention measures to comply with the stormwater pollution prevention requirements of local, State and Federal regulatory agencies, including, but not limited to the Texas Commission on Environmental Quality (TCEQ) and the United States Environmental Protection Agency (EPA)." Erosion control shall begin at the onset of the project (prior to mobilization) and be maintained throughout the duration of the work until final acceptance.

3.02 ERECTION/INSTALLATION/APPLICATION/OR CONSTRUCTION

- A. Excavation: Shall include the removal of any trees, stumps, brush, debris or other obstacles that obstruct the line of work, and the excavation and removal of all earth, rock or other material to the extent necessary to install the utility and all appurtenances in conformance with the line and grades shown on the plans or as specified herein.
- B. Lift Station Components: The components of the lift station shall be installed in accordance with the recommendation of the manufacturer of each component used.

Installation of the pump chamber shall be done in accordance with the written instructions provided by the manufacturer. These instructions shall be securely attached to and readily visible on the outside of the main chamber of the pump station.

3.03 OPERATOR TRAINING

- A. The Contractor shall provide start-up training for the personnel of the Owner regarding the operation of the equipment installed.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This item shall govern for the entire construction of City traffic signal installations with, where applicable, illumination in accordance with the layouts and details shown on the Plans and with the traffic signal equipment specifications included herein.
- B. This item shall include all labor, materials, tools, equipment, and any incidentals necessary to complete the installation of City traffic signals in the limits of the project. All materials shall be furnished new by the Contractor; however, the City will furnish signal heads and mounting hardware, controller and cabinet, pedestrian signal heads and push buttons and signal poles.

1.02 UNIT PRICES

- A. Installing "Mast Arm Poles" will be measured as each mast arm pole installed.
- B. Installing "Meter Poles" will be measured as each meter pole installed. If meter assembly is placed on one of the signal poles, meter poles will still be measured as one unit per power source.
- C. Installing "Controllers" will be measured as each traffic signal controller installed.
- D. Installing "Heads" will be measured as each traffic signal head installed. A signal head is defined as one unit facing one direction. Thus a four way three section would be defined as four heads and five section Yellow Arrow, Green Arrow, Red, Yellow, Green would be one head.
- E. Installing "Loop Detectors" will be measured by the linear foot of sawed groove.
- F. "Conduit" will be measured by the linear foot, not including the length measured as boring conduit.
- G. "Boring Conduit" will be measured by the linear foot of bored conduit, in areas where open trench work is not allowed.
- H. Installing "Pullboxes" will be measured as each pullbox, complete in place.

1.03 SUBMITTALS

- A. When the project is complete, the keys for the controller cabinets shall be delivered to the Engineer. At least two (2) copies of the instruction manual and wiring diagrams for the controller furnished shall be left inside the controller cabinet.

1.04 INSTALLER QUALIFICATIONS

- A. A qualified signal technician shall perform or supervise the work, and shall be the individual who makes out the appropriate forms upon completion of the work. The qualified signal technician shall be responsible for signal turn on.

PART 2 PRODUCTS

2.01 MATERIALS

A. POWER CONNECTION

1. Any required materials not provided by the power company shall be supplied and installed by the Contractor in accordance with the Plans. Unless otherwise called for in the Plans, the power connection shall be made to a 120/240 volt, single-phase, 60-cycle A.C. supply. The wire used for the power connection shall at least be the minimum size indicated on the Plans and shall be insulated for 600 volts. The common wire shall be coded white and the positive wire shall be coded black. The City will pay for all power consumed during tests.

B. CONDUIT

1. All conduit and fittings shall be of evidence of approval by Underwriter's Laboratories. The Contractor may, at his own expense, use conduit of larger size than specified on the Plans providing that the larger size is used for the entire length of the conduit run. Conduit terminating in posts or pedestal bases shall extend vertically, approximately 2 inches above the concrete foundation. Field bends in rigid metal conduit shall have minimum radius of 12 diameters of the nominal size of the conduit. Each length of galvanized rigid metal conduit, where used, shall be reamed and threaded on each end and couplings shall be made up tight. PVC conduit shall be joined by the solvent-weld method in accordance with the conduit manufacturer's recommendation. No reducer couplings shall be used unless specifically indicated on the Plans. All conduit terminations shall be fitted with bushings.
2. Unless otherwise shown on the Plans, all conductors shall be in conduit except when in metal poles.
3. All conduit and fittings shall have the burrs and rough places smoothed and shall be clean and free of obstructions before the cable is installed. Ends of conduit shall be capped or plugged until starting of wiring. Upon request by the Engineer, the Contractor shall draw full size metal brush, attached by swivel joint to a pull tape through metal conduit and a spherical template having a diameter not less than 75 percent of the inside diameter through PVC conduit to insure that the conduit is clean and free from obstructions. A nylon or nonmetal pull tape shall be used in pulling cables and conductors through PVC conduit. Metal tapes will not be permitted in PVC conduit unless approved by the Engineer. The conduits shall be placed as shown on the Plans or as directed by the Engineer. Unless otherwise shown on the Plans or directed by the Engineer, all conduit shall be placed at least 36 inches (3 feet) deep.
4. Conduit placed for concrete encasement shall be secured and supported in such a manner that the alignment will not be disturbed during placement of the concrete. No concrete shall be placed until all of the conduit ends have been capped and all box openings closed.
5. PVC conduit which is to be placed under existing pavement, sidewalks, and driveways shall be placed by first providing a void through which the PVC conduit shall be inserted. The void shall be accomplished by boring, unless otherwise approved by the Engineer. If it is determined by the Engineer that it is impractical to place the conduit as outlined above due to unforeseen obstructions, permission will be granted by the Engineer for the Contractor to cut the existing pavement.
6. Pits for boring shall not be closer than 2 feet to the back of the curb or the outside edge of the shoulder unless otherwise directed by the Engineer. The boring method used shall not interfere with the operation of street, highway, or other facility, and shall not weaken or damage any embankment, structure, or pavement. Boring is to be done by mechanical means providing a maximum one-inch overcut for the conduit to be placed, and use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Water jetting will not be permitted.

C. WIRING

1. All wire and cable shall conform to the requirements of type and gauge shown on the Plans unless specifically covered by other items of this contract. Except for span wire suspended cables and electrical wiring within steel signal poles, all cables and single conductor wire within 21 feet above the ground shall be placed in metal conduit. Power lines carried down poles shall be placed in metal conduit. Power entrance to a ground-mounted controller shall be made through underground conduit.
2. Wiring for the controller shall consist of connecting to its terminals (1) wires to signals, (2) wires to detectors, (3) the power wires, and (4) the ground wires. Other wiring for the controller shall be as required by the wiring diagrams and furnished with the controller by the manufacturer.
3. Wiring for the signals shall consist of connecting the terminal block in each individual section to the common terminal block in each signal face assembly and, where applicable, connecting the common terminal block in each individual signal section to the terminal block in the signal face assembly terminal compartment. All connecting wires and all conductors running from any terminal points located in the pole or transformer base to the signal face assembly terminals shall be No. 12 solid American Wire Gauge. No aluminum wiring will be permitted.
4. The ends of all wires which are to be attached to terminal posts shall be provided with self-insulated solderless terminals that meet the requirements of the UL test specifications. Numbered identification tags of metal plastic or tape shall be placed around each wire adjacent to wire ends in the controller, signal heads, and signal pole base terminal boxes.
5. Unless otherwise called for in the Plans, splices will be permitted in the wires of signal and detector conductors only in the transformer base or handhole of each signal pole and at terminal points shown or called for in the Plans. If, however, the lead-in conductors from the detectors to the controller are of different type than the detector leads, a watertight splice acceptable to the Engineer may be made in a pullbox adjacent to the detector location. Any other splices may be made only with written permission of the Engineer. All splices shall be watertight.
6. The Contractor shall be responsible for testing each continuous length of insulated conductor. The testing shall be done after installation and prior to connecting the ends. Each conductor shall exhibit the following minimum D.C. insulation resistance to ground when tested at 500 volts D.C.

<u>AWG SIZE</u>	<u>MEGOHM RESISTANCE (60 F)</u>
1	336,000 Divided by Length in Feet
2	310,000 Divided by Length in Feet
4	374,000 Divided by Length in Feet
6	450,000 Divided by Length in Feet
8	592,000 Divided by Length in Feet
10	566,000 Divided by Length in Feet
12	668,000 Divided by Length in Feet
14	784,000 Divided by Length in Feet

7. All or part of conductors may be tested at the Engineer's direction. The Contractor will be required to furnish megger for testing. Conductors exhibiting a value less than the above values shall be rejected and shall be replaced by the Contractor at his own expense.

D. LOOP DETECTORS

1. The Contractor shall saw a groove for inductance loop vehicle detector placement. The groove shall be of the dimensions shown on the standard sheet. After sawing the groove, he shall place the loop detector wire to the number of turns indicated on the standard sheets.
2. Loop wire shall be #14 AWG XHHW stranded.

3. The Contractor shall set a pullbox not more than 25 feet from the edge of the pavement. One-inch conduit shall be placed from the pavement edge to the pullbox.
4. Belden shielded cable shall be provided from the pullbox to the controller.
5. Loop sealant shall be a one-part polyurethane material designed to cure in the presence of moisture and shall be suitable for use in both asphaltic and concrete pavement.
6. The sealant shall be designed to enable traffic to pass over the filled slot immediately after application without tracking or stringing. The sealant shall not shrink in volume during or after its curing process.

E. GROUNDING AND BONDING

1. The signal housing, controller housing, signal common and service common shall be grounded. All grounding shall be as shown on the Plans and/or as may be indicated in the manufacturer's specifications and wiring diagrams. All grounding devices used shall conform to the requirements of the National Electrical Code. The service common at the pole from which the power is taken shall be grounded. Metal conduit and metal signal posts or pedestals shall be bonded to form a continuous system and shall be effectively grounded. Bonding jumpers shall be No. 6 copper wire or equal.

F. CONCRETE

1. All concrete materials and their preparations shall be in accordance with the section of these specifications titled "Portland Cement Concrete".

G. CONCRETE FOUNDATIONS FOR CONTROLLER AND SIGNAL POSTS

1. Excavation for all required foundations shall be done in accordance with lines and depths indicated on the Plans. All loose material shall be removed from the excavation before the concrete is placed. Any water shall be removed by pumping or bailing. The use of explosives will not be permitted.
2. Foundations shall be constructed to the dimensions shown on the Plans or directed by the Engineer. Care shall be used to insure that the top of the finished foundation is level. Anchor bolts and conduits shall be held rigidly in place by a template until the concrete is set. A mechanical vibrator shall be used for compacting and working in concrete. After the concrete has been placed and the top struck off, it shall be covered with wet cotton or burlap mats, for not less than 96 hours. All bracing and templates for anchor bolts shall remain in place of 96 hours after the concrete is poured. During that time, the anchor bolts and conduit shall not be subjected to any applied strain.
3. Backfill shall be tamped with mechanical tamps in 6 inch layers to the density of the surrounding ground. Where excavation is made in the surfaced shoulder, the shoulder shall be replaced with material equal to the original construction.
4. All excavated material not required for backfill shall be promptly removed and disposed of by the Contractor outside the limits of the project.
5. No concrete shall be placed when the atmospheric temperature is at or below 40° F (taken in shade away from artificial heat) unless permission to do so is given by the Engineer. Curing and placement of concrete at temperatures of less than 40° F, when such placement is permitted by the Engineer, shall be in accordance with the requirements of TxDOT Item, "Concrete Structures".

H. CLEANING, PAINT, AND PAINTING

1. All cleaning, paint, and painting, where required, shall conform to the requirement of TxDOT Item, "Cleaning, Paint, and Painting". The metal-pipe conduit and exposed conduit fittings which are not galvanized shall be given one coat of No. 802 Aluminum paint after they are in place.
2. No painting will be required for controller housings or signal heads except those parts on which the paint has been scratched or marred, and such parts shall be given two coats of high-grade enamel of the same paint as the factor paint.

PART 3 EXECUTION

3.01 NOTIFICATION

- A. Prior to beginning operations, a pre-construction conference between representatives of the City and the Contractor will be arranged by the City. In this meeting, the Contractor will outline the proposed work procedures and give his plans for performing the work while providing for the safe passage of traffic at all times. Plans, specifications, unusual conditions, and other pertinent items regarding the work will be discussed.

3.02 UTILITIES

- A. The Contractor will contact all utility companies known to use the right-of-way. He will meet with utility representatives on the ground and make an effort to locate all facilities, which may be adjacent to the proposed construction. The Contractor will be responsible for adjustments in project construction that may be needed because of conflicts with underground utilities.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Minimum design and functional requirements of vehicle loop detectors and loop lead-in cable within a traffic signal system.

1.02 UNIT PRICES

- A. Detector loops will be paid for at the unit price bid for "Detector Loop", of the types and sizes specified in the bid items. These prices shall each be full compensation for furnishing and installing all detector loops, including marking locations of loops, saw cuts, loop wires, sealant, attachment devices, and for all labor, tools, equipment, and incidentals as necessary to complete the work.
- B. Detector lead-in cable will be paid for at the unit price bid for "Detector Lead-In cable, 2C #14 AWG" as shown in the plans. These prices shall be full compensation for furnishing and installing all detector lead-in cable including the splicing and testing and for all labor, tools, equipment, and incidentals as necessary to complete the work.

PART 2 PRODUCTS

2.01 LOOP DETECTORS

- A. Loop wire conductors shall be #14 AWG, soft drawn, stranded wire, Type XHHW, rated for 600V.

2.02 LEAD-IN CABLE

- A. Detector lead-in cable shall be a twisted 100% shielded pair of #14 AWG stranded wire and a #16 AWG stranded drain wire in a chrome vinyl jacket. (Beldon 8720 or an approved equivalent shall be used).

PART 3 EXECUTION

3.01 DETECTOR LOOPS

- A. The installation of loop detectors shall occur as indicated on the plans "Detector Details".
- B. The layout of the loop detector shall be performed by the Contractor in the presence of the Engineer. The Engineer shall be notified in advance of installation at a particular site location and will verify the spotting by the installation crew. In the event that it is not possible for the Engineer to be available as specified above, the Contractor shall proceed with the layout task. Detector loop locations relative to the back of curb as shown on "Layout Plans" shall be maintained, unless written permission is received from the Engineer.
- C. Slots shall be cut in the roadway, as shown in the plans, into which the loop wire shall be installed. The saw slots shall be cleaned thoroughly with clean dry air from an air compressor. The saw slots shall be checked and cleared of any debris and jagged edges before the loop wires are placed. The loop wires and polyethylene tubing shall be placed in the saw cut with a non-blunt object. After the loops are placed in saw cut 2-inch rubber or plastic base pieces spaced 18-inches apart shall be installed to hold the loop wires down.
- D. Slot sealant shall be a one-part formula, requiring no mixing, as Type 3M detector loop sealant, or approved equal. All saw cuts must be of sufficient width and depth, that all loop wire contained in the cut is completely encapsulated when the epoxy sealant is poured.

- E. Loop wire cable and plastic duct shall run continuously, without splicing from the ground box, through the 1" connecting conduit to the loop configuration in the pavement and returned through the conduit to the ground box, for connection to lead-in cable.
- F. The successive turns of loop wire for each different loop configuration is shown on the "Detector Details." The two lead-in wires shall be twisted together to form a symmetrically twisted pair. The loop lead-in shall be twisted a minimum of five (5) turns per foot.
- G. Where two or more loop lead-ins enter a ground box, a minimum separation of one (1) foot shall be maintained between loop leads underneath the pavement surface.
- H. A minimum of 2" loop wire slack shall be provided at each expansion joint in the concrete pavement.
- I. The loop wires shall be connected to the detector lead-in cable in the pullbox adjacent to the loop location. This connection shall be a waterproof splice in which the conductors are soldered. The drain wire in the lead-in cable shall be left open at the splice and grounded at the cabinet terminals only, unless otherwise recommended by the detector manufacturer. The methods of reinsulating shall have a dielectric strength at least equal to the original insulation. The specific method of splicing shall be demonstrated to the Engineer for approval.

3.02 DETECTOR LOOP TESTING

- A. Prior to pouring the slot sealant, the loop shall be checked in the pullbox for continuity and resistance. Series resistance shall not be more than 10 ohms. In addition, the integrity of the insulation shall be checked by applying a megger between each end of the loop lead-in and the nearest reliable electrical ground (e.g., street light, fire hydrant, etc.). In the event that no available ground exists, a suitable ground shall be established for the measurement (e.g., driven metal spike). The megger reading shall not be less than 10 megohms under any conditions. The Contractor shall document the results of the megger test and submit documentation to the Engineer for approval. Tests shall not be performed without prior notification of the Engineer.
- B. After the slot sealant has been placed and the detector lead-in cable has been spliced to the loop wire and the spliced sealed, the Contractor shall repeat the tests as described in Paragraph A. above except that the tests shall be performed in the controller cabinet. The Contractor shall document the results of this "after" test and submit documentation to the Engineer for approval. If the loops do not meet the test requirements, the Contractor shall find the cause for the test failing and correct the fault to the satisfaction of the Engineer and retest the loop and lead-in all at the expense of the Contractor.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pedestrian push-button installation.

1.02 UNIT PRICES

- A. Pedestrian push buttons will be measured per each. Materials required and used in installation, such as supplemental signs and mounting hardware shall not be paid for directly, but shall be considered subsidiary to the Item "Pedestrian Push Buttons". Pedestrian push buttons, installed in place, will be paid for at the unit prices bid as specified in the bid item list. Said payment shall be full compensation for furnishing and installing push buttons, supplemental use signs, and for all labor, tools, equipment, materials and incidentals necessary to complete the work.

PART 2 PRODUCTS

2.01 PEDESTRIAN PUSH BUTTONS

- A. Pedestrian push buttons shall have permanent signs within the unit or signs permanently attached to the unit which explain the purpose of the push buttons and define specific crossings and signal assignments. Push buttons shall be of the direct push contact type, entirely insulated from the case and be of brass or other corrosion resistant material. The assembly shall be sturdy, weatherproof and secure against electrical shock to the user. The case of the unit shall be tapped for ½ inch pipe, for appropriate conduit connection.

PART 3 EXECUTION

3.01 PEDESTRIAN PUSHBUTTONS

- A. Pedestrian push buttons shall be permanently attached to the traffic signal strain pole with appropriate galvanized or stainless steel hardware and shall be mounted forty inches (40") above the ground or sidewalk.

END OF SECTION

PART 1 G E N E R A L**1.01 SECTION INCLUDES**

- A. Traffic Signal Conduit
- B. Traffic Controller Concrete Cabinet Foundations
- C. Ground (pull) Boxes

1.02 UNIT PRICES**A. CONDUIT**

1. Conduit of the respective sizes and material type specified on the Plans, will be measured per linear foot, Materials required and used in installation, such as couplings and connecting hardware, will not be measured directly, but will be considered subsidiary to the item "Conduit".
2. Conduit, provided and installed in place will be paid for at the unit price bid for respective size and type specified in the bid item list. Said prices shall be full compensation for furnishing and installing all described connecting hardware, for cleaning existing conduit sections (those to be reused) and for all labor, tools, materials, equipment and incidentals necessary to complete the work.

B. GROUND (PULL) BOXES

1. Ground boxes will be measured per each unit. Materials required and used in installation, such as bedding gravel, will not be measured directly, but will be considered subsidiary to the Item "Ground Boxes".
2. Ground boxes, provided and installed in place as shown on the plans will be paid for at the unit price bid specified in the bid item list. Said prices shall be full compensation for furnishing and installing and for all labor, tools, materials, equipment and incidentals necessary to complete the work.

C. CABINET FOUNDATION

1. Foundations will be measured per each unit. Materials required and used in installation, such as reinforcing steel, ground rods and forms will not be measured directly but will be considered subsidiary.
2. Foundations installed in place, will be paid for at the unit price bid for respective types specified in the bid item list. Said prices shall be full compensation for furnishing and installing all required materials, such as reinforcing steel, concrete, ground rods, anchor bolts, and for all labor, materials, tools, equipment, all backfilling, and incidentals necessary to complete the work.

PART 2 P R O D U C T S**2.01 MATERIALS****A. Conduit**

1. All conduit and fittings shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories, and shall be marked in accordance with the applicable requirements of the NEC.
2. All conduit and fittings shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories, and shall be marked in accordance with the applicable requirements of the NEC.

3. Ground boxes, expansion joints and conduit fittings shall be fabricated from a material similar to the connecting conduit unless indicated otherwise on the plans and shall be listed by Underwriters Laboratories.
4. Rigid metal conduit shall be steel, hot-dipped galvanized inside and outside. When tested in accordance with ASTM designation: A 90, zinc coating shall be a minimum of 1.5 ounces per square foot. Electrical metallic tubing and intermediate metal conduit shall be steel, hot-dipped galvanized on the outside and protected on the inside with a suitable corrosion resistant material. Fittings shall be rain-tight. Set screw and pressure cast fittings will not be permitted.
5. Flexible conduit shall be liquid-tight metal meeting requirements of NEC and shall be UL-listed. Where conduit system is metallic, all lengths of flexible metal conduit shall be fitted with bonding jumpers.

B. GROUND (PULL) BOX

1. The assembly shall consist of box, cover, and extension (if required). The box and extension shall be precast concrete. The cover shall be galvanized steel. The cover shall be fabricated so as to fit properly in a recessed lip for full and stable contact on the box and be secured thereon with at least two stainless steel bolts. The legend "Traffic Signals" shall be integrally cast into the top surface of the cover, and the cover shall be provided with a sturdy, stainless steel drop handle to facilitate removal.
2. The ground boxes shall have the minimum outside dimensions of as shown in the plans. The bottom portion of each will be open, with sturdy flange around the perimeter so that the box seats firmly on the top of extension. A minimum of four knockouts, to accept three-inch duct, one on each end and side, shall be provided in each box and extension section.
3. Concrete used for construction the precast concrete ground boxes shall be Class A conforming to the requirements of the Texas Department of Transportation Specifications for "Portland Cement Concrete" and "Reinforcing Steel".

PART 3 EXECUTION

3.01 CONDUIT

- A. The conduit, ground boxes, fittings and incidental shall be placed in accordance with the lines, grades, details and dimensions shown on the plans, or as directed by the Engineer. Installation of conduit shall be in accordance with the requirements of NEC. Conduit placed for concrete encasement shall be secured and supported in such a manner that the alignment will not be disturbed during the placement of the concrete. No concrete shall be placed until all of the conduit ends have been capped and all box openings closed.
- B. Where conduit is threaded in the field, a standard conduit cutting die with a 3/4 inch tape per foot shall be used. Conduit placed on structures shall be firmly fastened within 3 feet of each outlet box, ground box or fitting and at other locations as required by the NEC.
- C. When required by the Engineer, immediately prior to installation of conductors or final acceptance, a spherical template having a diameter of not less than 75 percent of the inside diameter of the conduit shall be drawn through the conduit to insure that the conduit is free from obstruction; then all conduit ends shall be closed using permanent type caps.
- D. Conduit terminating in controller cabinet shall extend vertically, approximately two inches above the concrete foundation. Field bends in rigid metal conduit shall have a minimum radius of 12 diameters of the nominal size of the conduit.

- E. Each length of galvanized rigid metal conduit shall be reamed and threaded on each end and couplings shall be made up tight. White-lead paint or equal shall be used on threads of all joints. No reducer couplings shall be used unless specifically indicate don the Plans.
- F. All conduit and fittings shall have the burrs and rough places smoothed and shall be clean and free of obstructions before the cable is installed. Ends of conduits shall be capped or plugged until starting of wiring. The conduits shall be placed as shown on the Plans or as directed by the Engineers, conduit placed in an open trench or under existing pavement shall be placed at least 36 inches deep.
- G. Pits for jacking or boring shall not be closer than two feet to the back of the curb or outside edge of the shoulder unless otherwise directed by the Engineer. The jacking or boring method used shall not interfere with the operation of street, highway, or other facility, and shall not weaken or damage any embankment, structure, or pavement. Heavy jacks are to be used for jacking. Boring is to be done by mechanical means providing a maximum one-inch cover cut for the conduit to be place, and use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Water jetting will not be permitted. Where conduit is to be placed under existing asphaltic pavement, the jacking method is to be used unless written approval is given by the Engineer for placement of conduit by boring.
- H. The Contractor may, at his own expense, use conduit of larger size than specified on the Plans providing that the larger size is used for the entire length of conduit run.
- I. Unless otherwise shown on the Plans, all conductors shall be in conduit except when in metal poles. All conduit and fittings shall be of the sizes and types shown on the plans.
- J. A 1/8 inch nylon pull rope shall be included in all conduits installed.

3.02 GROUND (PULL) BOX

- A. The box shall be used for terminating and beginning conduit runs of various sizes and also for accessibility when pulling signal or interconnect cable.
- B. The construction and installation of the ground boxes shall be carried out in compliance with the requirements herein stated and in conformity with the details shown on the plans. Upon completion of the work, each installation shall present a neat finished appearance.

3.03 CABINET FOUNDATIONS

- A. All concrete materials and their preparations shall be in accordance with the section in the specification titled "Portland Cement Concrete." All concrete used in the project shall have the following mix proportions and characteristics:
 - 1. Minimum Sacks of Cement (Type II Portland) per cubic yard-5.0
 - 2. Maximum Water - Cement Ratio - 6.5
 - 3. Maximum Size of Aggregate - 1 inch
 - 4. Minimum Compressive Strength in psi (28 day cure at 70°F.) - 3000
 - 5. Slump Range in inches - 3 to 5
- B. Use of a cement dispersing agent is permissible, but not required when the temperature of ambient air or of the concrete mix is above 85°F.
- C. Excavation for all required foundations shall be done in accordance with lines and depth indicated on the Plans. All loose material shall be removed from the excavation before the

- concrete is placed. Any water shall be removed by pumping or bailing. The use of explosives will not be permitted.
- D. Foundations shall be constructed to the dimensions shown on the Plans or directed by the Engineer. Care shall be used to insure that the top of the finished foundation is exactly level. Anchor bolts and conduits shall be held rigidly in place by a template until the concrete is set. A mechanical vibrator shall be used for compacting and working the concrete. After the concrete has been placed and the top struck off, it shall be covered with wet cotton or burlap mats, for not less than ninety-six (96) hours.
- E. Backfill shall be tamped with mechanical tamps in 6-inch layers to the density of the surrounding ground. Where excavation is made in the surfaced shoulder, the shoulder shall be replaced with material equal to the original construction.
- F. All excavated material not required for backfill shall be promptly removed and disposed of by the Contractor outside the limits of the project.
- G. No concrete shall be placed when the atmosphere temperature is at or below 40°F. (Taken in shade away from artificial heat) unless permission to do so is given by the Engineer.

END OF SECTION

NOTE TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Indicate on the Drawings the liner coverage requirements. All exposed interior surfaces should be shown as covered with liner. As a minimum, show the location of the lower terminal edge for all cast-in-place structures. The lower terminal edge in lift station wet wells is normally 1'-0" below the "all pumps off" elevation (normal low water level). The lower terminal edge in manholes and junction structures is normally a minimum of 6 inches below the top of the grout or concrete fill, fillet, or bench.

END OF NOTE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification covers polyvinylchloride compound-jacketed polyethylene-insulated multi-conductor cable, and polyvinylchloride compound-insulated single conductor wire, rated 600 volts, for use in signal systems in underground conduit, as aerial cable supported by a messenger or for induction loop detector wire. Cable under this specification shall be composed of uncoated copper conductors individually insulated with heat-stabilized polyethylene (multi-conductor) or with polyvinylchloride compound (single conductor) as specified herein. Multiple insulated conductors shall be laid up in a compact form, bound with suitable tape, and jacketed with polyvinylchloride compound.

1.02 UNIT PRICES

- A. Single and multi-conductor cable, installed and in place, and of the size and number of conductors specified on the Plans, will be paid for at the unit prices bid as specified in the bid item list. Said payment shall be full compensation for furnishing and installing cable with proper grounding, and for all labor, tools, materials, equipment and incidentals necessary to complete the work.

PART 2 PRODUCTS

2.01 MATERIALS

A. CONDUCTORS

- 1. The copper conductors shall, before insulating, conform to the requirements of ASTM Designation B-3, latest revision for soft annealed copper wire, and ASTM B-8 for concentric lay, stranded copper wire.
- 2. The number of size of the conductors shall be as specified in the plans and specifications.

B. INSULATION

1. MULTI-CONDUCTOR CABLE

- a. The insulating compound before application to the conductors shall be heat-stabilized polyethylene conforming to the requirements of ASTM Designation D1248, 63T, Type 1, Class B, Grade 4. The insulation shall be applied concentrically about the conductor. Insulation after the application to the conductors shall meet the following requirements when tested in accordance with the procedures given in ASTM Designation D1351, latest revision, and ASTM Designation D470, latest revision.
- b. Physical Properties of Polyethylene insulation
 - i Initial Properties:
 - Tensile strength, lbs. Per sq. in., minimum 1400
 - Elongation at rupture, percent, minimum 350
 - ii After 48 hours in air over at 100°C:
 - Tensile strength, percent of original, minimum 75
 - Elongation at rupture, percent of original, minimum 75
 - iii Cold Bend Test, 1 hour at -55°C.; plus or minus 1 degree no cracks (Mandrel diameter 2.5 times insulation diameter).
- 2. The nominal thickness of the insulation shall be not less than that specified in Table 1. The minimum thickness of the insulation shall be not less than 90 percent of the nominal value.
- 3. MOISTURE ABSORPTION
 - a. After a twenty-four hour immersion in tap water at 50°C. plus or minus 1°C., the specific inductive capacity of the insulation shall be not more than 2.5 After a

continued fourteen day immersion, the specific inductive capacity shall be not more than 1.5 percent higher than the value determined at the end of the first day, nor more than 1.0 percent higher than at the end of the seventh day.

- b. The moisture absorption tests shall be conducted in accordance with methods specified in PCEA S-61-402, NEMA WC5, latest revision.

4. ELECTRICAL PROPERTIES

- a. Each processed length of insulated conductor before cabling shall withstand the test voltage specified in Table 1 for a period of 5 minutes after immersion in water for not less than 6 hours and while still immersed.
- b. Each processed length of insulated conductor, after withstanding the Dielectric Strength Test, and while still immersed, shall comply with the insulation resistance requirements of Table 1.
- c. The Dielectric Strength and Insulation resistance Tests shall be conducted in accordance with the requirements of ASTM Designation D470, latest revision.

TABLE 1
INSULATION THICKNESS, TEST VOLTAGE AND INSULATION RESISTANCE

Conductor Size AWG	Insulation Thickness, Inch	Test Voltage	Insulation Resistance at 60 F. Megohms-1000 Feet
20	.025	2500	15,000
19	.025	2500	15,000
18	.025	2500	15,000
17	.025	2500	15,000
16	.025	2500	14,800
15	.025	2500	13,700
14	.025	2500	12,600
13	.030	3000	13,200
12	.030	3000	12,100
11	.030	3000	11,000
10	.030	3000	10,100
9	.030	3000	9,200
8	.030	3000	8,300

- d. The insulation OF single-conductor cable shall be tough, durable, stabilized polyvinylchloride compound meeting the requirements of Underwriter's Laboratories Type THW
- e. The physical characteristics of the insulation shall be as given in Table II. Tests of these characteristics shall be made in accordance with ASTM designation D-470, latest revision

TABLE II

- i Initial Properties:
- Tensile strength, lbs. per sq. inch, min. 2300
 - Elongation, percent, min. 250
- ii After 120 hours in Air Oven at 100°C:
- Tensile strength, percent of original, min. 85
 - Elongation at rupture, percent of original, min. 60
- iii Cold Bend Test. 1 Hour at -55°C.
(Mandrel Diameter 2.5 times covering diameter) No cracks
- iv Flame Test, self-extinguishing in minutes, max. 1

5. THICKNESS, DIAMETERS AND WEIGHTS

- a. The completed conductor shall conform to the requirements of Table III

- b. The thickness of the insulation shall be not less than 90% of the nominal value in Table III.
- c. The minimum spot thickness shall be not less than 70% of the nominal thickness.

TABLE III

Conductor Size AWG	Nominal Thickness of Covering	Approx. O.D. Inches	Approx. Weight Lbs./M Ft.
4	.045"	.300	131
6	.045"	.260	85
8	.045"	.220	56
10	.030"	.174	34
12	.030"	.140	23

C. CABLE COLOR-CODING**1. MULTI-CONDUCTOR CABLE**

- a. Standard color coding for cables shall be in accordance with Table IV. When permitted by the purchaser, the conductor coding may be numerals and words printed on the conductor insulation. Base colors shall be obtained by the use of colored insulation. Tracers shall be colored stripes or bands which are part of, or firmly adhered to, the surface of the insulation in such a manner as to afford distinctive circuit coding throughout the length of each wire. Tracers may be in continuous or broken lines, such as a series of dots or dashes, and shall be applied longitudinally, annularly, spirally or in other distinctive patterns.

**TABLE IV
CONDUCTOR COLORS AND SEQUENCE**

Conductor No.	Base Color	First Tracer
1	Black	
2	White	
3	Red	
4	Green	
5	Orange	
6	Blue	
7	White	Black
8	Red	Black
9	Green	Black
10	Orange	Black
11	Blue	Black
12	Black	White
13	Red	White
14	Green	White
15	Blue	White
16	Black	Red
17	White	Red
18	Blue	Red
20	Red	Green
21	Orange	Green

- b. The color sequence may be repeated as necessary. Color code sequence applies when cable is composed of mixed sizes.
- c. Special color coding, when specified in unpaired conductor cables, shall consist of black for all conductors except that one conductor shall be identifiable conductor in each layer.
- d. For combination cables consisting of pairs with single conductors, color code sequence given in Table IV, shall be used for pairs, repeated as necessary.

- e. Back covering shall be used for signal and power circuit positive. White covering shall be used for signal and power circuit common. Red covering shall be used for detector positive. Blue covering shall be used for detector circuit common. Covering colors shall be obtained by use of colored polyvinylchloride.
- D. CONDUCTOR ASSEMBLY (MULTI-CONDUCTOR CABLE)
1. TWO-CONDUCTOR CABLE
 - a. Two-conductor cables shall have a maximum length of lay no more than 30 times the installed conductor diameters.
 - b. Two-conductor cables shall be of the round, twisted type.
 - c. Fillers shall be used where necessary to form a two-conductor round twisted cable.
 2. MULTI-CONDUCTOR CABLES HAVING MORE THAN TWO CONDUCTORS
 - a. In multi-conductor cables having more than two conductors, the single conductors shall be laid up symmetrically in layers with lay not exceeding the following:

# of Conductors	Maximum Length of Lay
3	35 times insulated conductor diameter
4	40 times insulated conductor diameter
5 +	15 times assembled core diameter

- b. Each layer of conductors in the cable shall be laid in a direction opposite to that of adjacent layers. When permitted by the purchaser, unidirectional lay may be used. The outer layer shall be left-hand lay.
 - c. Fillers shall be used, where necessary, to secure a uniform assembly of conductors of a firm, compact cylindrical core. Fillers shall be of a non-metallic moisture-resistant material which has no injurious effect on adjacent components.
 - d. The conductor assembly shall be covered with a spiral wrapping of a moisture-resistant tape applied so as to lap at least 10 percent of its width.
- E. JACKET (MULTI-CONDUCTOR CABLE)
1. Over the taped conductor assembly there shall be applied a tightly fitting polyvinylchloride compound jacket which shall meet the following requirements when tested in accordance with ASTM Designation D-1047, latest revision.
 2. PHYSICAL PROPERTIES OF POLYVINYLCHLORIDE JACKET
 - i Initial properties:

• Tensile Strength, lbs., per sq. in., minimum	1800
• Elongation at rupture Percent, minimum	250
 - ii After 5 days in air over at 100°C.

• Tensile Strength, percent of original, minimum	85
• Elongation at rupture, percent of original, minimum	60
 - iii Head Shock Test, Air Oven, 1 hour at 121°C. No cracks
 - iv Heat Distortion Test, Air Oven, 1 hour at 121°C.

• Decrease in thickness, percent maximum	50
 - v Cold Bent Test, 1 hour at -40°C. No cracks
 - vi Flame Test, minutes burning, maximum 1
 - vii After 4 hours in ASTM No. 2 oil at 70°C.

• Tensile Strength, percent of original, min.	80
• Elongation at rupture, percent of original, min.	60
 3. The nominal thickness of the jacket shall be as specified in Table V. The average thickness shall be not less than 90% of the specified thickness. The minimum thickness shall be not less than 70% of the nominal thickness.

TABLE V

Calculated Diameter of Cable Under Jacket, Inches	Jacket Thickness Mils
0.425 and less	45
0.426 - 0.700	60
0.701 - 1.500	80
1.501 - 2.500	110
2.501 and larger	140

F. IDENTIFICATION

1. Each shipping length of multi-conductor cable shall have a tape showing the name of the manufacturer and the year in which the cable is manufactured, placed over or under the tape covering the conductor assembly before the application of outer coverings. As an alternate method of identification, the above information may be applied to the outer surface of the jacket.
2. Each shipping length of single conductor shall have indented printing on a tape or other permanent identification showing the name of the manufacturer and the year in which the conductor is manufactured.

G. PACKING AND MARKING FOR SHIPMENT

1. Reels for multi-conductor cable shall be substantially constructed and in good condition. The cables shall be suitably protected. Each end of the cable shall be available for testing, properly sealed, and protected against injury. Each reel shall be plainly and permanently marked with manufacturer's full description of the cable, giving the length of the cable on the reel, the number of conductors in the cable and the date of shipment from the factory.

H. GROUNDING AND BONDING

1. There shall be a properly installed and connected ground rod for each controller cabinet and power drop to reduce any extraneous voltage to a safe level. The location of the ground rod shall be such as to minimize the length of the grounding-conductor run. All grounding circuits shall be substantial and permanent and shall be electrically continuous with an ohms-to-ground resistance not to exceed 10 ohms when tested by a volt-ohm-meter.
2. The signal pole housing, controller housing, signal common and service common shall be grounded. All grounding shall be as shown on the plans and/or may be indicated in the manufacturer's specifications and wiring diagrams. All grounding devices used shall conform to the requirements of the National Electrical Code. The service common at the pole from which the power is taken shall be grounded.
3. Metal conduit and metal signal posts or pedestals shall be bonded to form a continuous system and shall be effectively grounded. Bonding jumpers shall be No. 6 copper wire or equal.
4. The grounding conductor shall be a #6 AWG stranded copper wire. The conductor shall be bonded to ground rods. Ground rod electrodes shall be copper-bonded steel being at least 3/8 inch in diameter and shall be driven into the ground to a depth sufficient to provide the required resistance between electrodes and ground (10 ohms). All ground rods shall be a minimum of six feet long. When the location precludes driving a single ground rod to a depth of six feet or when a multiple ground rod matrix is used to obtain the required resistance to ground, ground rods shall be spaced at least six feet apart and bonded by a minimum #6 AWG copper wire. Connections to underground metallic conduit shall not be considered sufficient for grounding requirements. Connection of grounding circuits to grounding electrodes shall be by devices which will ensure a positive, fail-safe grip between the conductor and the electrode (such as lugs or pressure connectors). No splice joint will be permitted in the grounding conductor.

2.02 MATERIAL TESTS

A. SAMPLING, INSPECTING AND ACCEPTANCE

1. Inspection and tests shall be made prior to shipment and at the place of manufacture.
2. The Contractor shall furnish the Engineer in suitable form, a certified report of the tests made on the cable to show compliance with this specification.
3. Tests on Entire Cable - The individual conductors of each length of completed cable shall meet the voltage and insulation resistance requirements of Section 4, except that the final electrical test on multiple conductor cables may be made without immersion in water. Each conductor of a multiple conductor cable shall be tested against all other conductors and shield if present.
4. Sample Tests - One sample for establishing conformity to this specification shall be taken from each 10,000 feet or fraction thereof, of each type and size of cable except that for the physical dimensions and the visual inspection a sample shall be taken from each reel. In case that these samples fail to meet the requirements of this specification, two additional samples shall be selected from new cable lengths and the lot shall be accepted if retests are both satisfactory. However, in case of any failure on the retest, the lot shall be rejected.

PART 3 EXECUTION

3.01 INSTALLATION OF CABLE

A. GENERAL

1. The cables shall be installed in the conduit. The conduit must be continuous, reasonably dry, completely free of debris, and without any sharp projections, edges, or short bends. The conductors shall be installed in such manner and by such methods as to insure against harmful stretching of the conductor or damage to the insulation and shall conform to the recommendations of the cable manufacturer. The Contractor shall furnish, at the request of the Engineer, at least two copies of the manufacturer's recommendations, including methods of attaching pulling tension per conductor size and per radius of conduit bend, and the type of lubricant to be used.
2. All cables in a given conduit run shall be pulled at the same time and the conductors shall be assembled to form one loop in such a manner that the pulling tension is distributed to all the cables. Long, hard pulls will necessitate the use of pulling eyes. For short runs, the cables may be gripped directly by the conductors by forming them into a loop to which the pull wire or rope can be attached. The insulation on each conductor shall be removed before the loop is formed. The method used will depend on the anticipated maximum pulling tension in each case.
3. In many instances, existing conduits which contain signal cable are to be used for the installation of new cables. In such locations, the existing cable(s) may be used to pull in the new cables. Should the Contractor desire to install new cables without removing the existing cables, the new installation shall be done in such a way as to prevent damage to the existing and/or new cables. In the event of damage, the Contractor shall bear the responsibility of replacement of defective cables.
4. The manufacturer's recommended maximum pulling tensions shall not be exceeded under any circumstances. If so required by the Engineer, the Contractor shall insert a dynamometer in the pull wire as the cables are being pulled into the conduit to demonstrate that the maximum tensions are not being exceeded. The cable shall be fed freely off the reel into the conduit without making a reverse curve. At the pulling end, the pull wire and or other suitable devices shall be used as required to reduce any hazards to the cable during installation. The cables shall be adequately lubricated to reduce friction and further minimize possible damage. Such lubricants shall not be the grease or oil type used on lead sheathed cables but shall be one of several commercially available wire pulling compounds that are suitable for these kinds of cables. They shall consist of soap,

talc, mica, or similar materials and shall be designed to have no deleterious effect on the cables being used.

5. The cables shall be neatly trained to their destinations in manholes, cabinets, pole bases, pullboxes, and all other terminations. The cable manufacturer's recommended values for the minimum bending radii to which cables may be bent for permanent training during installation shall be adhered to. These limits do not apply to conduit bends, sheaves or other curved surfaces around which these cables may be pulled under tension while being installed. Larger radius bends are required for such conditions.

B. WIRE AND CABLE

1. All wire and cable shall conform to the requirements shown on the plans, except wire and cable specifically covered by other items of this contract. The minimum size of conductors shall be as indicated on the plans.

C. CONTROLLER CABINET WIRING

1. Wiring for the controller shall consist of connecting to its terminals (1) wires to signals (2) wires to detectors (3) wires to pedestrian push buttons (4) the power wires, (5) the ground wires, and (6) the interconnect wires. At the controller all conductors from the field shall have fork terminals for connections. Other wiring for the controller shall be as required by the wiring diagrams and instructions furnished with the controller by the manufacturer.
2. All field wiring in cabinets shall be neatly done. Incoming cables shall be trained to their destination and neatly laced together. Communication and detector lead-in cables shall be clearly identified by use of metal or plastic tags. For example: Eastbound Right Lane.

D. SIGNAL HEAD WIRING

1. Wiring for the signal head shall consist of connecting the terminal block in each signal section to the common terminal block in each signal face and where applicable, connecting the common terminal block in each signal face to the terminal block in the signal-head terminal compartment. All such connecting wires shall be number twelve (#12) American Wire Gauge. All conductors running from any terminal points located in the pole or transformer base to the signal head terminals shall likewise be number twelve (#12) AWG. The Contractor shall furnish the #12 AWG for this work

E. TERMINALS AND SPLICES

1. Except for controllers, the ends of all wires which are to be attached to terminal posts shall be provided with solderless terminals that meet the requirements of the National Electrical Code.
2. Unless otherwise called for in the plans, splices will be permitted in the wires of signal conductors only in the base of each signal pole at terminal points called for in the plans. If lead-in conductors from detectors to controller are of different type than the detector leads, a watertight splice, acceptable to the Engineer, may be made in ground box adjacent to the detector location. Splices at points other than as stated above may be made only with the written permission of the Engineer. All splices shall be watertight. Splicing methods shall be in accordance with good electrical practice and the cable manufacturer's recommendations. All materials used shall be high quality and specifically intended for these purposes. The cables shall be trained to their final position and cut to proper lengths. The jacket and insulation shall be removed as required. In doing this, use proper care to insure against nicking the conductors. The connector shall be soldered. Heat shall be applied by the use of hot solder. Heating the connection with a direct flame will not be permitted. Care shall be used to protect the insulation when soldering. The entire surface shall be cleaned taking special care in cleaning outside jacket in order to remove the wax finish. Before the first layer of tape is wrapped, the entire area shall be coated with an electric grade rubber cement. After this solvent has dried, the connection shall be insulated with electrical grade rubber splicing compound tape to proper thickness. This tape requires a pressure and thus must be stretched to

2/3 width when applied. The completed splice shall be covered with a half-lap layer of vinyl plastic electrical tape. This wrapping shall be smooth but the tape shall not be stretched more than necessary.

3. Splices in communication cables shall include the shield. Splices between cable pairs shall be made with Scotchlock solderless connectors designed for this specific application. The completed splice shall be insulated with a re-enterable plastic splice case. Splices at points other than those shown on the plans may be made only with the written permission of the Engineer.
4. The Engineer shall select at random at least 5 splices to be thoroughly inspected. The Contractor shall, in the presence of the Engineer, sectionalize the splice to expose the various layers of materials and the connector. The splice shall be thoroughly checked for compliance to these special provisions. The splice shall then be remade by the Contractor. This work shall not require extra payment, but is considered subsidiary to other items in the contract. All of the splices selected for this inspection shall conform to the requirement of these special provisions. If any splices fail to meet these requirements, ten (10) more splices shall be selected at random by the Engineer for inspection.

F. ENCLOSED WIRING

1. Except for span wire suspended cables and electrical wiring within steel signal poles, all cables and single conductor wire above the ground surface shall be enclosed in approved metal conduit up to but no closer than one foot of the lowest power conductor. The power entrance to the controller may be made through underground polyvinylchloride conduit.

G. IDENTIFICATION OF SIGNAL WIRES

1. A color-coded signal cable shall be used to wire bases pillboxes and controllers. Colors shall be continuous from the point of origin to the point of termination. Splices will be permitted if same colors are spliced.

END OF SECTION

PART 1 DESCRIPTION

- 1.01 Furnish and place reflectORIZED pavement markings of the types, colors, sizes, widths and thickness shown on the plans in accordance with Special Specification, Item 6110 "ReflectORIZED Pavement Markings with Retroreflective Requirements" TxDOT Standard Specifications for construction 2004 Edition or most current.

END OF SECTION

PART 1 G E N E R A L**1.01 SUMMARY**

- A. Job includes all labor and materials for complete and operable installations indicated on drawings and specifications completed in every necessary detail and appurtenance inferred by requirements indicated.
- B. Work includes testing and demonstration of correct operation of complete system.

1.02 REFERENCES

- A. Comply with applicable provisions and recommendations of the following Standards, except as otherwise shown or specified.
 - 1. NEC National Electrical Code
 - 2. NESC National Electrical Safety Code
Local and State Codes, Ordinances and Laws
 - 3. NEMA Standards of National Electrical Manufacturers Association
 - 4. IEEE Institute of Electrical and Electronic Engineers
 - 5. ANSI American National Standards Institute
 - 6. ASTM American Society for Testing and Materials
 - 7. UL Underwriters Laboratories Inc
 - 8. OSHA Occupational Safety and Health Administration

1.03 MEASUREMENT AND PAYMENT

- A. There will be no direct measurement of direct payment for items covered in this Section unless otherwise indicated in the Bid Form.

1.04 SUBMITTALS

- A. Submit shop drawings, product data and samples required per specification and so arranged as to facilitate review.

1.05 QUALIFICATIONS

- A. All work performed by competent workmen skilled in their respective trades, installed in neat and first class manner per accepted industry-wide standards.

1.06 WARRANTY

- A. Warranty entire system to be of specific quality and free from defects in materials and workmanship and in perfect working order.
- B. Equipment and installation warranties shall be for one year minimum, after final acceptance of completed installation.

PART 2 P R O D U C T S

2.01 MATERIALS

- A. First class new materials of indicated strength, quality and functional characteristics, procured, stored and protected at contractor's expense. All new materials shall be UL-listed.
- B. Items of the same classification shall be identical including equipment, assemblies, parts and components.
- C. Exposed conduit, including elbows, couplings and nipples, shall be standard weight zinc-coated, steel rigid threaded conduit; shall meet the requirements of ANSI, and shall be hot-dipped galvanized inside and outside and over threads. Rigid Metal Conduit Fittings shall be of crouse-hinds or equal and of same material and finish as the conduit.
 - 1. Provide conduit accessories including straps, supports, hangers and expansion joints as instructed by the conduit manufacturer and as specified, complying with NEMA FB 1.
 - 2. Protect exposed conduit ends during construction with pipe or plug caps. Future and spare conduit ends shall have pipe plugs or caps.
 - 3. Crouse-hinds type STL or HTL thread lubricant shall be used on the conduit threads to prevent galling and to assure a good grounding path.
 - 4. The use of threadless couplings and connectors will not be permitted.
 - 5. All bushings shall be of the insulating type. Conduit extension fittings shall be provided with bonding jumpers.
 - 6. Continuous threaded nipples will not be permitted.
 - 7. The flexible conduit shall be limited to short runs of up to 4 feet, where flexibility is necessary or desirable and shall be liquid-tight.
 - 8. Provide dielectric Couplings between dissimilar metals.
 - 9. Conduit Runs: Straight, without unnecessary bends and offsets, qualifying as grounded raceway.
 - 10. If the conduit size not noted, the contractor to size per NEC, with minimum size of conduits not less than $\frac{3}{4}$ ".
- D. Grounding continuity shall be assured by means approved in the NEC.
- E. Underground conduits: Rigid PVC conduit schedule 40 shall be installed in accordance with manufacturers recommendation and strict compliance with the NEC. Minimum bending radius shall be not less than 36" or 10 X diameter, long radius. Provide red concrete envelope to protect against inadvertent digging and damage. The concrete shall be 2800 psi (minimum) strength at 28 days. Ducts under existing sidewalks shall be installed in 6" smooth steel pipe sleeve by jacking and boring. Ducts shall be placed with a minimum grade of 2 inches per 100 feet and conduits sloping towards pull boxes. PVC conduits shall meet NEMA Std. TC 2, TC 6, TC 7, TC 8 and UL 651. PVC Solvent shall meet ASTM D 2564.
- F. Provide liquid tight flexible metal conduit, up to 2 feet for connections to all non-submersible motors.

- G. Trenching and backfill: Trenches shall be back filled with excavated soil and compacted to the same density as the surrounding soil. Backfill may be accomplished by tamping or water jetting as required to achieve full settlement.
- H. All exterior enclosures, fuse boxes, distribution troughs shall be UL-listed, NEMA 4X, stainless steel. Interior enclosures shall be NEMA 1.
- I. Wiring: For ac power and control, the wires shall be THHN/THWN copper rated for 600 volts and 90 degrees Centigrade, #12 minimum for power wiring and #14 minimum for control wiring.
1. For dc signal wiring, use No. 18 minimum AWG stranded, shielded, insulated copper wire with thermoplastic insulation rated for 600 volts and 90 degrees Centigrade.
 2. Install wiring runs along horizontal and vertical routes to present a neat appearance. Angled runs are not acceptable.
 3. Group or bundle parallel runs or wire using plastic ties securely fastened to the panel or plastic troughs.
 4. Adequately support and restrain all wiring runs to prevent sagging or other movements.
 5. Color code and clearly number all wires at each end and in each fitting through which the wiring passes using Brady heat shrink wire markers. Bring all external connections to master numbered terminal boards. All wires on the back panel should be contained in wire troughs.
 6. Separate ac wiring from dc wiring.
 7. Separate and shield dc signal wiring from control and power wiring.
 8. Use insulated crimped spade lugs to connect wiring to terminals sized properly for wire and terminal screw.
 9. Provide master coded terminal strips and connect all input and output wiring to a designated terminal post. Connect no more than two (2) wires of any size to a single post.
 10. All equipment and components shall be solidly grounded to the control panel.
- J. Terminal Blocks:
1. Use barrier type terminal strips with compression type connections, 600 V rating and numeric identifiers beside each connection. Soldered type connections are not acceptable.
 2. Provide spare terminals equal in number to approximately 20 percent of the terminals used for each type of wiring, that is: dc signal wiring, dc control wiring and ac power and control wiring.
- K. Wire Marking: Provide wire markings at all wire terminations.
- L. Grounding: Ground all poles, light fixtures, contractors, switches, handles, panelboards, pumps, equipment, etc. Size per NEC or per plans, whichever is larger. The ground wire shall be copper.

- M. Grouting: Grouting shall be non-shrink.
- N. Warning Signs: Signs shall be designed to be in accordance with local standards and OSHA regulations. 145 Specifications for Accident Prevention Signs and Tags.
- O. Nameplates
 - 1. Each major component of equipment shall have as a minimum the manufacturer's name, address and catalog or style number on a nameplate securely attached to the item of equipment.
 - 2. Name plates shall be phenolic type, laminated white, with black letter engraving.

2.02 MANUFACTURERS

- A. Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product.

2.03 FINISHES

- A. Factory finish: All factory assembled equipment except non-ferrous or galvanized items and other items specified or scheduled to have a specific finish shall be delivered with a factory applied finish such as a baked-on machinery enamel which does not require additional field painting. Protect such equipment from damage and defacement. Any such factory finish that becomes marred, stained or otherwise damaged shall be fully and satisfactorily restored.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Installation shall comply with manufacturer recommendations.
- B. Deviations from the manufacturer's written instructions shall be subject to approval by the Engineer.

END OF SECTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Pipe and fittings, valves, sprinkler heads and accessories.
- B. Control system.

1.02 UNIT PRICES

- A. Measurement and payment for Landscape Irrigation will be made under this Section on a lump sum basis.
- B. Refer to Section 01025 - Measurement and Payment.

1.03 SYSTEM DESCRIPTION

- A. Electric solenoid controlled underground irrigation system.
- B. Source Power: 120 volt

1.04 SUBMITTALS

- A. Submit under provisions of Section 01300 - Submittals.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in performing the work of this section with minimum three years documented experience.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for piping and component requirements.

1.07 PRE-INSTALLATION CONFERENCE

- A. Convene one week prior to commencing work of this Section.

1.08 COORDINATION

- A. Coordinate work under provisions of Section 02901 - Landscape Planting.
- B. Coordinate the work with site landscape grading and delivery of plant life.

1.09 EXTRA MATERIALS

- A. Furnish extra components under provisions of Bid Schedule.
 - 1. Two sprinkler heads of each type and size.
 - 2. Two valve box keys.
 - 3. Two wrenches for each type head core and for removing and installing each type head.

PART 2 PRODUCTS**2.01 PIPE MATERIALS**

- A. Pipe shall be continuously and permanently marked with Manufacturers name, size, schedules, type, and working pressure.
- B. PVC Pipe ASTM D2411; 200 psi pressure rated upstream from controls, 160 psi downstream; solvent welded sockets rubber gasketed joints.
- C. Fittings: Type and style of connection to match pipe.
- D. Solvent Cement: ANSI/ASTM D2564 for PVC pipe and fittings.
- E. Sleeve material: 4" schedule 40 PVC.

2.02 OUTLETS

- A. Manufacturers or approved equal:
 - 1. Rainbird Model 180 4.
 - 2. Rainbird Model 1812
 - 3. Hunder Model PGP
- B. Rotary type sprinkler head: Pop-up type with screens; fully adjustable for flow and pressure; size as indicated; with letter or symbol designating degree of arc and arrow indicating center of spray pattern.
- C. Spray Type Sprinkler Head: Pop-up head with full circle, half circle, third circle, quarter circle and square pattern.

2.03 VALVES

- A. Manufacturers or approved equal:
 - 1. Rainbird Model PEB Series
- B. Gate Valves: Bronze construction, non-rising stem, and sized to line.
- C. Backflow Preventers: FEBCO 765 Bronze body construction, reduced pressure zone or pressure vacuum breaker type.
- D. Valve Box and Cover: rectangular 10" x 14" or 9" round.

2.04 CONTROLLER

- A. Manufacturers or approved equal:
 - 1. Rainbird Model RC1260C
- B. Valves: Electric solenoid wiring including required fittings and accessories.
- C. Wire conductors: color-coded.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify site conditions under provisions of Section 01040 - Coordination and Meetings.
- B. Verify location of existing utilities.
- C. Verify that required utilities are available, in proper location, and ready for use.

3.02 PREPARATION

- A. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover, and structures.
- B. Layout and stake locations of system components.
- C. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

3.03 TRENCHING

- A. Trench and filling as required.
- B. Trench size:
 - 1. Minimum Cover Over Installed Supply Piping: 18 inches.
 - 2. Minimum Cover Over Installed Branch Piping: 12 inches.
 - 3. Minimum Cover Over Installed Outlet Piping: 12 inches.
- C. Trench to accommodate grade changes.
- D. Maintain trenches free of debris, material, or obstructions that may damage pipe.
- E. Do not leave trenches open overnight.

3.04 INSTALLATION

- A. Install pipe, valves, controls, and outlets in accordance with manufacturer's instructions.
- B. Connect to utilities.
- C. Set outlets and box covers at finish grade elevations.
- D. Install control wiring as required. Provide 10-inch expansion coil at each valve to which controls are connected, and at 100-ft intervals. Bury wire beside pipe. Mark valves with neoprene valve markers containing locking device. Set valve markers in 160-psi PVC pipe risers exiting from top of valve to finish grade.
- E. After piping is installed, but before outlets are installed and filling commences, open valves and flush system with full head of water.
- F. Coordinate pipe installation with conduit installation.

3.05 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed.
- B. Prior to filling, test system for leakage for whole system to maintain 100-psi pressure for one hour.

3.06 FILLING

- A. Provide 3-inch sand cover over piping, fill trench and compact to subgrade elevation. Protect piping from displacement.

3.07 ADJUSTING

- A. Adjust control system to achieve time cycles required.
- B. Change and adjust head types for full water coverage as directed.

3.08 DEMONSTRATION

- A. Provide system demonstration.
- B. Instruct Owner or City of Victoria's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance material as basis for demonstration.

END OF SECTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Fence framework, fabric, and accessories.
- B. Excavation for post bases, concrete foundation for posts and center drop for gates.
 - 1. Manual gates and related hardware.

1.02 MEASUREMENT AND PAYMENT

- A. Payment for fencing shall be on a linear foot basis for height noted.
- B. Payment for gates shall be per unit.
- C. Refer to Section 01025 - Measurement and Payment for Unit Price Procedures.

1.03 SYSTEM DESCRIPTION

- A. Fence Height shall be as indicated on Drawings or as noted to match height of existing.
- B. Extension arms for barbed wire shall match existing.
- C. Line Post Spacing shall not exceed 10 feet, or as shown on Drawings.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01300, Submittals.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
- C. Product Data: Provide data on fabric, posts, accessories, fittings and hardware that indicates that items match or exceed the quality of existing.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

1.06 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

PART 2 P R O D U C T S

2.01 GALVANIZED FENCING

- A. Fence fabric shall be No. 9 steel wire, hot galvanized after weaving, to match or exceed existing.
- B. existing.
- C. Framework shall be hot-dipped galvanized with a minimum coating of two ounces/sf, or one ounce/sf plus 30-micrograms/square inch chromate conversion coating.
- D. Line posts shall conform to ASTM A570 Grade 45 steel or ASTM A569, cold rolled steel.

- E. End corner, angle, and pull posts shall conform to ASTM A570 Grade 45 steel or ASTM A569 for steel pipe. Top rails shall be 1.65 x 1.25-inch formed C-section; or 1.6-inch round ASTM A569, 1.35 lbs/ft; or 1-5/8-inch outside diameter steel pipe, 2.27 lbs/ft. Top rails shall pass through openings provided for that purpose in post tops.
- F. Fabric ties shall be hog rings, galvanized steel wire not less than 9-ga with a zinc coating of not less than 1.2 ounces/sf.
- G. Bolts and nuts shall be in conformance with ASTM A307 and shall be galvanized in accordance with AASHTO M232.
- H. Install horizontal braces fabricated of 1-5/8-inch, 2.27-lb copper bearing steel pipe at all corner, gate, and end posts.
- I. Gates shall be either swing or slide as shown on the plans. Swing gates shall be hinged to swing 90 degrees from closed to open or hinged to swing 180 degrees from close to open. Slide gates shall be roller type with no vertical obstructions. All gate leaves shall have intermediate members and diagonal stress rods as required for rigid construction and shall be free from sag or twist. All gates shall be fitted with vertical extension arms or shall have frame end member extended to carry barbed wire. Gate posts for gates shall be 4-inch, 9.1 lb pipe. Gate frames shall be made of 2-inch outside diameter, castings. Fabric shall be the same as for the fence. Gates shall have malleable iron ball and socket hinges, catches, stops and padlocks with three keys each. Posts for single gates shall be the same as end posts.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install chain link fence in accordance with the directions of the manufacturer and these Specifications.
- B. Install fence posts at not more than 10-ft centers and at least 36 inches into the ground in a Class B concrete base. Allow concrete to cure for at least 7 days before erecting remainder of fence. Fasten fabric to line posts with wire ties spaced about 14 inches apart and to top rail spaced about 24 inches apart.
- C. Use standard chain link fence stretching equipment to stretch the fabric before tying it to the rails and posts. Repeat the stretching and tying operations about every 100 feet.
- D. Erect gates so they swing or slide in the appropriate direction. Provide gate stops as required. Secure hardware, adjust, and leave in perfect working order. Adjust hinges and diagonal bracing so that gates will hang level. Adjust rollers and guides of sliding gates so that gates are level.
- E. At small natural or drainage ditches where it is not practical for the fence to conform to the contour of the ground, span the opening below the fence with wire fastened to stakes of required length. The finished fence shall be plumb, taut, true to line and ground contour. When directed, stake down the chain link fence at several points between posts.
- F. Where new fence joins an existing fence, set a corner post and brace post at the junction and brace as directed. If the connection is made at other than the corner of the new fence the last span of the old fence shall contain a brace.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnishing all plants, labor, equipment, appliances and materials for landscape planting. Rough and finish grading is part of the landscape work.

1.02 UNIT PRICES

- A. Measurement for Landscape Planting is on a Lump Sum.
- B. Refer to Section 01025 - Measurement and Payment.

1.03 PLANT SCHEDULE

- A. The plant schedule gives quantities, scientific names, common names, sizes, and special remarks.
- B. The plant list conforms with "Standardized Plant Names," 1942, and "American Standard for Nursery stock," 1949, revised January 2, 1969, as prepared by the American Joint Committee on Horticultural Nomenclature and the American Association of Nurserymen, Inc.
- C. In case of discrepancies between the plant list and drawings, the working drawings shall govern.

1.04 SUBMITTALS

- A. Submit samples of the plants and grasses to be used for approval prior to installation. Inspection will be done on the project site.
- B. Provide materials from the same source and of the same quality and variety as those inspected and approved.
- C. Soils and/or compost materials must be approved at their source prior to delivery.

1.05 DELIVERY AND STORAGE OF MATERIALS

- A. Pack all plant material to provide protection against damage from wind, weather or other possible sources. Tie plants to prevent whipping when shipment is made by truck.
- B. When shipment is made by rail, pack plants and ventilate cars as required to prevent sweating.
- C. Provide a platform from all B&B root balls over 24 inches in diameter.
- D. Store plants on the site as directed.
- E. Spray with antitranspirant at time of delivery in warm season months. Apply at rates in accordance with manufacturer's recommendations.

1.06 SUBSTITUTIONS

- A. Substitution of larger size or better grade than specified will be allowed, but with no increase in unit cost.

- B. Substitution of an alternate species may be accepted upon written approval from the Engineer and City Engineer.

1.07 ACCEPTANCE AND APPROVAL

- A. There will be no partial acceptance of grasses.
- B. At the completion of the project, final approval of grasses will be given when the following conditions are met:
 - 1. There are no bare spots larger than 1 square foot.
 - 2. The total area of bare spots does not exceed 5 percent of the entire grass area.

1.08 WARRANTY

- A. Provide 1-year warranty on all plants and grasses. The warranty period commences after final completion.
- B. Replace plants that fail during the warranty period according to the specifications governing the original plants.
- C. Periodically inspect plants for proper watering and spraying, during warranty period.
- D. Damage caused by natural hazards such as hail, high winds or storm is not covered by the guarantee.
- E. Plant materials and grasses which die due to insects or diseases are included in the warranty.
- F. Existing plant material required to be moved on the site will be protected under the warranty.

1.09 SOIL ANALYSIS

- A. Submit for approval an analysis of all soils obtained from off-site sources prior to delivery.
- B. Analysis of existing soil is not required.

1.10 PLANT CERTIFICATES

- A. Submit inspection certificates approved by the Engineer and City Engineer as required by law with the invoice for each shipment or order of stock:
 - 1. Submit certificates to the Engineer and City Engineer for review in ample time to be reviewed and meet installation schedule.

1.11 PROTECTION OF PERSONS AND PROPERTY

- A. Take all reasonable precautions to prevent injury to people and to avoid damage to existing structures, plants and grasses. Keep the area free of hazardous obstructions.
- B. Construct barricades where necessary for the protection of persons and property. Mark all barricades with red and white paint and with red reflectors. Erect barricades in the following locations:
 - 1. Areas dangerous to workmen and passersby.
 - 2. Along adjoining property that requires protection.
 - 3. Across streets and walks that are temporarily closed or rerouted.
 - 4. Around plants and trees to be protected.

- C. Excavations larger than 1 foot deep and 1 foot wide must be covered when not attended.
- D. Existing trees which may be subject to damage must be protected by fencing or boxing.
- E. During the course of planting operations, protect all installed plants and lawns from damage. If heavy equipment or materials must be moved across lawns, use planks or pontoons to protect the turf. Similarly protect walks across which heavy equipment must pass.

1.12 DEFINITIONS

- A. "In situ" refers to any soil which is existing and in place on the project site at the time landscape work commences.
- B. "Establishment period" refers to a period of 45 days after installation during which time 5 percent of the construction costs will be withheld.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. Provide a friable soil which is rich in organic matter. Obtain from naturally well-drained areas of uniform loam which is free from subsoil, brush, objectionable weeds and other litter, or contamination and free from clay lumps, stones, stumps, roots, or other objects larger than 1 inch in diameter. The topsoil must also be free from toxic substances and any other material or substances which might be harmful to plant growth or be a hindrance to grading, planting and maintenance operations.
- B. Topsoil obtained from excavation or borrow operations shall have 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 passing the #280 sieve.
- 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.
- D. Submit written certification that topsoil meets the above criteria before delivery of soil to the site. Certification shall be signed by the Contractor and Seller of the topsoil.
- E. Topsoil available on the site may be used in any designated areas to be landscaped if previously inspected and approved in writing.

2.02 FERTILIZER

- A. Provide an inorganic commercial fertilizer which is uniform in composition, dry and free flowing, in original unopened containers, each bearing the manufacturer's guaranteed analysis. All fertilizer shall have the composition of 50% SCU (Sulfur Coated Urea.) Caked, damaged or otherwise unsuitable fertilizer will not be accepted.
 - 1. For lawns: 15-10-5.
 - 2. For ground cover areas, shrub beds and tree holes: 12-24-12.

2.03 ADDITIVES

- A. Adjustment of pH: For topsoil to attain the specified pH level, furnish raw, ground agricultural limestone containing not less than 85 percent calcium carbonate of which 50 percent will pass through a 100-mesh sieve and 90 percent through a 70-mesh sieve. Wait 2 months after planting before application of fertilizer.
- The following Table is a guideline to establish the pounds of limestone needed per 1,000 sq. ft. of turf:

Pounds of Limestone Needed per 1,000 sq. ft.

Soil pH	Sands, Loamy Sands	Sandy Loam	Clay Loam, Clay
>6.0	0	0	0
5.1 - 6.0	50	75	100
<5.0	100	125	175

- B. Humus: Provide a rich humus material free of sticks, stones, weedy roots, or other foreign matter. Humus must have ample water holding capacity and plant food retention. Use a humus with a dark brown to black color.
- C. Top Dressing Mulch: Provide cedar, cypress or redwood bark that is evenly shredded, consisting of 90 percent organic matter, brown in color, and free of harmful minerals. Maximum particle size not to exceed 3 inch in diameter.
- D. Sharp Sand: Obtain clean sharp sand of hard durable grains, free from dirt, organic matter or other impurities. Use sand with a grade between 0.05 mm and 2 mm.
- E. Concrete Gravel: Provide clean, crushed stone consisting of hard, durable, uncoated particles free from injurious amounts of soft friable, thin or laminated pieces. Use gravel which conforms to ASTM C 33. The sieve size will be 3/4 inch, 90 to 100 percent passing.

2.04 CONSTRUCTION MATERIALS

- A. Tree Guys:
- Guy Wires. Use 10-gage galvanized annealed iron wire.
 - Hose will be 2-ply, fiber-reinforced dull green rubber at least 3/4 inch diameter.
 - Turnbuckles will be galvanized, with a 3-inch minimum lengthwise opening and fitted with screw eyes.
- B. Stakes:
- For use in identifying tree and shrub locations.
 - Use 1" x 2" pine, or equivalent, 18 inches long.
 - Use waterproof marker for identification.
 - Where applicable for anchoring trees, use wood deadmen of at least 2" x 4" stock, 36 inches long and buried 3 feet.
 - For supporting guyed trees, use stakes that are of at least 2" x 4" stock, 36 inches long. Notch stakes for guy wires 2 inches from the top.
 - Use tree stakes that are of sound and durable quality capable of withstanding aboveground and underground conditions either "T" Post or Treated Lodge Poles.
- C. Edging:
- Provide 1/2" x 4", Cypress, Redwood, Cedar or Treated Lumber headerboard.

2. Provide 1" x 2" x 12", Cypress, Redwood, Cedar or Treated Lumber stakes.
 - D. Tree Wrap: Use 4-inch-wide tree wrap, corrugated, breathable brown paper specifically manufacture for protecting young trees from sunscald, windburn, rodents and cold temperatures, approved by the Engineer and City Engineer. Tree wrapping shall have qualities to resist insect infestation.
 - E. Tree Guards/Protector: Tree guards shall be used to protect all trees from mower and trimmer damage. Tree guards shall be approved by the Engineer and City Engineer. Tree guards shall be constructed out of top quality vinyl for long life and measure at least 22" in height. Tree guards shall have the capability to expand as the tree grows.
 - F. Materials for Flagging Trees:
 1. Mark guyed trees with surveyors white plastic tape.
 2. Use surveyor's plastic tape for marking as follows.
 - a. Red to be removed.
 - b. Yellow to be transplanted.
 - c. Green to remain.
 - d. Blue to identify special handling.
 - G. Labels: Legibly label plants with durable labels that identify the plant by scientific and common name. Use waterproof ink.
 - H. Tree Seal: All pruning cuts, bruises, or scars over 3/4 inch in diameter on trees will be treated with a commercial tree wound dressing.
 - I. Polyethylene: Use virgin base, resin blended polyethylene sheeting with carbon black concentrate of 2.5 percent.
- 2.05 SPRAYS
- A. Sterilization:
 1. Use approved solution of "Dyclomec 4G" or equal for areas to be planted.
 2. Use 'Pramitol' or equal for areas to be paved.
 - B. Herbicides:
 1. Use round-up or an approved equal systemic Non-Selective, Post Emergent Herbicide on specified areas to kill all vegetation.
 2. Use "Confront" or equal for general control of broadleaf weeds in lawns.
 3. Use "Preemerg, Eptam, Dryclomec" or equal for ground cover.
 4. Use an approved pre-emergent to control seed germination in specified areas.
 - C. Antitranspirant:
 1. Use approved antitranspirant for all plant material that is stored and/or heeled-in on the site.
 2. Use approved antitranspirant on all planted trees and shrubs.
 - D. Root Stimulant: Use approved root stimulant on all newly planted trees, shrubs, vines and/or ground cover areas.
- 2.06 PLANT CHARACTERISTICS
- A. Provide plants which are true to type and name, and typical of their species or variety. Plants must have a normal, well-developed branch structure, with a vigorous root system, and must be generally sound and healthy. Use plants which are free from defects, including:
 1. Disfiguring knots.

2. Sun scald.
 3. Injuries.
 4. Bark abrasions.
 5. Plant diseases.
 6. Insect eggs.
 7. Borers.
 8. Infestations.
- B. Select well-informed plants balanced between height and spread typical of the species or variety with branches in normal position. Heading back plants to meet size limits will not be permitted.
- C. Unless otherwise specified, all plants will be nursery grown and at least twice transplanted. Use plants which have been growing under similar climatic conditions to those of the project for at least 2 years prior to the date of the contract. Recently stepped-up plants will not be acceptable. All B&B or bare root plants must be freshly dug; heeled-in or cold storage plants will not be accepted.
- D. Balled, bare root and container-grown plants will conform to the definitions given in the American Standards for Nursery Stock.
- E. No tree will be accepted which has had leaders cut or damaged, or which has a thin, weak trunk and/or poorly formed tops.
- F. Regardless of sample selection, a plant may be rejected at the site by the Engineer or City Engineer.

2.07 NURSERY STOCK

- A. Deciduous Trees: Provide trees which are straight and symmetrical and have a persistently preferred main leader. The crown must be in good overall proportion to the entire height of the tree. Where a clump is specified, a plant having a minimum of three stems originating from a common base at the ground line will be furnish. Measure trees by average caliper of trunk.
1. For trees up to 4 inches in diameter, measure caliper 6 inches above ground.
 2. For trunks larger than 4 inches, measure caliper 12 inches above ground.
- B. Evergreen Trees: Form of the top will be typical of the species and not unnaturally sheared or color-treated. Measure by average caliper. Caliper will be taken 6 inches above the ground on trees up to 4 inches in diameter and 12 inches above the ground on trees larger than 4 inches.
- C. Vines and Ground Cover: Provide plants which are container-grown for sufficient time to ensure adequate root growth to hold the soil in place and retain the original shape when removed from the container.

2.08 FIELD-COLLECTED PLANTS

- A. Field-collected plants must be grown in favorable locations that ensure fibrous roots and vigorous growth. Such plants will be selected on site by the Landscape architect.
- B. Provide balls at least 1/3 greater in diameter than those specified for nursery stock.
- C. If dug in dormant season and bare root is acceptable, the spread of roots must be at least 1/3 greater than the spread of roots for bare root nursery stock.

2.09 SEED

- A. Seasonal Limitations:
 - 1. Bermuda:
 - a. Unhulled seeds may be planted between October and March.
 - b. Hulled seeds may be planted between April and September.
 - 2. Perennial Ryegrass:
 - a. Plant only from September through November 15.
- B. Bermuda: Provide common Bermuda seed that is extra-fancy, treated, lawn type. Deliver in original, unopened container showing weight, analysis, name of vendor and germination test results. Wet, moldy, or otherwise damaged seed will not be accepted.
- C. Rye: Deliver Perennial Ryegrass seed in original unopened containers. Seed must be fresh, clean, and mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled.

2.10 HYDROMULCH

- A. Provide hydromulch second as noted in Section 02932 - Hydromulch Seeding.

2.11 GRASS

- A. Obtain certified sod from an approved source.
- B. Provide material which is true to type and name, and is typical of the species or variety.
- C. Delivery:
 - 1. Identify and tag sods with correct scientific and common name for each species.
 - 2. Do not deliver more sods than can be planted within eight hrs.
 - 3. Transport and deliver sods in/on pallets.
 - 4. Protect sods against dehydration, overheating or contamination during transportation and delivery.
 - 5. Cover unplanted sods with moistened burlap to prevent dehydration or overheating while awaiting installation.
 - 6. Sods must be harvested within 12 hours of planting and arrive at the project site in a moist condition.
- D. Products:
 - 1. Selected material will be from an agent, approved by the Engineer and City Engineer and authorized by the Texas Department of Agriculture.
 - 2. Material to be uniform in color, leaf texture and density.
 - 3. Material to be graded #1 or better.
 - 4. Uniform mowed height at time of harvesting material: 1 1/2 inches.
 - 5. Inspected and certified free of diseases, nematodes, and undesirable insects by authorized representative of Texas Department of Agriculture.
 - 6. Material will not be acceptable if it contains any quack grass, Johnson grass, poison ivy, nut grass, thistle, common bent grass, wild garlic, morning glory, perennial sorrell or brome grass.
 - 7. Turf will be considered weed free when found to contain less than 1 percent of dandelion, jimson weed, mustard, chickweed, per 100 square feet.

PART 3 EXECUTION

3.01 WORK CONDITIONS

- A. Site Availability: Begin no landscape work where conflicting site work by Others is incomplete or as otherwise directed by the Engineer or City Engineer.
- B. Weather Restrictions: Stop all work during inclement weather such as drought, high winds, excessive rain, extreme heat, cold or freeze. Obtain authorization before resuming work.

3.02 PLANTING PROCEDURES

- A. Temporary Nursery: A temporary nursery may be used to store plants, but no more than 5 days before planting. Keep plants well watered and protected.
 - 1. Immediately upon delivery. Apply spray from top to bottom. Thoroughly cover plants, but not to the point of run-off. Spray block units and not individual plants. Use a low-pressure, fine-mist applicator. Spray at rates recommended in the manufacturer's directions.
 - 2. Handle all balled and burlapped plants by the ball only.
 - 3. Upon delivery, immediately heel-in bare root plants. Open bundles, separate plants, set roots in trenches and cover with topsoil. Water plants with an approved root stimulant containing vitamin B.
 - 4. Handle container plants by the container.
 - 5. Handle ground cover plants in flats. Pack flats tightly together and sprinkle plants everyday.
 - 6. Special plants so designated must be kept in an approved enclosure or planted the day of delivery.
 - 7. Store soils and additives on approved platforms.
- B. Digging and Handling:
 - 1. The actual planting operation must proceed without delay and in a manner to avoid undue drying of the roots because of exposure to air and sun. Keep an ample supply of sawdust available to cover the roots. Keep the roots well covered and moist until the plants can be placed in the final location and permanently planted.
 - 2. Handle all plant stock with care to prevent injuries to the trunk, branches and roots.
 - 3. Dig bare root plants when fully dormant. Keep all of the root system intact; do not prune the root system. However, any roots that are broken, crushed, or bruised must be cleanly cut back to sound wood. Make the cut on an angle so that the exposed end faces downward. Seal any cut root exceeding 3/4 inch in diameter with an approved tree wound dressing.
 - 4. Balled and burlapped plants must have the root system encased in a firm, solid ball of natural earth, wrapped in burlap and tightly bound. Each ball must be of sufficient size to encompass all the fibrous feeding roots and not smaller than required by the American Standards for Nursery Stock. The ball must remain firm and compact throughout the planting operations.

3.03 SITE PREPARATION

- A. Existing Trees:
 - 1. Protection: Protect tops, trunks and roots of trees to remain on the site. Before starting work, box, fence or otherwise protect trees subject to construction damage. Remove boxing when directed. Permit no stockpiles of heavy equipment within the branch spread of trees.
 - 2. Removal: Remove trees marked for removal. Do not remove any tree without proper authorization. Stumps within 36 inches of final grade must also be removed.

3. Pruning: Cut and trim trees only as directed by the Engineer and City Engineer. Do not cut any tree without proper authorization from the Engineer and City Engineer. Trim existing trees of dead or diseased limbs. Trim limbs in accordance with standards established by the International Society of Arboriculture. Trees shall not be topped as a normal practice. Topping is defined as the sever cutting back of limbs to stubs larger than three inches in diameter with the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree. Cover cuts with an approved tree wound dressing.
- B. Grading Around Trees: As required, fill or grade within the branch spread of trees to remain, observing the following requirements.
1. For trenching beneath trees, tunnel under the tree roots with careful hand digging. Avoid cutting or injuring roots.
 2. Do not raise or lower the grade around an existing tree in any way, unless so directed.
- C. Placing Topsoil:
1. Disk, drag, harrow or handrake subgrade. Scarify the subgrade to a depth of 1-1/2 inches. Before placing topsoil, rake the subsoil surface clear of stones, wood, rubbish and other debris. Place no topsoil until the subgrade preparation has been approved.
 2. Spread, rake and compact topsoil to form a layer with a minimum depth of 4 inches in lawn areas and 6 inches in shrub areas. Place topsoil to conform to finished gradients as shown on the grading plan.
 3. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Section 01564 - Waste Material Disposal.
- D. "In Situ" soil Preparation:
1. Cross-till in two directions all existing soil in designated areas to be planted, as follows:
 - a. In lawn areas to a minimum depth of 6 inches.
 - b. In shrub areas to a minimum depth of 10 inches.
 2. Evenly broadcast fertilizers and soil additives and thoroughly work into soil.
 - a. Smooth all tilled and amended areas to establish a rough gradient.
 - b. Deeply irrigate all tilled and amended areas to thoroughly wet soil particles and promote settlement.
 - c. After a settlement period of not less than 5 days, and before proceeding with any planting, smooth and rake as necessary to establish finish gradient as required.
 3. In all areas which have been utilized for parking, storage or construction lots and/or where heavy equipment has been used, cross-rip the entire compacted areas in two directions to a depth of 10 inches before tilling and amending the soil as specified. A heavy float or drag harrow should be used to smooth all surface areas.
 - a. Verify location of all underground utilities 48 hours before ripping.
 - b. Ripping teeth should not be set at more than 10-inch spacing.
- E. Fertilizer: Evenly broadcast and work fertilizer into soil at the following rates:
1. Lawns: 1 1/2 pounds of N (50% Sulfur Coated Urea) per 1,000 square feet.
 2. Ground Cover, Shrub, and Tree Areas: 1 1/2 N pounds (50% Sulfur Coated Urea) per 1,000 square feet.
- F. Additives:
1. Humus. Evenly broadcast and work into in-situ soil at a rate of one cubic yard per 200 square feet.
 2. Sharp Sand. Evenly broadcast and work into in-situ soil at a rate of one cubic yard per 200 square feet.
 3. Concrete Gravel. Utilize as a drainage course as shown on construction drawings.

3.04 PLANTING TREES, SHRUBS, AND GROUND COVER

- A. Layout: Before proceeding with planting operations, notify the Engineer and City Engineer 3 working days in advance to coordinate a site visit. Set stakes and/or all 5-gallon and larger sized plants in their permanent locations and acquire approval from Landscape Architect. Do not place plant and/or stakes in planter areas until soil has been placed and approved.
- B. Excavation: Excavate holes for placement of plants.
- C. Setting Trees and Shrubs:
 - 1. Set all plants plumb or straight and centered in the pit or hold.
 - 2. Form a 6-inch-deep ring around the inside perimeter of the bottom of the tree pit to facilitate drainage away from the roots and/or ball of the plant. Place the plant upright on the remaining mound of undisturbed soil. Spread the roots of bare root plants to their natural position and cut off all broken or frayed roots. Place balled and burlapped plants with their balls still wrapped.
 - 3. When balled and burlapped plants are being set, loosen all burlap, ropes and wire from the tops and the sides of the ball before backfilling with soil. Do not remove burlap from beneath the ball.
 - 4. For boxed trees, remove all box sides, bottom and bands, taking care not to injure the root ball.
- D. Backfilling Around Trees and Shrubs:
 - 1. Backfilling each plant hole with a planting soil mixture for all "in situ" planted areas as follows: 60 percent soil, 20 percent humus, and 20 percent sand.
 - 2. Construct a minimum 4-inch-high soil berm to form a watering basin around newly planted trees and shrubs. On all slopes except minor ones, form soil into an adequate dam or shoulder on the downhill side to catch and hold water and prevent erosion. Properly regrade the slope on the uphill side.
 - 3. Hedge plants may be planted in a continuous trench instead of pits. Evenly space plants true to line and regrade after settlement.
- E. Guying, Staking and Wrapping: Support all trees immediately after planting by the use of guys and/or stakes as noted in the plant list.
 - 1. Guy each tree with three guys equally spaced around the tree. Where possible, attach each guy to the tree trunk at major branch crotches of the tree at least 4 feet above ground height. Encase guy wires in cloth-reinforced rubber hose to prevent cutting into the bark. Place encased guy wire around the trunk in a single loop. Stretch the guy at a 60-degree angle to a notched stake driven completely into the ground or to a deadman buried at least 3 feet below finished grade. Use a deadman where underground utilities are within 4 feet of finished grade. Wire should be equally taut to prevent the tree from swaying in wind. Mark each wire 3 feet above the ground with a 12-inch streamer of plastic white surveyor's tape.
 - 2. Use three stakes for trees with a trunk 3- to 4-inch caliper; two for trunks with less than 3-inch caliper. Space stakes equally about each tree and drive vertically into the ground 2-1/2 to 3 feet. Avoid injuring ball or roots. Attach strands of wire around the trunk at the meeting of the primary branches and to each stake. Encase the wire around the trunks with cloth-reinforced rubber hose to prevent cutting into the bark.
- F. Top Dressing Mulch: Provide a 1-inch layer of shredded hardwood mulch top dressing mulch for all ground cover and planter areas. Provide a 2-4 inch layer of mulch in the basis of all shrubs and trees.

3.05 PLANTING GRASS

- A. Preparation. Prepare imported topsoil and/or "in situ" soil. Hand rake to remove all sticks, stones and clods larger than 1 inch. Apply the final grade but do not mechanically compact the soil.
- B. Seed.
 - 1. Evenly broadcast seed specified in 2.09 at the following rates:
 - a. Bermuda: one pound per 1,000 sq. ft.
 - b. Rye: 6 pounds per 1,000 sq. ft.
 - 2. Roll the entire seeded area in two directions with a dry/weighted roller.
 - 3. Lightly rake the finished area to embed the seed. Do not cover with any material to hamper growth.
 - 4. Lightly but thoroughly sprinkle the entire seeded area with water after top dress application.
- C. Sod.
 - 1. Use Bermuda (common), Buffalo (609 or Prairie), or St. Augustine sod in accordance with 2.11a.
 - 2. Prepare soil in accordance with 3.03.
 - 3. Apply eptam (or approved equal) to all areas to be sodded. Follow manufacturer's recommended rates and apply during soil preparation period.
 - 4. Lay sod in a running bond pattern. Pieces should be consistently cut with joints tightly butted together. Water the in-place sod liberally and roll it in two direction with a heavy roller. Areas not level due to fluctuations in the sod depth should be covered and leveled with a 50/50 mix of sharp sand and topsoil. Fertilize in 6 weeks as directed by landscape Architect.

3.06 CLEANING AND MAINTENANCE

- A. Maintenance. Requirements for maintenance begin when the work commences and continue until substantial completion and written provisional acceptance. Plant maintenance includes all necessary watering, cultivation, weeding, pruning, wound dressing, disease and insect pest control, protective spraying, and replacement of unacceptable materials. Maintenance also includes straightening plants which lean or sag, adjusting plants which settle or are planted at an improper height, and implementing any other procedure consistent with good horticulture practice and necessary to ensure normal, vigorous and healthy growth of all plantings.
 - 1. Watering. Water until acceptance. The quantity of water applied at one time must be sufficient to penetrate the soil to a minimum depth of 8 inches at a rate which will prevent saturation of the soil. Use water that is free of impurities or any substance which might injure the plants.
 - 2. Weeding. Keep all planting areas free of weeds and undesirable grasses. Use methods and materials approved by the Engineer and City Engineer.
 - 3. Disease and Insect Pest Control. Inspect all plant materials at least once a month to locate any disease or insect pest infestation. Identify or have identified the nature or species of the infestation. Submit the proposed method of control for approval prior to application of control measures.
 - 4. Fertilizing. Fertilize at the rates indicated in these specifications. Time of application will be as directed by the Engineer and City Engineer.
- B. Cleaning.
 - 1. During planting, remove excess and waste materials regularly. As work in an area is completed, thoroughly clean the area. Remove debris, rubbish, subsoil and waste materials from the site and dispose of in a legal manner. Trash burning on the site will not be allowed.

SECTION 02901

CITY OF VICTORIA

STANDARD SPECIFICATIONS

LANDSCAPE PLANTING

2. Any paved areas where products are placed must be cleaned periodically to prevent damage or the accumulation of debris.
3. Existing grass areas damaged by planting operations must be cleaned, regraded, sodded and left in an acceptable condition.
4. Upon completion of construction and before final acceptance, remove all temporary facilities, tools, equipment, surplus materials, and debris. Broom clean and wash all paved areas. Leave the premises neat and clean.

END OF SECTION

SECTION 02901

CITY OF VICTORIA
STANDARD SPECIFICATIONS

LANDSCAPE PLANTING

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. This Section is applicable to plant sites, parks, or large areas. When used, it is not necessary to include Section 02920 - Topsoil, 02932 - Hydromulch Seeding, 02935 - Sodding or 02935 -Tree Planting.
- B. Do not use this Section for normal paving or utility projects. Use the above listed Sections as applicable.

END OF NOTES

PART 1 GENERAL

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 topsoil. Include payment in Section 02932 - Hydromulch Seeding and Section 02935 - Sodding.
- B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

PART 2 PRODUCTS

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.
- 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 EXECUTION

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 02225 - Roadway Excavation.

3.03 PLACEMENT

- A. For areas to be seeded or sodded, scarify or plow existing material to a minimum depth of 4 inches, or as indicated on the Drawings. 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 shown on the Drawings.

SECTION 02920

CITY OF VICTORIA
STANDARD SPECIFICATIONS

TOPSOIL

- 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

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Seeding, fertilizing, mulching, and maintenance of areas indicated on Drawings.

1.02 UNIT PRICES

- A. Measurement for hydromulch seeding is on a square yard basis.
- 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 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 (*lolium 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.

SECTION 02932**CITY OF VICTORIA
STANDARD SPECIFICATIONS****HYDROMULCH SEEDING**

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	40 40 30	Oct 1 to Dec 31
Perennial Rye Grass	40	Sept 1 to Nov 15

- 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:

1. Nitrogen: 10 Percent
2. Phosphoric Acid: 20 Percent
3. 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 EXECUTION**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 and City 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 acceptable an 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

PART 1 GENERAL

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. Measurement for sodding is on a square yard basis.

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 Engineer and City Engineer to be suitable for proper placement.
- B. Water and fertilize new sod.
- C. Guarantee sod to be growing 60 days after the acceptance of sod installation and at final project acceptance.
- D. Maintenance Period: Begin maintenance immediately after sod is installed and continue for a 60-day period or until final project acceptance, whichever is longer.
- E. Notify Engineer and City Engineer 10 days before end of maintenance period for inspection.

PART 2 PRODUCTS

2.01 SOD

- A. Species: Bermuda (*Cynodon dactylon*), Buffalo (*Buchloe dactyloides*), or St. Augustine (*Stenotaphrum secundatum*). City Engineer shall approve any substitute varieties of grasses.
- 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.
- C. Size: 12 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. Nitrogen shall be 50% sulfur coated urea (SCU).

2.03 WEED AND INSECT TREATMENT

- A. Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to the Engineer and City 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. Weed control shall not be used on any sodded area for at least six weeks after sod has been placed. Contractor shall use an approved weed control that is registered with the State of Texas Department of Agriculture. Use of State-Limited or Restricted-Use pesticides shall be approved for use by the Engineer and City Engineer. Forty-eight (48) hour notification shall be required to home/land owners prior to pesticide application. The Contractor shall provide proof of notification to the Engineer prior to application of pesticide.

2.04 WATER

- A. Potable, available on-site through Contractor's water trucks. Do not use private resident's water.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that topsoil 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. Apply fertilizer at a rate of 5 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 and City 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. Do not remove more than one-third of grass leaf surface.
 4. Sodded areas requiring mowing within 1 month after installation, shall be mowed with a lightweight 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 5 pounds per 1,000 square feet or as recommended by manufacturer. Fertilizer shall not be placed until 4 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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnishing landscape planting. Rough and finish grading is part of the landscape work.

1.02 UNIT PRICES

- A. No separate payment will be made for trees and shrubs. Include payment in lump sum payment for Landscape Planting.
- B. Refer to Section 01025 - Measurement and Payment.

1.03 SUBMITTALS

- A. Submit certification from supplier that each type of tree and shrub conforms to reference standards.
- B. Soils and compost materials must be approved at their source prior to delivery.

1.04 DELIVERY AND STORAGE OF MATERIALS

- A. Pack plant material to provide protection against damage from wind, weather or other possible sources. Tie plants to prevent whipping when shipment is made by truck.
- B. Provide a storage platform for balled-and-burlapped root balls over 24 inches in diameter.
- C. Store plants on the site as directed.
- D. Spray with antitranspirant at time of delivery in warm season months. Apply at rates in accordance with manufacturer's recommendations.

1.05 SUBSTITUTIONS

- A. Substitution of larger size or better grade than specified will be allowed, but with no increase in unit cost.
- B. Substitution of an alternate species may be accepted upon written approval from the City Engineer.

1.06 WARRANTY

- A. Provide 1-year warranty on plants. The warranty period commences after final completion.
- B. Replace plants that fail during the warranty period according to the specifications governing the original plants.
- C. Periodically inspect plants for proper watering and spraying, during warranty period.
- D. Damage caused by natural hazards such as hail, high winds or storm is not covered by the guarantee.
- E. Plant materials which die due to insects or diseases are included in the warranty.
- F. Existing plant material required to be moved on the site will be protected under the warranty.

1.07 SOIL ANALYSIS

- A. Submit for approval an analysis of soils obtained from off-site sources prior to delivery.
- B. Analysis of existing soil is not required.

1.08 PLANT CERTIFICATES

- A. Submit inspection certificates as required by law with the invoice for each shipment or order of stock. Submit certificates to the Engineer and City Engineer in ample time to be reviewed to meet installation schedule.

1.09 PROTECTION

- A. Take reasonable precautions to prevent damage to existing structures and plants. Keep the area free of hazardous obstructions.
- B. Protect trees which may be subject to damage.
- C. During planting, protect installed plants and lawns from damage. If heavy equipment or materials must be moved across lawns, use planks or pontoons to protect the turf. Similarly, protect walks across which heavy equipment must pass.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. Provide a friable soil which is rich in organic matter. Obtain from naturally well-drained areas of uniform loam which is free from subsoil, brush, objectionable weeds and other litter, or contamination and free from clay lumps, stones, stumps, roots, or other objects larger than 1 inch in diameter. The topsoil must also be free from toxic substances and any other material or substances which might be harmful to plant growth or be a hindrance to grading, planting, and maintenance operations.
- B. Topsoil obtained from excavation or borrow operations shall have the following characteristics:
 - 1. pH value: between 6.5 and 7.5.
 - 2. Liquid limit: 50 or less.
 - 3. Plasticity index: 10 or less.
 - 4. Gradation: maximum of 40 percent passing the #280 sieve.
- 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.
- D. Submit written certification that topsoil meets the above criteria before delivery of soil to the site. Certification shall be signed by the Contractor and Seller of the topsoil.
- E. Topsoil available on the site may be used in any designated areas to be landscaped if previously inspected and approved in writing.

2.02 FERTILIZER

- A. Provide an inorganic commercial fertilizer which is uniform in composition, dry and free flowing, in original unopened containers, each bearing the manufacturer's guaranteed analysis. Caked, damaged or otherwise unsuitable fertilizer will not be accepted.
 - 1. For lawns: 12-24-12 with 50% sulfur coated urea.
 - 2. For ground cover areas, shrub beds and tree holes: 20-10-5 with 50% sulfur coated urea.

2.03 CONSTRUCTION MATERIALS

- A. Tree Guys:
 - 1. Guy Wires. Use 10-gauge galvanized annealed iron wire.
 - 2. Hose will be 2-ply, fiber-reinforced dull green rubber at least 3/4 inch diameter.
 - 3. Turnbuckles will be galvanized, with a 3-inch minimum lengthwise opening and fitted with screw eyes.
- B. Stakes:
 - 1. For use in identifying tree and shrub locations.
 - a. Use 1" x 2" pine, or equivalent, 18 inches long.
 - b. Use waterproof marker for identification.
 - 2. Where applicable for anchoring trees, use wood deadmen of at least 2" x 4" stock, 36 inches long and buried 3 feet.
 - 3. For supporting guyed trees, use stakes that are of at least 2" x 4" stock, 36 inches long. Notch stakes for guy wires 2 inches from the top.
 - 4. Use tree stakes that are of sound and durable quality capable of withstanding aboveground and underground conditions either T-post or treated lodge poles.
- C. Tree Seal: Pruning cuts, bruises, or scars over 3/4 inch in diameter on trees will be treated with a commercial tree wound dressing within 24 hours of cutting or injury to tree.

2.04 SPRAYS

- A. Sterilization:
 - 1. Use approved solution of "Dyclomec 4G" or equal for areas to be planted.
 - 2. Use 'Pramitol' or equal for areas to be paved.
- B. Herbicides:
 - 1. Use an approved systemic non-selective, post emergent herbicide on specified areas to kill all vegetation.
 - 2. Use "Confront" or equal for general control of broadleaf weeds in lawns.
 - 3. Use "Preemerg, Eptam, Dryclomec" or equal for ground cover.
 - 4. Use an approved pre-emergent to control seed germination in specified areas.
- C. Root Stimulant: Use approved root stimulant on newly planted trees, shrubs, vines and ground cover areas.

2.05 PLANT CHARACTERISTICS

- A. Provide plants which are true to type and name, and typical of their species or variety. Plants must have a normal, well-developed branch structure, with a vigorous root system, and must be generally sound and healthy. Use plants which are free from defects, including:
 - 1. Disfiguring knots.
 - 2. Sun scald.
 - 3. Injuries.
 - 4. Bark abrasions.
 - 5. Plant diseases.

6. Insect eggs.
 7. Borers.
 8. Infestations.
- B. Select well-formed plants balanced between height and spread typical of the species or variety with branches in normal position. Heading back plants to meet size limits will not be permitted.
 - C. Unless otherwise specified, all plants will be nursery grown and at least twice transplanted. Use plants which have been growing under similar climatic conditions to those of the project for at least 2 years prior to the date of the contract. Recently stepped-up plants will not be acceptable. All balled-and-burlapped plants or bare root plants must be freshly dug; heeled-in or cold storage plants will not be accepted.
 - D. Balled, bare root and container-grown plants will conform to the definitions given in the American Standards for Nursery Stock.
 - E. No tree will be accepted which has had leaders cut or damaged, or which has a thin, weak trunk or poorly formed tops.
 - F. Regardless of sample selection, a plant may be rejected at the site by the Engineer or City Engineer.

2.06 NURSERY STOCK

- A. Deciduous Trees: Provide trees which are straight and symmetrical and have a persistently preferred main leader. The crown must be in good overall proportion to the entire height of the tree. Where a clump is specified, a plant having a minimum of three stems originating from a common base at the ground line will be furnish. Measure trees by average caliper of trunk.
 1. For trees up to 4 inches in diameter, measure caliper 6 inches above ground.
 2. For trunks larger than 4 inches, measure caliper 12 inches above ground.
- B. Evergreen Trees: Form of the top will be typical of the species and not unnaturally sheared or color-treated. Measure by average caliper. Caliper will be taken 6 inches above the ground on trees up to 4 inches in diameter and 12 inches above the ground on trees larger than 4 inches.
- C. Vines and Ground Cover: Provide plants which are container-grown for sufficient time to ensure adequate root growth to hold the soil in place and retain the original shape when removed from the container.

PART 3 EXECUTION

3.01 WORK CONDITIONS

- A. Site Availability: Begin no landscape work where conflicting site work is incomplete or as otherwise directed by the Engineer and City Engineer.
- B. Weather Restrictions: Stop work during inclement weather such as drought, high winds, excessive rain, extreme heat, cold or freezing temperatures as directed by the Engineer and City Engineer. Obtain authorization before resuming work.

3.02 SITE PREPARATION

- A. Existing Trees:
 - 1. Protection: Protect tops, trunks and roots of trees to remain on the site. Before starting work, box, fence or otherwise protect trees subject to construction damage. Remove boxing when directed. Do not stockpile materials or heavy equipment within the branch spread of trees.
 - 2. Removal: Remove trees marked for removal. Do not remove any tree without proper authorization. Stumps within 36 inches of final grade must be removed.
 - 3. Pruning and Surgery: Cut and trim trees only as directed; do not cut any tree without proper authorization. Trim existing trees of dead or diseased limbs. Cut limbs close to the trunk. Cover cuts over 3/4 inch in diameter with an approved tree wound dressing.
- B. Grading Around Trees: As required, fill or grade within the branch spread of trees to remain, observing the following requirements.
 - 1. For trenching beneath trees, tunnel under the tree roots with careful hand digging. Where possible, avoid cutting or injuring roots.
 - 2. Do not raise or lower the grade around an existing tree in any way, unless so authorized in writing by Engineer or City Engineer.
- C. Placing Topsoil:
 - 1. Disk, drag, harrow or handrake subgrade. Scarify the subgrade to a depth of 1-1/2 inches. Before placing topsoil, rake the subsoil surface clear of stones, wood, rubbish and other debris. Place no topsoil until the subgrade preparation has been approved.
 - 2. Spread, rake and compact topsoil to form a layer with a minimum depth of 4 inches in lawn areas and 6 inches in shrub areas. Place topsoil to conform to finished gradients as shown on the grading plan.
 - 3. Remove spilled topsoil from curbs, gutters, and paved areas and dispose of excess topsoil in accordance with requirements of Section 01564 - Waste Material Disposal.
- D. Fertilizer: Evenly broadcast and work fertilizer into soil at the following rates:
 - 1. Lawns: 1 N pounds per 1,000 square feet. Use 50% sulfur coated urea.
 - 2. Ground Cover, Shrub, and Tree Areas: 1 N pounds per 1,000 square feet. Use 50% sulfur coated urea.

3.03 PLANTING TREES, SHRUBS, AND GROUND COVER

- A. Layout: Before proceeding with planting operations, notify the Engineer and City Engineer 3 working days in advance to coordinate a site visit. Set stakes to locate plants or place 5-gallon and larger sized plants in their permanent locations and acquire approval from Landscape Architect. Do not place plants or stakes in planter areas until soil has been placed and approved.
- B. Excavation: Excavate tree pits and holes for placement of plants. Dig pits for trees and large shrubs in 15-gallon containers or larger at least 2 feet wider than the diameter of the tree root ball. For 1- and 5-gallon or equivalent stock, dig holes at least 6 inches wider than the root ball.
- C. Setting Trees and Shrubs:
 - 1. Set plants plumb or straight and centered in the pit or hold. Place plants at such a level that, after settlement, the crown of the plant should be level with the ground surface.
 - 2. Form a 6-inch-deep ring around the inside perimeter of the bottom of the tree pit to facilitate drainage away from the roots or ball of the plant. Place the plant upright on the remaining mound of undisturbed soil. Spread the roots of bare root plants to their natural position and cut off all broken or frayed roots. Place balled-and- burlapped plants with their balls still wrapped.

3. When balled-and-burlapped plants are being set, loosen burlap, ropes and wire from the tops and the sides of the ball before backfilling with soil. Do not remove burlap from beneath the ball.
- D. Backfilling Around Trees and Shrubs:
1. Backfilling each plant hole with a planting soil mixture for planted areas as follows: 80 percent soil approved by the City Engineer and 20 percent sand.
 2. Initially place in layers around the roots or ball of the plant a mixture of backfill material excluding the sand. Carefully tamp each layer of soil to avoid injury to the roots or ball and to fill voids. Work mixture in among the roots of bare-root plants. When about two-thirds of the hole has been backfilled, fill the hole with water and allow the soil to settle around the roots. After the water has been absorbed, fill the hole with a complete soil mixture, including sand and tamp to grade. Bring any settlement to grade by adding soil.
 3. Construct a minimum 4-inch-high soil berm to form a watering basin around newly planted trees and shrubs. On all slopes except minor ones, form soil into an adequate dam or shoulder on the downhill side to catch and hold water and prevent erosion. Properly regrade the slope on the uphill side.
 4. Hedge plants may be planted in a continuous trench instead of pits. Evenly space plants true to line and regrade after settlement.
- E. Guying, Staking and Wrapping: Support trees immediately after planting by the use of guys or stakes.
1. Guy each tree with three guys equally spaced around the tree. Where possible, attach each guy to the tree trunk at major branch crotches of the tree at least 4 feet above ground height. Encase guy wires in cloth-reinforced rubber hose to prevent cutting into the bark. Place encased guy wire around the trunk in a single loop. Stretch the guy at a 60-degree angle to a notched stake driven completely into the ground or to a deadman with the tip buried at least 3 feet below finished grade. Use a deadman where underground utilities are within 4 feet of finished grade. Wire should be equally taut to prevent the tree from swaying in wind. Mark each wire 3 feet above the ground with a 12-inch streamer of plastic white surveyor's tape.
 2. Use three stakes for trees with a trunk 3- to 4-inch caliper; two for trunks with less than 3-inch caliper. Space stakes equally about each tree and drive vertically into the ground 2-1/2 to 3 feet. Avoid injuring ball or roots. Attach strands of wire around the trunk at the meeting of the primary branches and to each stake. Encase the wire around the trunks with cloth-reinforced rubber hose to prevent cutting into the bark.

3.04 CLEANING AND MAINTENANCE

- A. Maintenance. Requirements for maintenance begin when the work commences and continue until substantial completion and written provisional acceptance. Plant maintenance includes necessary watering, cultivation, weeding, pruning, wound dressing, disease and insect pest control, protective spraying, and replacement of unacceptable materials. Maintenance also includes straightening plants which lean or sag, adjusting plants which settle or are planted at an improper height, and implementing any other procedure consistent with good horticulture practice and necessary to ensure normal, vigorous and healthy plant growth.
1. Watering. Water until acceptance. The quantity of water applied at one time must be sufficient to penetrate the soil to a minimum depth of 8 inches at a rate which will prevent saturation of the soil. Use water that is free of impurities or any substance which might injure the plants.
 2. Weeding. Keep planting areas free of weeds and undesirable grasses. Use approved methods and materials.
 3. Disease and Insect Pest Control. Inspect plant materials at least once a month to locate any disease or insect pest infestation. Identify or have identified the nature or species of the infestation. Submit the proposed method of control for approval prior to application of control measures.

B. Cleaning.

1. During planting, remove excess and waste materials regularly. As work in an area is completed, thoroughly clean the area. Remove debris, rubbish, subsoil and waste materials from the site and dispose of in a legal manner. Trash burning on the site will not be allowed.
2. Any paved areas where products are placed must be cleaned periodically to prevent damage or the accumulation of debris.
3. Existing grass areas damaged by planting operations must be cleaned, and returned to the condition prior to start of planting work.
4. Upon completion of construction and before final acceptance, remove temporary facilities, tools, equipment, surplus materials, and debris. Clean all paved areas. Leave the premises neat and clean.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Design, construction, erection and removal of structural concrete formwork.

1.02 UNIT PRICES

- A. No separate payment will be made for concrete formwork under this Section. Include payment in unit price for structural concrete.
- B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

- A. Conform to Section 01300 - Submittals.
- B. Shop Drawings: Show location, member size and loading of shoring. When reshoring is permitted, submit plans showing locations and member size of reshoring.
- C. Product Data and Samples:
 - 1. Corrugated Fiberboard Carton Forms: Submit certification of compliance with design criteria, description of forms, and one-foot-long sample.
 - 2. Form-coating Materials: Submit trade or brand names of manufacturers and complete description of products.
 - 3. Form ties and related accessories, including taper tie plugs, if taper ties are used.
 - 4. Form gaskets.
- D. Detailed Layout for Slip-forming: Submit detailed layout of proposed slipforming, including description of equipment, rate of progress, and other data to show suitability of method. Show provisions for ensuring attainment of required concrete surface finish.

PART 2 PRODUCTS**2.01 MATERIAL**

- A. Smooth Forms: New plywood, metal, plastic, tempered concrete-form hardboard, dressed lumber faced with plywood or fiberboard lining, or metal-framed plywood-faced panel material, to provide continuous, straight, smooth surfaces. Form material shall be free of raised grain, torn surfaces, worn edges, patches, dents or other defects. Furnish material in largest practical sizes to minimize number of joints and, when indicated on Drawings, conform to joint system indicated. Form material shall have sufficient strength and thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Rough Forms: Plywood, metal, dressed or undressed lumber free of knots, splits or other defects, or other material acceptable to the Engineer and City Engineer of sufficient strength and thickness to withstand pressure of newly placed concrete without bow or deflection.
- C. Plywood: Conform to PS 1, Class 1.
- D. Lumber: Conform to PS 20.
- E. Edge Forms and Intermediate Screed Strips: Type and strength compatible with the screed equipment and methods used.

- F. Plastic Forms: One-piece forms for domes, beams and pan joists. Single lengths for columns not exceeding height of 7'-6". For columns over 7'-6", use 7'-6" sections and filler sections as needed. To facilitate removal of pan joist forms, taper sides 1 inch per foot.
- G. Metal Pan Joist Forms: Removable type; fabricated of minimum 14-gage steel; one piece between end closures. Adjustable forms not allowed. Taper sides 1 inch per foot to facilitate removal.
- H. Earth Cuts for Forms:
1. Use earth cuts for forming unexposed sides of grade beams cast monolithically with slabs on grade.
 2. Where sides of excavations are stable enough to prevent caving or sloughing, following surfaces may be cast against neat-cut excavations:
 - a. Sides of footings.
 - b. Inside face of perimeter grade beams not monolithic with slab on grade. When inside face is cast against earth, increase beam width indicated on Drawings by 1 inch.
 - c. Both faces of interior grade beams not monolithic with slab on grade. When grade beam is cast against earth, increase beam width indicated on Drawings by 2 inches.
- I. Corrugated Fiberboard Carton Forms:
1. Corrugated fiberboard carton forms, when called for, are intended to form a void space beneath pile-supported and pier-supported slabs and other structural elements as shown.
 2. Provide products of a reputable manufacturer regularly engaged in commercial production of double-faced corrugated fiberboard carton forms, constructed of waterproof paper and laminated with waterproof adhesive.
 3. Fiberboard forms: Capable of supporting required dead load plus construction loads, and designed to lose their strength upon prolonged contact with moisture and soil bacteria.
 4. Seal cuts and ends of each form section by dipping in waterproof wax, unless liners and flutes are completely impregnated with waterproofing.
 5. Size forms as indicated on Drawings. Assemble as recommended by manufacturer, either with steel banding at 4'-0" maximum on centers, or, where liners and flutes are impregnated with waterproofing, with adequate stapling.
- J. Circular Forms:
1. Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation. Provide manufacturer's seamless units to minimize spiral gaps and seams.
 2. Fiberglass or steel forms may be used for round-section members.
- K. Shores: Wood or adjustable metal, with bearing plates; with double wedges at lower end.
- L. Form Ties:
1. Use commercially manufactured ties, hangers and other accessories for embedding in concrete. Do not use wire not commercially fabricated for use as a form accessory.
 2. Fabricate ties so ends or end fasteners can be removed without causing spalling of concrete faces. Depth from formed concrete face to the embedded portion: At least 1 inch, or twice the minimum dimension of tie, whichever is greater.
 3. Provide waterstop feature for form ties used on liquid-containing structures and on concrete walls which will have earth backfill on one side.
 4. Removable ties: Taper ties may be used when approved by the Engineer and City Engineer. In the hole left by the removal of the taper tie, insert a preformed neoprene or polyurethane plug sized to seat at the center of the wall.

- M. Form Coating: Commercial formulation of form oil or form-release agent having proven satisfactory performance. Coating shall not bond with, stain or otherwise adversely affect concrete surfaces, or impair their subsequent treatment, including application of bonding agents, curing compounds, paint, protective liners and membrane waterproofing.
- N. Coating for Plastic Forms: Alkali-resistant gel-coat.
- O. Chamfer Strips: Unless otherwise indicated on Drawings, provide 3/4 inch chamfer strips in corners of forms to produce beveled edges where required by Part 3, Execution.
- P. Form Gaskets: Polyethylene rod, closed cell, 1-inch diameter.

2.02 DESIGN OF FORMWORK

- A. Conform to ACI 117, ACI 347 and building codes, unless more restrictive requirements are specified or shown on Drawings. Contractor shall design concrete formwork, including shoring and bracing. Design formwork for applicable gravity loads, lateral pressure, wind loads and allowable stresses. Camber formwork to compensate for anticipated deflection during placement of concrete when required to maintain specified tolerances. Design formwork to be readily removed without impact, shock or damage to concrete surfaces and adjacent materials.
- B. Slip Forming: Permitted on written approval of the Engineer and City Engineer. Contractor shall demonstrate suitability of method proposed.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Formwork Construction
 1. Construct and maintain formwork so that it will maintain correct sizes of members, shape, alignment, elevation and position during concrete placement and until concrete has gained sufficient strength. Provide for required openings, offsets, sinkages, keyways, recesses, moldings, anchorages and inserts.
 2. Construct forms for easy removal without damage to concrete surfaces.
 3. Make formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins. Provide gaskets for wall forms to prevent concrete paste leakage at their base.
 4. Place chamfer strips in forms to bevel edges and corners permanently exposed to view, except top edges of walls, and slabs which are indicated on Drawings to be tooled. Do not bevel edges of formed joints and interior corners unless indicated on Drawings. Form beveled edges for vertical and horizontal corners of equipment bases. Unless otherwise indicated on Drawings, make bevels 3/4 inch wide.
 5. Provide temporary openings at bases of column and wall forms and other points as required for observation and cleaning immediately before concrete is placed.
 6. Where runways are required for moving equipment, support runways directly on the formwork or structural members. Do not allow runways or supports to rest on reinforcing steel.
 7. Use smooth forms on formed concrete surfaces required to have smooth form finish or rubbed finish as specified in Section 03345 - Concrete Finishing.
 8. Rough forms may be used on formed concrete surfaces indicated to have rough form finish as specified in Section 03345 - Concrete Finishing.

- B. Forms for Surfaces Requiring Smooth Form Finish:
1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Uniformly space form ties and align in horizontal and vertical rows. Install taper ties, if used, with the large end on the wet face of the wall.
 2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back up joints with extra studs or girts to maintain true, square intersections.
 3. Form molding shapes, recesses and projections with smooth-finish materials and install in forms with sealed joints to prevent displacement.
 4. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines.
 5. Provide exterior exposed edges with 3/4-inch chamfer or 3/4-inch radius.
 6. Arrange facing material in orderly and symmetrical fashion. Keep number of joints to practical minimum. Support facing material adequately to prevent deflection in excess of allowable tolerances.
 7. For flush surfaces exposed to view in completed structure, overlap previously- placed hardened concrete with form sheathing by approximately 1 inch. Hold forms against hardened concrete to maintain true surfaces, preventing offsets or loss of mortar.
- C. Forms for Surfaces Requiring Rubbed Finish: Provide forms as specified in paragraph 3.01B, Smooth Form Finish. Use smooth plywood or fiberboard linings or forms, in as large sheets as practicable, and with smooth, even edges and close joints.
- D. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure supports for types of screeds required.
- E. Circular Forms: Set forms in one piece for full height of member.
- F. Surfaces to Receive Membrane Waterproofing: Coordinate surface finish, anchors, reglets and similar requirements with membrane waterproofing applicator.
- G. Fireproofing Steel Member: Construct forms to provide not less than the concrete thickness necessary, measured from face of steel member, to provide the required fire rating. Forms for concealed surfaces may be unlined.
- H. Tolerances:
1. Unless noted otherwise on Drawings, construct formwork so concrete surfaces will conform to tolerance limits listed in Tables 03100A and 03100B at end of this Section.
 2. Establish sufficient control points and bench marks as references for tolerance checks. Maintain these references in undisturbed condition until final completion and acceptance of the Work.
- I. Adjustment of Formwork:
1. Use wedges or jacks to provide positive adjustment of shores and struts. After final inspection and before concrete placement, fasten in position wedges used for final adjustment of forms.
 2. Brace forms securely against lateral deflections. Prepare to compensate for settling during concrete placement.
 3. For wall openings, construct wood forms that facilitate necessary loosening to counteract swelling of forms.
- J. Corrugated Fiberboard Carton Forms:
1. Place on smooth firm bed of suitable material to prevent vertical displacement; set tight to prevent horizontal displacement. Exercise care to avoid buckling of forms. Install in accordance with manufacturer's directions and recommendations.

2. Fit carton forms tightly around piles and piers; completely fill the space between subgrade and concrete placement with carton forms to form a void space.
3. Protect carton forms from moisture and maintain in a dry condition until concrete is placed on them. If they become wet before placement of concrete, allow them to dry and carefully inspect for strength before concrete is placed.
4. Before concrete placement, replace damaged or deteriorated forms which are incapable of supporting concrete dead load plus construction live loads.

3.02 PREPARATION OF FORM SURFACES

- A. Clean surfaces of forms and embedded materials before placing concrete. Remove accumulated mortar, grout, rust and other foreign matter.
- B. Coat forms for exposed or painted concrete surfaces with form oil or form-release agent before placing reinforcement. Cover form surfaces with coating material in accordance with manufacturer's printed instructions. Do not allow excess coating material to accumulate in forms or to contact hardened concrete against which fresh concrete will be placed. Remove coating material from reinforcement before placing concrete.
- C. Forms for unexposed surfaces, other than retained-in-place metal forms, may be wet with water immediately before concrete placement in lieu of coating. When possibility of freezing temperatures exists, however, the use of coating is mandatory.

3.03 REMOVAL OF FORMS

- A. Time Limits:
 1. When repair of surface defects or finishing is required before concrete is aged, forms on vertical surfaces may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.
 2. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete. Leave formwork for water-retaining structures in place for at least 2 days. Formwork for non-water-retaining columns, walls, sides of beams and other formwork components not supporting weight of concrete may be removed after 12 hours, provided concrete has hardened sufficiently to resist damage from removal operations, and provided removal of forms will not disturb members supporting weight of concrete.
 3. Forms and shoring supporting weight of concrete or construction loads: Leave in place until concrete has reached minimum strength specified for removal of forms and shoring. Do not remove such forms in less than 4 days.
- B. Circular Paper or Spiral Tube Forms: Follow manufacturer's directions for form removal. Take necessary precautions to prevent damage to concrete surface. When removal is done before completion of curing time, replace form, tie in place and seal to retard escape of moisture.
- C. Removal Strength:
 1. Control Tests: Suitable strength-control tests will be required as evidence that concrete has attained specified strength for removal of formwork or shoring supporting weight of concrete in beams, slabs and other structural members. Furnish test cylinders and data to verify strength for early form removal.
 - a. Field-cured Test Cylinders: When field-cured test cylinders reach specified removal strength, formwork or shoring may be removed from respective concrete placements.
 - b. Laboratory-cured Test Cylinders: When concrete has been cured as specified for structural concrete for same time period required by laboratory-cured cylinders to reach specified strength, formwork or shoring may be removed from respective

concrete placements. Determine length of time that concrete has been cured by totaling the days or fractions of days, not necessarily consecutive, during which air temperature surrounding concrete is above 50 degrees F and concrete has been damp or thoroughly sealed against evaporation and loss of moisture.

2. Compressive Strengths: The minimum concrete compressive strength for removal of formwork supporting weight of concrete is 75 percent of specified minimum 28-day strength for class of concrete involved.

3.04 RESHORING

- A. When reshoring is permitted, plan operations in advance and obtain the Engineer's and City Engineer's approval of such operations. While reshoring is under way, keep live load off new construction. Do not permit concrete in any beam, slab, column or other structural member to be subjected to combined dead and construction loads in excess of loads permitted for developed concrete strength at time of reshoring.
- B. Place reshores as soon as practicable after form-stripping operations are complete but in no case later than end of day on which stripping occurs. Tighten reshores to carry required loads without over stressing construction. Leave reshores in place until tests representative of concrete being supported have reached specified strength at time of removal of formwork supporting weight of concrete.
- C. Floors supporting shores under newly-placed concrete: Leave original supporting shores in place, or re-shore. Locate reshores directly under shore position above. Extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms and construction live loads in such manner that design superimposed loads of floors supporting shores are not exceeded.

3.05 FORM REUSE

- PART 4 Do not reuse forms that are worn or damaged beyond repair. Thoroughly clean and recoat forms before reuse. For wood and plywood forms to be used for exposed smooth finish, sand or otherwise dress concrete contact surface to original condition or provide form liner facing material. For metal forms, straighten, remove dents and clean to return forms to original condition.

SECTION 03100

CITY OF VICTORIA
STANDARD SPECIFICATIONS

CONCRETE FORMWORK

TABLE 03100A
TOLERANCES FOR FORMED SURFACES CONCRETE IN BUILDINGS**

VARIATION FROM	VARIATION IN	FOR ANY 10-FOOT LENGTH	FOR ANY 20-FOOT LENGTH OR ANY BAY	MAXIMUM FOR ENTIRE DIMENSION
PLUMB OR SPECIFIED BATTER	Lines And Surfaces of Columns, Piers, Walls And Arrises	1/4"	---	1"
	Exposed Corner Columns, Control Joint Grooves, And Other Conspicuous Lines	---	1/4"	1/2"
LEVEL OR SPECIFIED GRADE	Slab Soffits, Ceilings, Beam Soffits, And Arrises (Measured Before Removal of Shores)	1/4"	3/8"	3/4"
	Exposed Lintels, Sills, Parapets, Horizontal Grooves And Other Conspicuous Lines	---	1/4"	1/2"
DRAWING DIMENSIONS	Position of Linear Building Lines, Columns, Walls, And Partitions	---	1/2"	1"
	Size And Location of Sleeves, Floor Openings And Wall Openings	---	---	±1/4"
	Cross Section of Columns, Beams, Slabs, And Walls	---	---	+1/2", -1/4"
	Footings* in Plan	---	---	+2", -1/2"
	Footing Misplacement or Eccentricity in Direction of Error (The Lesser Of)	---	---	2% OF WIDTH OR 2"
	Footing Thickness Decrease	---	---	5%
	Footing Thickness Increase	---	---	NO LIMIT
	Step Rise in Flight of Stairs	---	---	±1/8"
	Step Tread in Flight of Stairs	---	---	±1/4"
	Consecutive Step Rise	---	---	±1/16"
	Consecutive Step Tread	---	---	±1/8"
* Footing tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items. ** Includes water and wastewater process structures.				

TABLE 03100B
TOLERANCES FOR FORMED SURFACES
CONCRETE IN BRIDGES, WHARVES AND MARINE STRUCTURES

VARIATION FROM	VARIATION IN	MAXIMUM
PLUMB OR SPECIFIED BATTER	SURFACES OF COLUMNS, PIERS AND WALLS	1/2" in 10'
LEVEL OR SPECIFIED GRADE	TOP SURFACES OF SLABS	See Section 03345
	TOP SURFACES OF CURBS AND RAILINGS	3/16" in 10'
DRAWING DIMENSIONS	CROSS SECTION OF COLUMNS, CAPS, WALLS, BEAMS AND SIMILAR MEMBERS	+1/2", -1/4"
	THICKNESS OF DECK SLABS	+1/4", - 1/8"
	SIZE AND LOCATION OF SLAB AND WALL OPENINGS	± 1/2"
	FOOTINGS IN PLAN	+2", -1/2"
	FOOTING MISPLACEMENT OR ECCENTRICITY IN DIRECTION OF ERROR (THE LESSER OF)	2% of WIDTH OR 2"
	FOOTING THICKNESS DECREASE	5%
	FOOTING THICKNESS INCREASE	NO LIMIT
	STEP RISE IN FLIGHT OF STAIRS	±1/8"
	STEP TREAD IN FLIGHT OF STAIRS	±1/4"
	CONSECUTIVE STEP RISE	±1/16"
	CONSECUTIVE STEP TREAD	±1/8"

END OF SECTION

SECTION 03100

*CITY OF VICTORIA
STANDARD SPECIFICATIONS*

CONCRETE FORMWORK

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Tables: In paragraph 3.01H (Tolerances), there are references to two tables of tolerances, for two separate classes of structures. If there are no structures falling in one of the classes for the particular project, omit the inapplicable reference, and the corresponding table at the end of the Section.
- B. This Section is not necessary with Section 03305.

END OF NOTES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural concrete reinforcement and grouting of reinforcement dowel bars into hardened concrete.

1.02 UNIT PRICES

- A. No separate payment will be made for reinforcing steel or grouting that is part of the Work as bid. Include payment in unit price for structural concrete.
- B. Measurement for reinforcing steel installed as extra work is on a per-pound basis.
- C. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

- A. Conform to Section 01300 - Submittals.
- B. Shop Drawings:
 - 1. Submit shop drawings detailing reinforcement fabrication, bar placement location, splices, spacing, bar designation, bar type, length, size, bending, number of bars, bar support type and other pertinent information, including dimensions. Provide sufficient detail for placement of reinforcement without use of Contract Drawings. Information shall correspond directly to data listed on bill of materials.
 - 2. Use of reproductions of Contract Drawings by Contractor, Subcontractor, erector, fabricator or material supplier in preparation of shop drawings (or in lieu of preparation of shop drawings) signifies acceptance by that party of information shown thereon as correct, and acceptance of obligation to pay for any job expense, real or implied, arising due to errors that may occur thereon. Remove references to Design Engineer, including seals, when reproductions of Contract Drawings are used as shop drawings.
 - 3. Detail shop drawings in accordance with ACI 315, Figure 6.
 - 4. Submit shop drawings showing location of proposed additional construction joints as required under Section 03250 - Joints in Concrete Structures, and obtain approval of the Engineer and City Engineer, prior to submitting reinforcing steel shop drawings.
- C. Bill of Materials: Submit with shop drawings.
- D. Product Data:
 - 1. Mechanical Bar Splices: Submit manufacturer's technical literature, including specifications and installation instructions.
 - 2. Epoxy grout proposed for anchoring reinforcing dowels to hardened concrete: Submit manufacturer's technical literature including recommended installation procedures.
- E. Certificates:
 - 1. Submit steel manufacturer's certificates of mill tests giving properties of steel proposed for use. List manufacturer's test number, heat number, chemical analysis, yield point, tensile strength and percentage of elongation. Identify proposed location of steel in work.
 - 2. Foreign-manufactured reinforcing bars shall be tested for conformance to ASTM requirements by a certified independent testing laboratory located in United States. Certification from any other source is not acceptable. Submit test reports for review. Do not begin fabrication of reinforcement until material has been approved.

1.04 HANDLING AND STORAGE

- A. Store steel reinforcement above ground on platforms, skids or other supports. Protect reinforcing from mechanical injury, surface deterioration and formation of excessive, loose or flaky rust caused by exposure to weather. Protect epoxy-coated reinforcing from formation of any amount of rust.

1.05 QUALITY ASSURANCE

- A. Notify the Engineer and City Engineer at least 48 hours before concrete placement so that reinforcement may be inspected, and errors corrected, without delaying Work.

PART 2 PRODUCTS

2.01 MATERIAL

- A. Reinforcing Bars: Deformed bars conforming to ASTM A615, grade as indicated on Drawings, except column spirals and those shown on Drawings to be smooth bars. Where grade is not shown on Drawings, use Grade 60.
- B. Smooth Bars: Where indicated on Drawings, use smooth bars conforming to ASTM A36; ASTM A615, Grade 60; or ASTM A675, Grade 70.
- C. Column Spirals: Bars conforming to ASTM A615, Grade 60, or wire conforming to ASTM A82.
- D. Epoxy-Coated Deformed Bars, Column Spirals and Smooth Bars: Conform to ASTM A775/A775M.
- E. Welded Wire Fabric:
 - 1. Welded Smooth Wire Fabric: Conform to ASTM A185.
 - 2. Welded Deformed Wire Fabric: Conform to ASTM A497.
 - 3. Provide wire size, type and spacing as shown. Where type is not shown on Drawings, use welded smooth wire fabric.
 - 4. Furnish welded wire fabric in flat sheets only.
- F. Tie Wire: 16-1/2 gage or heavier annealed steel wire. Use plastic-coated tie wire with epoxy-coated reinforcing steel.
- G. Bar Supports: Provide chairs, riser bars, ties and other accessories made of plastic or metal, except as otherwise specified. Use bar supports and accessories of sizes required to provide required concrete cover. Where concrete surfaces are exposed to weather, water or wastewater, provide plastic accessories only; do not use galvanized or plastic-tipped metal in such locations. Provide metal bar supports and accessories rated Class 1 or 2 conforming to CRSI MSP-1 Manual of Standard Practice. Use epoxy-coated bar supports with epoxy-coated reinforcing bars.
- H. Slabs on Grade: Provide chairs with sheet metal bases or provide precast concrete bar supports 3 inches wide, 6 inches long, and thick enough to allow required cover. Embed tie wires in 3-inch by 6-inch side.
- I. Mechanical Bar Splices:
 - 1. Conform to ACI 318; use where indicated on Drawings.
 - a. Compression splices shall develop ultimate stress of reinforcing bar.
 - b. Tension splices shall develop 125 percent of minimum yield point stress of reinforcing bar.

2. Regardless of chemical composition of steel, any heat effect shall not adversely affect performance of reinforcing bar.
- J. Welded Splices:
 1. Provide welded splices where shown and where approved by the Engineer and City Engineer. Welded splices of reinforcing steel shall develop a tensile strength exceeding 125 percent of the yield strength of the reinforcing bars connected.
 2. Provide materials for welded splices conforming to AWS D1.4.
- K. Epoxy Grout: High-strength rigid epoxy adhesive, conforming to ASTM C881, Type IV, manufactured for purpose of anchoring dowels into hardened concrete and the moisture condition, application temperature and orientation of the hole to be filled. Unless otherwise shown, depth of embedment shall be as required to develop the full tensile strength (125 percent of yield strength) of dowel, but not less than 12 diameters.

2.02 FABRICATION

- A. Bending: Fabricate bars to shapes indicated on Drawings by cold bending. Bends shall conform to minimum bend diameters specified in ACI 318. Do not straighten or rebend bars. Fabricate epoxy-coated reinforcing steel to required shapes in a manner that will not damage epoxy coating. Repair any damaged epoxy coating with patching material conforming to Item 4.4 of ASTM A775/A775M.
- B. Splices:
 1. Locate splices as indicated on Drawings. Do not locate splices at other locations without approval of the Engineer and City Engineer. Use minimum number of splices located at points of minimum stress. Stagger splices in adjacent bars.
 2. Length of lap splices: As shown on Drawings.
 3. Prepare ends of bars at mechanical splices in accordance with splice manufacturer's requirements.
- C. Construction Joints: Unless otherwise shown, continue reinforcing through construction joints.
- D. Bar Fabrication Tolerances: Conform to tolerances listed in ACI 315, Figures 4 and 5.
- E. Standard Hooks: Conform to the requirements of ACI 318.
- F. Marking: Clearly mark bars with waterproof tags showing number of bars, size, mark, length and yield strength. Mark steel with same designation as member in which it occurs.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean reinforcement of scale, loose or flaky rust and other foreign material, including oil, mud or coating that will reduce bond to concrete.

3.02 INSTALLATION

- A. Placement Tolerances: Place reinforcement within tolerances of Table 03210A at the end of this Section. Bend tie wire away from forms to maintain the specified concrete coverage.
- B. Interferences: Maintain 2-inch clearance from embedded items. Where reinforcing interferes with location of other reinforcing steel, conduit or embedded items, bars may be moved within specified tolerances or one bar diameter, whichever is greater. Where greater movement of bars is required to avoid interference, notify the Engineer and City Engineer. Do not cut

- reinforcement to install inserts, conduit, mechanical openings or other items without approval of the Engineer and City Engineer.
- C. Concrete Cover: Provide clear cover measured from reinforcement to face of concrete as listed in Table 03210B at the end of this Section, unless otherwise indicated on Drawings.
- D. Placement in Forms: Use spacers, chairs, wire ties and other accessory items necessary to assemble, space and support reinforcing properly. Provide accessories of sufficient number, size and strength to prevent deflection or displacement of reinforcement due to construction loads or concrete placement. Use appropriate accessories to position and support bolts, anchors and other embedded items. Tie reinforcing bars at each intersection, and to accessories. Blocking reinforcement with concrete or masonry is prohibited.
- E. Placement for Concrete on Ground: Support bar and wire reinforcement on chairs with sheet metal bases or precast concrete blocks spaced at approximately 3 feet on centers each way. Use minimum of one support for each 9 square feet. Tie supports to reinforcing bars and wires.
- F. Vertical Reinforcement in Columns: Offset vertical bars by at least one bar diameter at splices. Provide accurate templates for column dowels to ensure proper placement.
- G. Splices:
1. Do not splice bars, except at locations indicated on Drawings or reviewed shop drawings, without approval of the Engineer and City Engineer.
 2. Lap Splices: Unless otherwise shown or noted, Class B, conforming to ACI 318-89, Section 12.15.1. Tie securely with wire prior to concrete placement, to prevent displacement of splices during concrete placement.
 3. Mechanical Bar Splices: Use only where indicated on Drawings or approved by the Engineer and City Engineer. Install in accordance with manufacturer's instructions.
 - a. Couplers located at a joint face shall be of a type which can be set either flush or recessed from the face as shown. Seal couplers prior to concrete placement to completely eliminate concrete or cement paste from entering.
 - b. Couplers intended for future connections: Recess 1/2-inch minimum from concrete surface. After concrete is placed, plug coupler and fill recess with sealant to prevent contact with water or other corrosive materials.
 - c. Unless noted otherwise, match mechanical coupler spacing and capacity to that shown for the adjacent reinforcing.
- H. Construction Joints: Place reinforcing continuous through construction joints, unless noted otherwise.
- I. Welded Wire Fabric: Install wire fabric in as long lengths as practicable. Unless otherwise indicated on Drawings, lap adjoining pieces at least 6 inches or one full mesh plus 2 inches, whichever is larger. Lace splices with wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps. Conform to WRI - Manual of Standard Practice for Welded Wire Fabric.
- J. Field Bending: Shape reinforcing bent during construction operations to conform to Drawings. Bars shall be cold-bent; do not heat bars. Closely inspect reinforcing for breaks. When reinforcing is damaged, replace, Cadweld, or otherwise repair, as directed by the Engineer or City Engineer. Do not bend reinforcement after it is embedded in concrete.
- K. Epoxy-coated Reinforcing Steel: Install in accordance with Paragraph 3.02J, Field Bending, and in a manner that will not damage epoxy coating. Repair damaged epoxy coating with patching material as specified in Paragraph 2.02A, Bending.

SECTION 03210

CITY OF VICTORIA
STANDARD SPECIFICATIONS

REINFORCING STEEL

- L. Field Cutting: Cut reinforcing bars by shearing or sawing. Do not cut bars with cutting torch.
- M. Welding of reinforcing bars is prohibited, except where shown on Drawings.

3.03 GROUTING OF REINFORCING AND DOWEL BARS

- A. Use epoxy grout for anchoring reinforcing and dowel steel to existing concrete in accordance with epoxy manufacturer's instructions. Drill hole not more than 1/4 inch larger than steel bar diameter (including height of deformations for deformed bars) in existing concrete. Just before installation of steel, blow hole clean of all debris using compressed air. Partially fill hole with epoxy, using enough epoxy so when steel bar is inserted, epoxy grout will completely fill hole around bar. Dip end of steel bar in epoxy and twist bar while inserting into partially filled hole.

TABLE 03210A
REINFORCEMENT PLACEMENT TOLERANCES

PLACEMENT	TOLERANCE IN INCHES
Clear Distance - To formed soffit: To other formed surfaces: Minimum spacing between bars:	 -1/4 ±1/4 -1/4
Clear distance from unformed surface to top reinforcement - Members 8 inches deep or less: Members more than 8 inches deep but less than 24 inches deep: Members 24 inches deep or greater: Uniform spacing of bars (but the required number of bars shall not be reduced): Uniform spacing of stirrups and ties (but the required number of stirrups and ties shall not be reduced):	 ±1/4 -1/4, +1/2 -1/4, +1 ±2 ±1
Longitudinal locations of bends and ends of reinforcement - General: Discontinuous ends of members: Length of bar laps:	 ±2 ±1/2 -1-1/2
Embedded length - For bar sizes No. 3 through 11: For bar sizes No. 14 and 18:	 -1 -2

SECTION 03210

CITY OF VICTORIA
STANDARD SPECIFICATIONS

REINFORCING STEEL

TABLE 03210B
MINIMUM CONCRETE COVER FOR REINFORCEMENT

SURFACE	MINIMUM COVER IN INCHES
Slabs and Joists - Top and bottom bars for dry conditions - No. 14 and No. 18 bars: No. 11 bars and smaller:	 1-1/2 1
Formed concrete surfaces exposed to earth, water or weather; over, or in contact with, sewage; and for bottoms bearing on work mat, or slabs supporting earth cover - No. 5 bars and smaller: No. 6 through No. 18 bars:	 1-1/2 2
Beams and Columns - For dry conditions - Stirrups, spirals and ties: Principal reinforcement: Exposed to earth, water, sewage or weather - Stirrups and ties: Principal reinforcement:	 1-1/2 2 2 2-1/2
Walls - For dry conditions - No. 11 bars and smaller: No. 14 and No. 18 bars: Formed concrete surfaces exposed to earth, water, sewage or weather, or in contact with ground - Circular tanks with ring tension: All others:	 1 1-1/2 2 2
Footings and Base Slabs - At formed surfaces and bottoms bearing on concrete work mat: At unformed surfaces and bottoms in contact with earth: Over top of piles: Top of footings -- same as slabs	 2 3 2

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Fibrous concrete reinforcement for shrinkage control.

1.02 UNIT PRICES

- A. No payment will be made for fibrous reinforcing under this Section. Include payment in unit price for concrete.

1.03 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 - Submittals.
- B. Submit manufacturer's product data indicating proposed fibrous concrete reinforcement materials for approval. Include documentation of performance history, compliance with applicable building codes, and ASTM C1116 Type III 4.1.3.
- C. Submit manufacturer's batching and mixing instructions; and recommended quantity, in pounds of fiber per cubic yard, to be added to each type and strength of concrete.
- D. Submit test data for design mixes in accordance with requirements of Sections 02521. Include results of tests accomplished in accordance with ASTM C94 and ASTM C1116 Type III 4.1.3; and ASTM C1116 (reference ASTM C1018) Performance Level I, outlined in Section 21 Note 7.

PART 2 PRODUCTS**2.01 FIBROUS CONCRETE REINFORCEMENT**

- A. Supply 100 percent virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement. Materials shall not contain reprocessed olefin.
- B. Provide fibrous concrete reinforcement materials to produce requirements for each type and strength of concrete designated. Minimum fiber reinforcement content shall be 4.5 pounds per cubic yard of concrete.
- C. Physical characteristics:
 - 1. Specific gravity 0.91
 - 2. Tensile strength 80 - 110 ksi.
 - 3. Fiber lengths 1 ½ inch minimum.

PART 3 EXECUTION**3.01 MIXING**

- A. Add fibrous concrete reinforcement to concrete materials at the time concrete is batched. Amounts shall conform to approved Submittals for each type of concrete required.
- B. Mix batched concrete in accordance with fibrous concrete reinforcement manufacturer's instructions and recommendations. Attain uniform and complete distribution of fiber reinforcement.

SECTION 03240

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STANDARD SPECIFICATIONS

FIBROUS REINFORCING

3.02 PLACING AND FINISHING

- A. Place and finish concrete materials in accordance with requirements of Sections 02521. Finish to minimize protruding fibers.

3.03 FIELD QUALITY CONTROL

- A. Provide services of a qualified technical representative to instruct concrete supplier in proper batching and mixing of materials to be provided.
- B. Submit certificates prepared by concrete supplier indicating amount of approved fibrous concrete reinforcement material added to each batch of concrete delivered to project site.

END OF SECTION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Fibrous concrete reinforcement for shrinkage control.

1.02 UNIT PRICES

- A. No payment will be made for fibrous reinforcing under this Section. Include payment in unit price for concrete.

1.03 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 - Submittals.
- B. Submit manufacturer's product data indicating proposed fibrous concrete reinforcement materials for approval. Include documentation of performance history, compliance with applicable building codes, and ASTM C1116 Type III 4.1.3.
- C. Submit manufacturer's batching and mixing instructions; and recommended quantity, in pounds of fiber per cubic yard, to be added to each type and strength of concrete.
- D. Submit test data for design mixes in accordance with requirements of Sections 02521 – Concrete Paving. Include results of tests accomplished in accordance with ASTM C94 and ASTM C1116 Type III 4.1.3; and ASTM C1116 (reference ASTM C1018) Performance Level I, outlined in Section 21 Note 7.

PART 2 PRODUCTS**2.01 MACRO SYNTHETIC FIBROUS REINFORCED READY MIX CONCRETE**

- A. Fibrous reinforced ready-mix concrete shall have a minimum compressive strength of 3,000 pounds per square inch at 28 days and shall contain a minimum of 5 sacks of cement per cubic yard and shall conform to Class A of Table 5 of Section 421.4, of the Standard Specifications of the Texas Department of Highways and Public Transportation, 2004 Edition. The mix shall also contain no less than 4 ½ pounds per cubic yard of concrete of Macro Synthetic Fibers or as recommended by the manufacturer, whichever is greater. The macro synthetic fibers shall have a minimum length of 1 ½ inches. The quantity of mixing water shall not exceed seven U.S. Gallons per sack (94 lbs) of Portland cement. The slump of the concrete shall not exceed five inches. Concrete, that has partially set shall not be re-tempered or remixed by adding additional ingredients, but shall be disposed of.

PART 3 EXECUTION**3.01 MIXING**

- A. Add macro synthetic fibers to the concrete mixture in accordance to the manufacturer's recommended instructions and after batching all other concrete materials.
- B. Mix concrete after application of macro synthetic fiber reinforcement for sufficient time, with a minimum of five minutes, to ensure uniform distribution of fibers throughout the concrete.

3.02 CURING MASS CONCRETE

- A. All tests for ingredients and concrete shall be made in accordance with the applicable methods of tests of the American Society for Testing Materials. The maximum size for coarse aggregate shall be 1.5 inches.

3.03 FIELD QUALITY CONTROL

- A. Provide services of a qualified technical representative to instruct concrete supplier in proper batching and mixing of materials to be provided.
- B. Submit Certificates prepared by concrete supplier indicating amount of approved fibrous concrete reinforcement material added to each batch of concrete delivered to project site.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Waterstops and similar joints in concrete structures intended to retain water or withstand hydrostatic pressure.

1.02 UNIT PRICES

- A. No separate payment will be made for joints under this Section. Include payment in unit price for structural concrete.
- B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

- A. The following definitions refer to concrete joints in water-retaining structures. Unless otherwise indicated, all such joints shall have a waterstop or sealant groove to prevent water penetration at the joint.
- B. Construction Joint: The joint or surface between two concrete pours, produced by placing fresh concrete in contact with a hardened concrete surface.
 - 1. A bond breaker may or may not be used, as indicated.
 - 2. Reinforcing steel is continuous through the joint, unless otherwise indicated.
- C. Contraction Joint: A joint similar to a construction joint, but intended to accommodate concrete shrinkage and similar movement.
 - 1. A bond breaker is always used.
 - 2. Reinforcing steel is held back 4-1/2 inches from the joint surface, and sleeved dowels are used so pours can move apart, unless otherwise indicated.
- D. Expansion Joint: A joint similar to a construction or contraction joint but intended to accommodate both expansion and contraction.
 - 1. Compressible joint filler is placed against the hardened concrete, to form and separate the second pour so pours can move together or apart.
 - 2. A centerbulb waterstop and joint sealant are used to fill the gap, unless otherwise indicated.
 - 3. Reinforcing steel is held back, and sleeved dowels are used to allow and control movement, unless otherwise indicated.
- E. Control Joint: A groove cut or formed in the face of a single pour, producing a weaker plane more likely to crack; used in an attempt to control locations of normal shrinkage cracks.
 - 1. Joint sealant is used to fill the groove.
 - 2. Reinforcing steel is continuous, since the pour is monolithic.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01300 - Submittals.
- B. Product Data: Information sufficient to indicate compliance with Contract Documents, including manufacturer's descriptive literature and specifications.
- C. Shop Drawings: Indicate type, size and location of each joint in each structure, and installation details.

- D. Samples: For extrusions, submit 6-inch lengths. For molded or fabricated items, submit whole items. Submit 6-inch beads for sealants and 6-inch square samples for coatings, on appropriate substrates.
- E. Quality Control Submittals: Submit manufacturer's instructions and recommendations for storage, handling and installation including material safety data sheets, and, where specified, test reports certified by an independent testing laboratory or the manufacturer, and manufacturer's certification that products furnished comply with Contract Documents.

1.05 QUALITY ASSURANCE

- A. Waterstop Inspection: Notify the Engineer and City Engineer to schedule inspection at least 24 hours prior to work involving waterstop installation or fabrication of waterstop field joints.
- B. Defects include but are not limited to the following:
 - 1. Offsets at joints greater at any point than 1/16 inch or 15 percent of material thickness, whichever is less.
 - 2. Exterior cracks at joints due to incomplete bond, which are deeper at any point than 1/16 inch or 15 percent of material thickness, whichever is less.
 - 3. At any point, any combination of offsets or exterior cracks resulting in a net reduction in the cross-sectional area of the waterstop greater than 1/16 inch or 15 percent of material thickness at any point, whichever is less.
 - 4. Misalignment of joint resulting in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
 - 5. Porosity in the welded joint as evidenced by visual inspection.
 - 6. Bubbles or inadequate bond which can be detected with a pen knife. If, while probing the joint with the point of a penknife, the knife breaks through the outer portion of the weld into a bubble, the joint is defective.
- C. Field Joint Samples: Prior to use of the waterstop material in the field, fabricate and submit for review a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used. Fabricate samples so material and workmanship represent fittings to be furnished. Field samples of fabricated fittings (crosses, tees, etc.) will be selected at random by the Engineer or City Engineer for testing by a laboratory at Owner's expense; they shall have a tensile strength across the joints equal to at least 600 psi when tested in accordance with ASTM D638. Contractor shall pay cost of failed tests and retesting required by failures.
- D. Construction Joint Sealant: Prepare adhesion and cohesion test specimens, as specified, at intervals of 5 working days while sealants are being installed.
- E. Sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:
 - 1. Prepare sealant specimen between two concrete blocks (1 inch by 2 inches by 3 inches); spacing between the blocks shall be 1 inch. Use coated spacers (2 inches by 1-1/2 inches by 1/2 inch) to ensure sealant cross-sections of 1/2 inch by 2 inches with a width of 1 inch.
 - 2. Cast and cure sealant according to manufacturer's recommendations except that curing period shall be not less than 24 hours.
 - 3. Following curing period, widen the gap between blocks to 1-1/2 inches. Use spacers to maintain this gap for 24 hours prior to inspection for failure.
- F. Sealant Installer: A competent waterproofing specialty contractor, approved by sealant manufacturer, having a record of successful performance in similar installations. Before beginning work, sealant manufacturer's representative shall instruct installer's crew in proper method of application.

1.06 WARRANTY

- A. Provide a written warranty covering entire sealant installation against faulty and incompatible materials and workmanship, and agreeing to repair or replace defective work at no additional cost to the Owner, for a period of 5 years.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with manufacturer's printed instructions.
- B. Store waterstops to permit free circulation of air around waterstop material.

PART 2 PRODUCTS

2.01 EPA POTABLE CLASSIFICATION

- A. All joint materials shall be materials that reach acceptability for use in potable water systems no later than 30 days after installation, as classified by the Environmental Protection Agency.

2.02 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 and City Engineer, provided that at no place shall waterstop thickness be less than 3/8 inch.
- C. Multi-Rib Waterstops: As detailed, and as manufactured by 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 and City Engineer. Use prefabricated joint fittings at intersections of ribbed-type waterstops.
- D. Other Waterstops: When types of waterstops not listed above are indicated on the Drawings, they are subject to these specifications.

SECTION 03250

CITY OF VICTORIA

STANDARD SPECIFICATIONS

JOINTS IN CONCRETE STRUCTURES

- E. Waterstop Properties: When tested in accordance with specified standards, waterstop material shall meet or exceed the following requirements:

<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM Standard</u>
Tensile Strength-min (psi):	1750	D638, Type IV
Ultimate Elongation-min (percent):	350	D638, Type IV
Low Temp Brittleness-max (degrees F):	-35	D746
Stiffness in Flexure-min (psi):	400	D747
Accelerated Extraction (CRD-C572) -		
Tensile Strength-min (psi):	1500	D638, Type IV
Ultimate Elongation-min (percent):	300	D638, Type IV
Effect of Alkalies (CRD-C572) -		
Change in Weight (percent):	+0.25/-0.10	-----
Change in Durometer, Shore A:	+5	D2240
Finished Waterstop –		
Tensile Strength-min (psi):	1400	D638, Type IV
Ultimate Elongation-min (percent):	280	D638, Type IV

2.03 JOINT SEALANT

- A. Material: Polyurethane polymer designed for bonding to concrete which is continuously submerged in water. Use no material with an unsatisfactory history of bond or durability when used in joints of liquid-retaining structures.
- B. Sealant Properties at 73 degrees F, 50 percent relative humidity:
1. Work Life: 45 - 180 minutes
 2. Time to Reach 20 Shore A Hardness (at 77 degrees F, 200 gr quantity): 24 hours, maximum
 3. Ultimate Hardness (ASTM D2240): 20 - 45 Shore A
 4. Tensile Strength (ASTM D412): 200 psi, minimum
 5. Ultimate Elongation (ASTM D412): 400 percent, minimum
 6. Tear Resistance (Die C ASTM D624): 75 pounds per inch of thickness, minimum
 7. Color: Light Gray
- C. Polyurethane Sealants for Waterstop Joints in Concrete:
1. Sealant: 2-part polyurethane; when cured, sealant shall meet or exceed ANSI/ASTM C920 or Federal Specification TT-S-0227 E (3) for 2-part material.
 2. Vertical and overhead horizontal joints: Use only "non-sag" compounds meeting ANSI/ASTM C920, Class 25, Grade NS, or Federal Specification TT-S-0227 E (3), Type II, Class A.
 3. Plane horizontal joints: Self-leveling compounds meeting ANSI/ASTM C920, Class 25, Grade P, or Federal Specification TT-S-0227 E (3), Type I. For joints subject to either pedestrian or vehicular traffic, use a compound providing non-tracking characteristics and having a Shore A hardness range of 35 to 45.
 4. Primer: Use only compatible materials manufactured or recommended for the application by the sealant manufacturer, in accordance with the printed instructions and recommendations of the sealant manufacturer.
- D. Acceptable Products: Polymeric Systems Inc. "PSI-270"; Pacific Polymers "Elastothane 227R"; Sika Corporation "Sikaflex 2C", or equal acceptable to the Engineer and City Engineer.
- E. Sealants for non-waterstop joints: Conform to Section 07920 - Sealants and Caulking.

2.04 MISCELLANEOUS MATERIALS

- A. Bearing Pad: ASTM D2000 neoprene, Grade 2 or 3, Type BC, tensile strength 1450 psi, 60 durometer hardness, unless otherwise indicated.
- B. Neoprene Sponge: ASTM D1056, Type 2C3-E1 closed-cell expanded neoprene.
- C. Preformed Joint Filler: ASTM D1752 Type I non-extruding type; neoprene sponge or polyurethane of firm texture, except as otherwise specified. Bituminous fiber type will not be permitted.
- D. Control Joint Former: Continuous plastic insert strips with anchorage ribs located at the bottom and an enlarged upper portion that is readily removable without damage to the concrete, and is sized to form sealant groove. Size to extend to at least 1/4 slab depth.
- E. Backing Rod: Extruded closed-cell polyethylene foam rod, compatible with joint sealant materials used, with a tensile strength not less than 40 psi, and compression deflection approximately 25 percent at 8 psi. Size: 1/8-inch larger in diameter than joint width, except use one-inch diameter rod for 3/4-inch wide joints.
- F. Bond Breaker: "Super Bond Breaker" manufactured by Burke Company, San Mateo, California; "Select Cure CRB", manufactured by Select Products Co., Upland, California, or equal acceptable to the Engineer and City Engineer. Bond breaker shall contain a fugitive dye so areas of application will be readily distinguishable.
- G. Slip Dowels: Smooth epoxy-coated bars conforming to ASTM A775.
- H. PVC Tubing: ASTM D2241, Schedule SDR 13.5.

2.05 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: One 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 PART 3 EXECUTION

3.01 INSTALLATION

- 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.

3.02 SPLICES IN WATERSTOPS

- A. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.
 - 1. Do not damage material by heat sealing.
 - 2. Splice tensile strength: At least 60 percent of unspliced material tensile strength.
 - 3. Maintain continuity of waterstop ribs and tubular center axis.
- B. Butt end-to-end joints of two identical waterstop sections may be made in the forms during placement of waterstop material.
- C. Prior to placement in formwork, prefabricate all waterstop joints involving more than 2 ends to be joined together, an angle cut, an alignment change, or the joining of 2 dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the Engineer and City 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. Where a centerbulb waterstop intersects and is joined to a non-centerbulb waterstop, take care to seal the end of the centerbulb, using additional PVC material if needed.

3.03 JOINT CONSTRUCTION

- A. Setting Waterstops:
 - 1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete. 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. Flat-strip waterstop: Prevent folding over by concrete during placement. Unless otherwise shown, hold waterstops in place with wire ties on 12-inch centers passed through the waterstop edge and tied to reinforcing steel.
 - a. Horizontal waterstops (with flat face in vertical plane): Hold in place by fastening upper waterstop edge to continuous supports.
 - b. Horizontal waterstops (with flat face in horizontal plane): Work concrete under waterstops by hand to eliminate air and rock pockets.
 - 3. Place centerbulb waterstops in expansion joints centered on joint filler material.
 - 4. 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.

- B. Joint Location: Unless specifically noted otherwise, provide construction joints at 25-foot maximum spacing for concrete construction. Where joints are shown spaced greater than 40 feet apart, provide additional joints to maintain the 25-foot maximum spacing. Submit joint locations for review by the Engineer and City Engineer.
- C. Joint Preparation: Prepare surfaces in accordance with Section 03310 - Structural Concrete. Unless otherwise indicated, bonding is required at horizontal concrete joints in walls. Except on horizontal wall construction joints, wall-to-slab joints, or where otherwise shown or specified, at joints where waterstops are required, coat the joint face of the first pour with bond breaker as specified.
- D. 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 with Contract Documents.
- E. Construction Joint Sealant:
1. In water bearing floor slabs and elsewhere where indicated, provide construction joints with tapered grooves filled with construction joint sealant. Leave groove-forming material in place until time grooves are cleaned and filled with joint sealant. After removing groove forms, remove laitance and fins and sandblast the grooves. Allow grooves to dry thoroughly, then blow out, immediately prime surfaces, place bond-breaker tape in bottom of groove and fill with construction joint sealant. Use no sealant without a primer. Completely fill sealant grooves. Thoroughly clean areas designated to receive sealant as specified for tapered grooves, prior to sealant application.
 2. Mix and install primer and sealant in accordance with manufacturer's printed instructions and recommendations. Do not coat sides of sealant groove with bond breaker, curing compound or other substance which would interfere with proper sealant bond. Allow at least 7 days for sealant to achieve final cure before filling structure with water.
 3. Thoroughly and uniformly mix 2-part catalyst-cured material.
 4. Remove and replace improperly cured sealants after the manufacturer's recommended curing time; thoroughly sandblast the groove to remove all traces of uncured or partially-cured sealant and primer, then re-prime and re-seal with specified sealant.
- 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 or City 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.
7. Adhesive Waterstop:
- a. Thoroughly clean the concrete surface on which the waterstop is to be placed with a wire brush and coat with primer.
 - b. If the surface is too rough to allow the waterstop to form a complete contact, grind to form an adequately smooth surface.
 - c. 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.
 - d. 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.
- G. Control Joints:
- 1. Where indicated, form in slabs by sawcutting, preformed plastic inserts or other means acceptable to the Engineer and City Engineer. Minimum insert or sawcut: 1/4 slab depth.
 - 2. Perform sawcutting during the curing period as soon as possible after concrete has reached its final set, has attained sufficient strength to support sawcutting operations without damage, and while it remains fully saturated.
 - 3. Leave the removable portion of plastic inserts in place and protect sawcuts against damage and intrusion of foreign material until the end of the curing period and until concrete has dried sufficiently to allow sealant installation.
 - 4. Sealant Installation: Blow foreign material from formed or sawcut space. Insert a foam backer rod to form a sealant depth equal to the width of the space but not less than 3/8 inch. Install sealant as specified elsewhere in the Contract Documents.

END OF SECTION

SECTION 03250

CITY OF VICTORIA
STANDARD SPECIFICATIONS

JOINTS IN CONCRETE STRUCTURES

NOTE TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. This Section is intended only for use in lift station, wastewater treatment and water plants.

END OF NOTE

PART 1 GENERAL**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.
- B. Minor paving such as driveways, sidewalks, medians, curbs and curb and gutter.

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 manufacturer's mill certificates for reinforcing steel.
- D. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.
- E. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details and other pertinent information.

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 PRODUCTS**2.01 CONCRETE MATERIALS**

- A. Portland cement: ASTM C150, Type I, II or III. Use Type II for concrete in contact with sewage. Use Type III when specifically called for or authorized by the Engineer.
- 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.
- 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: 3.0 pounds of fiber per cubic yard of concrete.
 - b. Physical Properties:
 - i. Material: Polypropylene.
 - ii. Length: 1 1/2 inch.
 - iii. Specific Gravity: 0.9l.
 - iv. Absorption: None.
 - v. Tensile Strength: 70-110 ksi.
 - vi. Modulus of Elasticity: 500 ksi.

- vii. Melt Point: 140 degrees F (60 degrees C).
 - viii. Flash Point: 932 degrees F (500 degrees C).
 - ix. Density: 3-pounds/cubic yard.
 - c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.
 - 2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A820.
 - a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
 - b. Physical Properties:
 - i. Material: Steel.
 - ii. Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1.
 - iii. Specific Gravity: 7.8.
 - iv. Tensile Strength: 40-400 ksi.
 - v. Young's Modulus: 29,000 ksi.
 - vi. Minimum Average Tensile Strength: 50,000 psi.
 - vii. 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. Classes of concrete as indicated on the Drawings and other Specifications shall be in accordance with Item 421, Table 4, TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.
- C. Concrete slump requirements shall be in accordance with Item 421, Table 8, TxDOT, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges", 2004.
- D. Add steel or polypropylene fibers only when called for on the Drawings or in another section of these Specifications.

PART 3 EXECUTION

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 or City 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 City 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 and City 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 as 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 through 8.
- C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of the Engineer and City 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.
- 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.
- G. Clean, maintain and operate equipment so that it thoroughly mixes material as required.
- H. Hand-mix only when approved by the Engineer and City Engineer.

3.05 PLACING CONCRETE

- A. Give sufficient advance notice to the Engineer and City 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 and City 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 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 and City 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.

3.07 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 and City 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 and City 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.

3.08 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 or City Engineer.

3.09 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.

3.10 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.

3.11 FIELD QUALITY CONTROL

- A. Testing shall be performed under provisions of Section 01410 - Testing Laboratory Services.
- B. Unless otherwise directed by the Engineer and City 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, Sections 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 or City Engineer, at no additional cost to the Owner.

3.12 PROTECTION

- A. Protect concrete against damage until final acceptance by the Engineer and City Engineer.
- 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 and City Engineer.

END OF SECTION

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. This section may be used where a project has only minor concrete placements such as manhole bases, small vaults, slabs on grade, etc.; where a project requires reinforced concrete for buildings, lift stations, hydraulic structures, and the like use Section 03310 - Structural Concrete.
- B. When this Section is used, it is not necessary to include Sections 03100 – Concrete Framework, 03210 – Reinforcing Steel, 03240 – Fibrous Reinforcing, 03250 – Joints in Concrete Structures, 03345 – Concrete Finishing or 03370 – Concrete Curing.

END OF NOTES

PART 1 GENERAL

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

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 two successive days, mean daily temperature is below 40 degrees F.

1.04 SUBMITTALS

- A. Conform to Section 01300 - Submittals.
- 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:
 - i. 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.

- ii. 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.
 - iii. 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 Engineer or City Engineer, 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:
 - i. 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:
 - (1) 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;
 - (2) Measure within 30 minutes after first 30 minutes of immersion to determine original length (not to be confused with "base length");
 - (3) Then submerge in saturated limewater, at 73 degrees F ± 3 degrees F, for 7 days;
 - (4) Then measure at age 7 days to establish "base length" for drying shrinkage calculations ("zero" days drying age);
 - (5) Calculate expansion (base length expressed as a percentage of original length);
 - (6) 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.
 - (7) 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 (at "zero" days drying age) 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.
- 4. Report shrinkage separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

- a. 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 Engineer or City Engineer.
 - b. Checking of batching and mixing operations.
 - c. Review of manufacturer's report of each cement shipment and conducting laboratory tests of cement.
 - d. Molding and testing reserve 7-day cylinders or field cylinders.
 - e. Conducting additional field tests for slump, concrete temperature and ambient temperature.
 - f. 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 City Engineer, 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 Engineer or City Engineer.
 - 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 Engineer or City Engineer, or the independent commercial testing laboratory selected by the City Engineer.
 - c. Replace concrete work judged inadequate by core tests, structural analysis or load tests at no additional cost to the Owner.
 - d. Core Tests:
 - i. 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.
 - ii. 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 Engineer and City Engineer 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.
 - iii. 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.
 - iv. Patch core holes in accordance with Section 03345 - Concrete Finishing.
 - e. Structural Analysis: When core tests are inconclusive or impractical to obtain, the Engineer or City Engineer 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 City Engineer 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 weather-tight 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 nonstable 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 PRODUCTS

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 Engineer and City Engineer 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 five 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 City Engineer, 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 three drying shrinkage test specimens and six 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 three compression test cylinders at 7 days and three at 28 days. Average compressive strength for the three 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 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 Engineer and City Engineer, 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:

<u>Concrete Type</u>	<u>Minimum Slump</u>	<u>Maximum Slump</u>
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:

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<u>Class (Normal- weight)</u>	<u>Minimum 28-Day Compressive Strength (psi)</u>	<u>Minimum Cement Content Pounds per Cubic Yard</u>
Concrete for Structures Containing Water or Wastewater		
A	4000	564 (6 Sacks)
B	1500	329 (3-1/2 Sacks)
C	3000	470 (5 Sacks)
D	5000	658 (7 Sacks)
H	3000	611 (6-1/2 Sacks)
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
<u>Class (Light- weight)</u>	<u>Minimum 28-Day Compressive Strength (psi)</u>	<u>Minimum Cement Content Pounds per Cubic Yard</u>
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: Unreinforced 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 BB: Unreinforced 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. Batch Mixing at Site:
1. Mix concrete in batch mixer conforming to requirements of CPMB "Concrete Plant Mixer Standards". Use mixer equipped with suitable charging hopper, water storage tank and water measuring device. Batch mixer shall be capable of mixing aggregates, cement and water into uniform mass within specified mixing time, and of discharging mix without segregation. Operate mixer according to rated capacity and recommended revolutions per minute printed on manufacturer's rating plate.
 2. Charge batch into mixer so some water will enter before cement and aggregates. Keep water running until one-fourth of specified mixing time has elapsed. Provide controls to prevent discharging until required mixing time has elapsed. When concrete of normal weight is specified, provide controls to prevent addition of water during mixing. Discharge entire batch before mixer is recharged.
 3. Mix each batch of two cubic yards or less for not less than 1 minute and 30 seconds. Increase minimum mixing time 15 seconds for each additional cubic yard or fraction of cubic yard.
 4. Keep mixer clean. Replace pick-up and throw-over blades in drum when they have lost 10 percent of original depth.
- D. 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.
- E. 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 EXECUTION

3.01 SPECIAL CONSIDERATIONS

- A. Concreting Under Water: Not permitted except where shown otherwise on Drawings or approved by the Engineer and City Engineer. When shown or permitted, deposit concrete under water by methods acceptable to the Engineer and City Engineer 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 Engineer's and City Engineer'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 judgement of the Engineer and City Engineer, 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 Engineer and City Engineer.
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 Engineer's and City Engineer'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 Engineer and City Engineer. 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 groundwater, if required, are subject to the Engineer's and City Engineer'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 City Engineer. Notify the Engineer and City Engineer 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 Engineer and City Engineer. 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. Scream 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.
- H. 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.

3.04 PUMPING OF CONCRETE

- A. If pumped concrete does not produce satisfactory results, in the judgement of the Engineer or City Engineer, 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 Engineer and City Engineer. 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 Engineer and City Engineer 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 Engineer and City Engineer.
- 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 and City Engineer.

END OF SECTION

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Coordinate this specification with other related specifications including the following related Sections.

RELATED SECTIONS

Section 03100 - Concrete Formwork.

Section 03210 - Reinforcing Steel.

Section 03250 - Joints in Concrete Structures.

Section 03345 - Concrete Finishing.

Section 03370 - Concrete Curing.

- B. This section must be used in combination with the related sections listed above as a group for reinforced concrete for buildings, lift stations, hydraulic structures, etc. Where a project has only minor concrete placements such as manhole bases, small vaults, slabs on grade, etc., Section 03305 - Concrete for Utility Construction may be used as a stand-alone section replacing this section and the five related sections.

END OF NOTES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

- A. Concrete seal slabs.

1.02 UNIT PRICES

- A. Measurement for seal slabs is on a cubic-yard basis, calculated from the measured surface area of slabs, in place, multiplied by slab depths indicated on the Drawings.
- B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

- A. Conform to Section 01300 - Submittals.
- B. Submit design mix and test data, prepared by a certified independent testing laboratory employed and paid by the Contractor, for each type and strength of concrete in the project. Include manufacturer's technical information for each type of admixture proposed for use on the project.

PART 2 P R O D U C T S

2.01 MATERIALS

- A. Concrete: Class B concrete with a minimum compressive strength at 28 days of 1500 psi, conforming to Section 03305 - Concrete for Utility Construction, or 03310 - Structural Concrete.

PART 3 E X E C U T I O N

3.01 PLACEMENT OF SEAL SLABS

- A. Place seal slabs at locations indicated on Drawings or as directed by the Engineer or City Engineer.
- B. Excavate trench or other excavation to depth required for pipe or other installation, plus depth of seal slab. Do not over-excavate.
- C. Place seal slabs within 4 hours of excavation to final grade.

END OF SECTION

SECTION 03311

CITY OF VICTORIA
STANDARD SPECIFICATIONS

SEAL SLABS

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Use of this section should be infrequent. Normally, seal slabs for lift stations and manholes are included in the price for structures, and this section is not needed. Use this section only where seal slabs must be priced separately. Concrete for seal slabs is defined in Section 03305 – concrete for Utility Construction and Minor Paving and Section 03310 – Structural Concrete. If this section is used in combination with structures where seal slabs are not separately priced, modify Paragraph 1.02 - Measurement and Payment to clarify this and prevent duplication of payment.

END OF NOTES

PART 1 DESCRIPTION

1.01 SCOPE

- A. This specification shall govern for all work necessary for coating the interior for the wet well by monolithic spray application of a high build, solvent-free epoxy coating to provide corrosion protection. This specification is a performance specification as defined in Section 1D General Condition, Subsection "Supplemental General Conditions," Art. SC-1 Definitions.

1.02 SECTION INCLUDES

- A. Requirements for surface preparation, repairs and solvent-free epoxy coating application to specified surfaces.

1.03 REFERENCES

- A. ASTM D638 – Tensile Properties of Plastics.
- B. ASTM D790 – Flexural Properties of Unreinforced and Reinforced Plastics.
- C. ASTM D695 – Compressive Properties of Rigid Plastics.
- D. ASTM D4541 – Pull-off Strength of Coatings Using Portable Adhesion Tester.
- E. ASTM D2584 – Volatile Matter Content.
- F. ASTM D2240 – Durometer Hardness, Type D.
- G. ASTM D543 – Resistance of Plastics to Chemical Reagents.
- H. ASTM C109 – Compressive Strength Hydraulic Cement Mortars.
- I. ACI 506.2-77 – specifications for Materials, Proportioning and Application of Shotcrete.
- J. ASTM C579 – Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.
- K. ASTM – The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
- L. NACE – The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.
- M. SSPC – The published standards of the Society of Protective Coatings, Pittsburgh, PA.
- N. Los Angeles County Sanitation District – Evaluation of Protective Coatings for Concrete
- O. SSPWC 210-2.3.3 – Chemical resistance testing published in the Standard Specifications for Public Works Construction, 1997 edition (otherwise known as "The Greenbook")

1.04 SUBMITTALS

- A. The following items shall be submitted:
 - 1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.

2. Material Safety Data Sheets (MSDS) for each product used.
3. Project specific guidelines and recommendations.
4. Applicator Qualifications:
 - a. Manufacturer certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.
 - b. Certification by the protective coating manufacturer that the equipment to be used for applying the products has been approved and Applicator personnel have been trained and certified for proper use of the equipment.
 - c. Three (3) years contracting experience under current company name and three (3) recent references of projects of similar size and scope. Applicator must also provide references indicating successful application on underground concrete or masonry substrates of a minimum 15,000 sf of 100% solids, high-build solvent-free epoxy coating by heated, plural component spray application.
 - d. Proof of any necessary federal, state or local permits or licenses necessary for the project.
5. Design details for any additional ancillary systems and equipment to be used is site and surface preparation, application and testing.
6. Or Equal Submittal: In order to be considered as an equal product, said product will have to meet the minimum characteristics as measure by the applicable ASTM standards referenced in paragraph 2.04 as measured by the applicable ASTM standards reference in paragraph 1.03. Testing results must be performed and presented by a bonded, third-party testing laboratory.

Note: Equal products must be approved a minimum of two (2) weeks prior to bid date. In order for a product to be considered equal the submitted product must provide proof of successfully passing the Los Angeles County Sanitation Districts Coating Evaluation Study and evidence from the City of Los Angeles Department of General Services Standards Division indicating the Department tested and the product "passed" SSPWC Section 210-2.3 Chemical Resistance Test. An applicator that has been trained and certified by the manufacturer must install all products.

Prior pre-approval is required to determine if the prospective product may be bid on this project. A product may be rejected as unacceptable should submittal to Owner not be received a minimum of two (2) weeks prior to bid date.

1.05 QUALITY ASSURANCE

- A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the epoxy coating manufacturer's recommendations.
- B. A NACE certified coating inspector ("Inspector") shall be provided by Owner. The Inspector will observe surface preparation, application and material handling procedures to ensure adherence to the specifications.

1.06 STORAGE AND HANDLING

- A. Products are to be kept dry, protects from weather and stored under cover.

- B. Products are to be stored and handled according to their material safety data sheets.

1.07 SITE CONDITIONS

- A. Applicator shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.
- B. **Products shall not be applied if the temperature is rising, this causes the concrete to out gas, affecting the product application.**

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. New concrete as defined in Specification 3A Normal Weight Concrete.
- B. Cementitious patching and repair materials should not be used unless proof of suitability and procedures for topcoating with an epoxy coating are approved by the epoxy coating manufacturer. Project specific submittals should be provided including application, cure time and surface preparations procedures which permit optimum bond strength with the epoxy coating.

2.02 EPOXY COATING MANUFACTURER

- A. Raven Lining Systems, Inc., Tulsa, Oklahoma 800-324-2810 or 918-584-2810 or FAX 918-582-4311.
- B. Polibrid Coatings, Inc., 6700 FM 802, Brownsville, Texas 78521, (956) 831-7818.
- C. Pre-approved equal.

2.03 REPAIR MATERIALS

- A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild to a flat surface, etc. as determined necessary by the Owner and epoxy coating applicator. Repair materials must be compatible with the specified epoxy coating and shall be applied in accordance with the manufacturer's recommendations.
- B. The following products may be accepted and approved as compatible repair basecoat materials for epoxy topcoating for use within the specifications:
 - 1. 100% solids, solvent-free epoxy grout specifically formulated for epoxy topcoating compatibility. The epoxy grout manufacturer shall provide instruction for trowel or spray application and for epoxy topcoating procedures.
 - 2. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowelled or pneumatically spray applied may be approved if specifically formulated to be suitable for epoxy topcoating.

2.04 EPOXY COATING

- A. EPOXY PRIMER: The primer shall be a flexible, moisture-tolerant, 80% solids, modified amine-adduct epoxy that can be applied to concrete, carbon steel or aluminum substrates. It shall be a two component system in a 2 parts resin (Side A) to 1 part hardener (Side B) ratio by volume (2A:1B) capable of being applied at the specified film thickness in a single application.

- B. TOPCOAT: A 100% solids, solvent-free two-component epoxy resin system thixotropic in nature and filled with select fillers to minimize permeability and provide sag resistance acceptable to these specifications.

Product Type	Amine cured epoxy
Color	Light Blue
Solids Content (vol %)	100
Mix Ratio	3:1
Compressive Strength, psi	18,000
Tensile Strength, psi	7,600
Tensile Elongation, %	1.50
Flexural Modulus, psi	600,000
Hardness, Type D	88
Bond Strength – Concrete	>Tensile Strength of Concrete
Chemical Resistance:	
Severe Municipal Sewer:	All types of service
Successful Pass:	Sanitation District of L.A. County Coating Evaluation Study or SSPWC 210.2.3.3

2.05 EPOXY COATING APPLICATION EQUIPMENT

- A. Manufacturer approved heated plural component spray equipment shall be used in the application of the specified epoxy coating.

2.06 REPAIR MATERIAL SPRAY APPLICATION EQUIPMENT (if spray applied)

- A. Spray applied repair materials shall be applied with manufacturer approved equipment.

PART 3 EXECUTION

3.01 ACCEPTABLE APPLICATORS

- A. Repair material applicators shall be trained to properly apply the cementitious mortar according to manufacturer's recommendations.
- B. Epoxy coating must be applied by a Certified Applicator of the epoxy coating manufacturer and according to manufacturer specifications.

3.02 EXAMINATION

- A. All structures to be coated shall be readily accessible to Applicator.
- B. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.
- C. Any active flows shall be dammed, plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated. Flows should be totally plugged and/or diverted when coating the invert. All extraneous flows into the manhole or vaults at or above the area coated shall be plugged and/or diverted until the epoxy has set hard to the touch.
- D. Installation of the epoxy coating shall not commence until the concrete substrate has properly cured in accordance with these specifications.

- E. Temperature of the surface to be coated should be maintained between 40 deg F and 120 deg F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. **Application cannot begin if the temperature is and/or is forecast to be rising, temperature of the substrate must be stabilized to prevent out gassing.**

3.03 SURFACE PREPARATION

- A. Applicator shall inspect all specified surfaces prior to surface preparation. Applicator shall notify Owner of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair material and/or epoxy coating.
- B. Applicator shall perform all surface preparation and epoxy coating installation.
- C. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts or other contaminants shall be removed. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.
- D. Surface preparation method(s) should be based upon the conditions of the substrate, service environment and the requirements of the repair materials and/or epoxy coating to be applied. Surfaces to received repair materials and/or epoxy coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the repair materials and/or epoxy coating and the substrate.
- E. Infiltration shall be stopped by using a material which is compatible with the repair materials and is suitable for topcoating with the epoxy coating.
- F. All surfaces should be inspected by the Inspector during and after preparation and before the repair material is applied.

3.04 APPLICATION OF REPAIR MATERIALS

- A. Areas where structural steel has been exposed or removed shall be repaired in accordance with the Owner's recommendations.
- B. Repair materials shall meet the specifications herein. The materials shall be trowel or spray applied utilizing proper equipment on to specified surfaces. The material thickness shall be specified by the Owner according to the projects' requirements and manufacturer's recommendations.
- C. Cementitious repair materials shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the epoxy coating. No bugholes or honeycomb surfaces should remain.
- D. The repair materials shall be permitted to cure according to manufacturer recommendations. Curing compounds should not be used unless approved for compatibility with the specified epoxy coating.
- E. After abrasive blast and leak repair is performed, all surfaces shall be inspected for remaining laitance prior to epoxy coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shotblast or other approved method. If repair materials are used, refer to these specifications for surface preparations. Areas to be coated must also be prepared in accordance with these specifications after receiving a cementitious repair material and prior to application of the epoxy coating.

- F. All surfaces should be inspected by Inspector during and after preparation and before the epoxy coating is applied.

3.05 APPLICATION OF EPOXY COATING

- A. Application procedures shall conform to the recommendations of the epoxy coating manufacturer, including material handling, mixing, environmental controls during application, safety and spray equipment.
- B. The spray equipment shall be specifically designed to accurately ratio and apply the specified epoxy coating materials and shall be regularly maintained and in proper working order.
- C. The epoxy coating material must be spray applied by a Certified Applicator of the epoxy coating manufacturer.
- D. Specified surfaces shall be coated by spray application of a moisture tolerant, solvent-free primer and 100% solids, epoxy coating as further described herein. The topcoat shall not be applied until solvent in primer has evaporated completely and it has set-up to a tack-free condition. Spray application shall be to a minimum wet and dry film thickness as defined below:

Concrete, New/Smooth Lift Stations Wet Wells or Junction Boxes:	125 mils average, thicker coating may be required based upon prepared surface profile

Concrete, New/Smooth Deep Tunnel Shafts or RCP Pipe:	125 mils average, thicker coating may be required based upon prepared surface profile.

- E. If necessary, subsequent topcoating or additional coats of the epoxy coating should occur as soon as the basecoat becomes tack free, but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.
- F. Fiberglass woven-roving fabric may be rolled into the resin or chopped glass spray applied with the resin for added tensile and flexural strength where desired.

3.06 TESTING AND INSPECTION

- A. During application, Applicator shall regularly perform and record epoxy coating thickness readings with a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, to ensure a monolithic coating and uniform thickness during application. A minimum of three readings per 200 square foot area shall be recorded. Applicator will submit all documentation on thickness readings to Inspector on a daily basis when coating application occurs.
- B. Laboratory shall perform holiday detection on all surfaces coated with the epoxy coating in the presence of Inspector. After the epoxy coating has set hard to the touch, surfaces shall first be dried, an induced holiday may then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark test shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO 188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional epoxy coating material can be hand applied to the repair

- area. All touch-up/repair procedures shall follow the epoxy coating manufacturer's recommendations. (Note: This procedure is sometimes difficult or impossible to perform in tight manhole or vault structures or may provide unreliable readings when testing coatings applied to concrete.)
- C. Upon Owner's request, a minimum of 10% of the total structure coated may be subjected to random adhesion (bond) testing per this section. Measurement of bond strength of the epoxy coating to the substrate may be examined in the accordance with ASTM D4541. Any areas detected to have inadequate bond strength shall be evaluated by the Owner.
- The adhesion (bond) testing shall be conducted by using 3 test dolly per structure. One test dolly shall be affixed within 2 ft of the bench area/bottom of structure, one test dolly shall be affixed in the middle of the structures wall area and the final test dolly shall be affixed within two foot of the top of the chimney area/top of the structure. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Applicator in strict accordance with manufacturer's recommendations.
- D. A final visual inspection shall be made by the Inspector and Applicator. Any deficiencies in the finished coating shall be marked and repaired by Applicator according to the procedures set forth herein.

END OF SECTION

PART 1 G E N E R A L**1.01 SECTION INCLUDES**

- A. Repairing surface defects.
- B. Finishing concrete surfaces including both formed and unformed surfaces.
- C. Sealing concrete surfaces.
- D. Installation of concrete fill and installation of concrete topping in bottoms of clarifiers and thickeners.

1.02 UNIT PRICES

- A. No separate payment will be made for concrete finishing under this Section. Include payment in unit price for structural concrete.

1.03 SUBMITTALS

- A. Conform to Section 01300 - Submittals.
- B. Submit manufacturer's technical literature on the following products proposed for use. Include manufacturer's installation and application instructions and, where specified, manufacturer's certification of conformance to requirements and suitability for use in the applications indicated.
 - 1. Floor hardener.
 - 2. Sealer.
 - 3. Epoxy floor topping.
 - 4. Epoxy penetrating sealer.
 - 5. Latex bonding agent.
 - 6. Epoxy adhesive.
 - 7. Abrasive aggregate.
 - 8. Evaporation retardant.

PART 2 P R O D U C T S**2.01 MATERIALS**

- A. Sealer/Dustproofer (VOC Compliant): Water-based acrylic sealer; non-yellowing under ultraviolet light after 200-hour test in accordance with ASTM D4587. Conform to local, state and federal solvent emission requirements.
- B. Epoxy Floor Topping: Two-component epoxy resin meeting ASTM C881 Type III, resistant to wear, staining and chemical attack, blended with granite, sand, trap rock or quartz aggregate, trowel-applied over concrete floor. Topping thickness, 1/8 inch; color, gray.
- C. Abrasive Aggregate for Nonslip Finish: Fused aluminum oxide grit, or crushed emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Material shall be factory graded, packaged, rustproof and nonglazing, and unaffected by freezing, moisture and cleaning materials.
- D. Epoxy Penetrating Sealer: Low-viscosity, two-component epoxy system designed to give maximum penetration into concrete surfaces. Sealer shall completely seal concrete surfaces from penetration of water, oil and chemicals; prevent dusting and deterioration of concrete

surfaces caused by heavy traffic; and be capable of adhering to floor surfaces subject to hydrostatic pressure from below. Color, transparent amber or gray; surface, nonslip.

- E. Latex Bonding Agent: Non-redispersable latex base liquid conforming to ASTM C1059. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.
- F. Bonding Grout: Prepare bonding grout by mixing approximately one part cement to one part fine sand meeting ASTM C144 but with 100 percent passing No. 30 mesh sieve. Mix with water to consistency of thick cream. At Contractor's option, a commercially prepared bonding agent used in accordance with manufacturer's recommendations and instructions may be used. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required. Submit manufacturer's technical information on proposed bonding agent.
- G. Patching Mortar:
 - 1. Make patching mortar of same materials and of approximately same proportions as concrete, except omit coarse aggregate. Substitute white Portland cement for part of gray Portland cement on exposed concrete in order to match color of surrounding concrete. Determine color by making trial patch. Use minimum amount of mixing water required for handling and placing. Mix patching mortar in advance and allow to stand. Mix frequently with trowel until it has reached stiffest consistency that will permit placing. Do not add water.
 - 2. Proprietary compounds for adhesion or specially formulated cementitious repair mortars may be used in lieu of or in addition to foregoing patching materials provided that properties of bond and compressive strength meet or exceed the foregoing and color of surrounding concrete can be matched where required. Use such compounds according to manufacturer's recommendations. When used in water and wastewater treatment structures, material shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.
- H. Epoxy Adhesive: Two-component, 100 percent solids, 100 percent reactive compound developing 100 percent of strength of concrete, suitable for use on dry or damp surfaces. Epoxy used to inject cracks and as a binder in epoxy mortar shall meet ASTM C881, Type VI. Epoxy used as a bonding agent for fresh concrete shall meet ASTM C881, Type V.
- I. Non-shrink Grout: See Section 03600 - Structural Grout.
- J. Spray-Applied Coating: Acceptable products are Thoro System Products "Thoroseal Plaster Mix" or equal. Color: Gray.
- K. Concrete Topping: Class H concrete with 3/8-inch maximum coarse aggregate size, as specified in Section 03310 - Structural Concrete.
- L. Concrete Fill: Class H concrete with 3/8-inch maximum coarse aggregate size, (Class C where fill thickness exceeds 3 inches throughout a placement), as specified in Section 03310 - Structural Concrete.
- M. Evaporation Retardant: Confilm, manufactured by Master Builders; Eucobar, manufactured by Euclid Chemical Company; or equal.

PART 3 EXECUTION

3.01 AGGREGATE CONCEALMENT

- A. Unless indicated otherwise on Drawings or approved by the Engineer and City Engineer, all surfaces to be finished shall be free of exposed aggregate.

3.02 REPAIRING SURFACE DEFECTS

- A. Defective Areas: Repair immediately after removal of forms. Remove honeycombed and other defective concrete down to sound concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to concrete surface. Thoroughly work bonding grout into the surface with a brush so that the entire surface is covered. Alternatively, a proprietary bonding agent may be used. Use bonding agent in accordance with manufacturer's instructions. While bonding coat is still tacky, apply premixed patching mortar. Thoroughly consolidate mortar into place and strike off to leave patch slightly higher than surrounding surface. To permit initial shrinkage, leave undisturbed for at least 1 hour before final finishing. Keep patched area damp for 7 days. Alternatively, a proprietary cementitious repair mortar may be used and placed in accordance with manufacturer's instructions. Do not use metal tools in finishing patches in formed walls which will be exposed.
- B. Tie Holes: Patch holes immediately after removal of forms. After cleaning and roughening with a wire brush on a rotary drill, thoroughly dampen tie hole and fill solid with patching mortar. Taper tie holes shall have the plug, specified in 03100 - Concrete Formwork, driven into the hole to the center of the wall before grouting. Completely fill taper tie holes with patching mortar except that non-shrink grout shall be used for all walls in contact with soil or liquid. On wall faces exposed to view, fill the outer 2 inches of the taper tie hole with patching mortar blended to match adjacent concrete.
- C. Cracks: Repair cracks in excess of 0.01 inch by pressure injection of moisture-insensitive epoxy-resin system. Submit proposed material and method of repair for approval prior to making repairs.
- D. Structural Repair: When required, make structural repairs after prior approval of the Engineer and City Engineer as to method and procedure, using specified epoxy adhesive or approved epoxy mortar.

3.03 FINISHING OF FORMED SURFACES

- A. Unfinished Surfaces: Finish is not required on surfaces concealed from view in completed structure by earth, ceilings or similar cover, unless indicated otherwise on Drawings.
- B. Rough Form Finish:
 - 1. No form facing material is required on rough form finish surfaces.
 - 2. Patch tie holes and defects. Chip off fins exceeding 1/4 inch in height.
 - 3. Rough form finish may be used on concrete surfaces which will be concealed from view by earth in completed structure, except concealed surfaces required to have smooth form finish, as shown on Drawings.
- C. Smooth Form Finish:
 - 1. Form facing shall produce smooth, hard, uniform texture on concrete. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.
 - 2. Patch tie holes and defects. Rub fins and joint marks with wooden blocks to leave smooth, unmarred finished surface.
 - 3. Provide smooth form finish on the wet face of formed surfaces of water-holding structures, and of other formed surfaces not concealed from view by earth in completed structure, except where otherwise indicated on Drawings. Walls that will be exposed

after future construction, at locations indicated on Drawings, shall have smooth form finish. Smooth form finish on exterior face of exterior walls shall extend 2 feet below final top of ground elevation. Exterior face of all perimeter grade beams shall have smooth form finish for full depth of grade beam.

D. Rubbed Finish:

1. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.
2. Remove forms as soon as practicable, repair defects, wet surfaces, and rub with No. 16 carborundum stone or similar abrasive. Continue rubbing sufficiently to bring surface paste, remove form marks and fins, and produce smooth, dense surface of uniform color and texture. Do not use cement paste other than that drawn from concrete itself. Spread paste uniformly over surface with brush. Allow paste to reset, then wash surface with clean water.
3. Use rubbed finish at locations indicated on Drawings, except where rubbed finish is indicated for a wall which will be containing a liquid, use spray-applied coating.

E. Spray-applied Coating: At Contractor's option, in lieu of rubbed finish, spray-applied coating may be applied after defects have been repaired and fins removed. Remove form oil, curing compound and other foreign matter that would prevent bonding of coating. Apply coating in uniform texture and color in accordance with coating manufacturer's instructions.

F. Related Unformed Surfaces: Tops of piers, walls, bent caps, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed. Float unformed surfaces to texture reasonably consistent with that of formed surfaces. Continue final treatment on formed surfaces uniformly across unformed surfaces.

3.04 HOT WEATHER FINISHING

- A. When hot weather conditions exist, as defined by Section 03310 - Structural Concrete and as judged by the Engineer or City Engineer, apply evaporation retardant to the surfaces of slabs, topping and concrete fill placements immediately after each step in the finishing process has been completed.

3.05 FINISHING SLABS AND SIMILAR FLAT SURFACES TO CLASS A, B AND C TOLERANCES

- A. Apply Class A, B and C finishes at locations indicated on Drawings.
- B. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. See Section 03100 - Concrete Formwork for edge forms and screeds.
- C. Consolidation and Leveling: Concrete to be consolidated shall be as stiff as practicable. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not permit manipulation of surfaces prior to finishing operations.
- D. Tolerances for Finished Surfaces: Check tolerances by placing straightedge of specified length anywhere on slab. Gap between slab and straightedge shall not exceed tolerance listed for specified class.

<u>Class</u>	<u>Straightedge Length in Feet</u>	<u>Tolerance in Inches</u>
A	10	1/8
B	10	1/4
C	2	1/4

- E. Raked Finish: After concrete has been placed, struck off, consolidated and leveled to Class C tolerance, roughen surface before final set. Roughen with stiff brushes or rakes to depth of approximately 1/4 inch. Notify the Engineer and City Engineer prior to placing concrete requiring initial raked surface finish so that acceptable raked finish standard may be established for project. Protect raked, base-slab finish from contamination until time of topping. Provide raked finish for following:
1. Surfaces to receive bonded concrete topping or fill.
 2. Steep ramps, as noted on Drawings.
 3. Additional locations as noted on Drawings.
- F. Float Finish:
1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.
 2. After initial floating, re-check tolerance of surface with 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots to Class B tolerance. Immediately re-float slab to a uniform, smooth, granular texture.
 3. Provide float finish at locations not otherwise specified and not otherwise indicated on Drawings.
- G. Trowel Finish:
1. Apply float finish as previously specified. After power floating, use power trowel to produce smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional troweling by hand after surface has hardened sufficiently. Do final troweling when ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling operations.
 2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to Class A tolerance. On surfaces intended to support floor coverings, remove defects which might show through covering by grinding.
 3. Provide trowel finish for floors which will receive floor covering and additional locations indicated on Drawings.
- H. Broom or Belt Finish:
1. Apply float finish as previously specified. Immediately after completing floated finish, draw broom or burlap belt across surface to give coarse transverse scored texture.
 2. Provide broom or belt finish at locations indicated on Drawings.

3.06 FINISHING SLABS AND SIMILAR FLAT SURFACES TO "F-NUMBER SYSTEM" FINISH

- A. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. Edge forms and screeds: Conform to Section 03100 - Concrete Formwork.
- B. Consolidation and Leveling: Concrete to be consolidated shall be as dry as practicable. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors

- with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not manipulate surfaces prior to finishing operations.
- C. Tolerances for Finished Surfaces: Independent testing laboratory will check floor flatness and levelness in accordance with Paragraph 3.12, Field Quality Control.
- D. Float Finish:
1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.
 2. Check tolerance of surface after initial floating with a 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots. Immediately refloat slab to uniform, smooth, granular texture to F_F20/F_L17 tolerance, unless shown otherwise on Drawings.
 3. Provide "F-Number System" float finish at locations indicated on Drawings.
- E. Trowel Finish:
1. Apply float finish as previously specified. After power floating, use power trowel to produce smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional trowelings by hand after surface has hardened sufficiently. Do final troweling when ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling operations.
 2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to an F_F25/F_L20 tolerance for slabs on grade and F_F25/F_L17 for elevated slabs, unless shown otherwise on Drawings. On surfaces intended to support floor coverings, remove defects, which might show through covering, by grinding.
 3. Provide "F-Number System" trowel finish at locations indicated on Drawings.
- 3.07 BONDED CONCRETE TOPPING AND FILL
- A. Surface Preparation:
1. Protect raked, base-slab finish from contamination until time of topping. Mechanically remove oil, grease, asphalt, paint, clay stains or other contaminants, leaving clean surface.
 2. Prior to placement of topping or fill, thoroughly dampen roughened slab surface and leave free of standing water. Immediately before topping or fill is placed, scrub coat of bonding grout into surface. Do not allow grout to set or dry before topping or fill is placed.
- B. Concrete Fill:
1. Where concrete fill intersects a wall surface at an angle steeper than 45 degrees from vertical, provide a 1.5-inch deep keyway in the wall at the point of intersection; size keyway so that no portion of the concrete fill is less than 1.5 inches thick. Form keyway in new walls; create by saw cutting the top and bottom lines and chipping in existing walls.
 2. Apply wood float finish to surfaces of concrete fill.
 3. Provide concrete fill at locations shown on Drawings.
- C. Bonded Concrete Topping in Bottom of Clarifiers and Thickeners:
1. Minimum thickness of concrete topping: 1 inch. Maximum thickness when swept in by clarifier and thickener equipment: 3 inches.
 2. Compact topping and fill by rolling or tamping, bring to established grade, and float. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. Coat surface with evaporation retardant as needed between finishing operations to prevent plastic shrinkage cracks.

3. Screed topping to true surface using installed equipment. Protect equipment from damage during sweeping-in process. Perform sweeping-in process under supervision of equipment manufacturer's factory representative. After topping has been screeded, apply wood float finish. During finishing, do not apply water, dry cement or mixture of dry cement and sand to the surface.
4. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Engineer or City Engineer, fill the tank with sufficient water to cover the entire floor for 14 days.
5. Provide bonded concrete topping in bottom of all clarifiers and thickeners.

3.08 EPOXY PENETRATING SEALER

- A. Surfaces to receive epoxy penetrating sealer: Apply wood float finish. Clean surface and apply sealer in compliance with manufacturer's instructions.
- B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: Apply minimum 2-inch-high coverage of floor coating on vertical surface.
- C. Mask walls, doors, frames and similar surface to prevent floor-coating contact.
- D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.
- E. Provide epoxy-penetrating sealer at locations indicated on Drawings.

3.09 EPOXY FLOOR TOPPING

- A. Surfaces to receive epoxy floor topping: Apply wood float finish unless recommended otherwise by epoxy floor topping manufacturer. Clean surface and apply epoxy floor topping in compliance with manufacturer's recommendations and instructions. Thickness of topping: 1/8 inch.
- B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: apply 2-inch-high coverage of floor coating on vertical surface.
- C. Mask walls, doors, frames and similar surfaces to prevent floor-coating contact.
- D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.
- E. Finished surface shall be free of trowel marks and dimples.
- F. Provide epoxy floor topping at locations indicated on Drawings.

3.10 SEALER/DUSTPROOFER

- A. Where sealer or sealer/dustproofers is indicated on Drawings, just prior to completion of construction, apply coat of specified clear sealer/dustproofing compound to exposed interior concrete floors in accordance with manufacturer's instructions.

3.11 NONSLIP FINISH

- A. Apply float finish as specified. Apply two-thirds of required abrasive aggregate by method that ensures even coverage without segregation and re-float. Apply remainder of abrasive aggregate at right angles to first application, using heavier application of aggregate in areas not sufficiently covered by first application. Re-float after second application of aggregate and complete operations with troweled finish. Perform finishing operations in a manner that will allow the abrasive aggregate to be exposed and not covered with cement paste.
- B. Provide nonslip finish at locations indicated on Drawings.

3.12 FIELD QUALITY CONTROL

- A. Flatness and levelness of slabs and similar flat surfaces that are indicated on Drawings to receive "F-Number System" finish will be checked by independent testing laboratory employed by Owner in accordance with Section 01410 - Testing Laboratory Services.
- B. Tolerances for "F-Number System" finished surfaces:
 - 1. Floor tolerance shall be determined in accordance with ASTM E1155.
 - 2. Floor flatness and levelness tolerances:
 - a. F_F defines maximum floor curvature allowed over 24 inches. Computed on the basis of successive 12-inch elevation differentials, F_F is commonly referred to as the "flatness F-Number."

$$F_F = \frac{4.57}{\text{Maximum difference in elevation, in decimal inches, between successive 12" elevation differences.}}$$

- b. F_L defines relative conformity of floor surface to horizontal plane as measured over 10-foot distance. F_L is commonly referred to as "levelness F-number."

$$F_L = \frac{12.5}{\text{Maximum difference in elevation, in inches, between two points separated by 10 feet.}}$$

- 3. Achieve specified overall slab tolerance. Minimum local tolerance (1/2 bay, unless otherwise designated by the Engineer and City Engineer): 2/3 of specified tolerance.
 - 4. Tolerance for floated finish: FF20/ F_L 17, unless otherwise shown on Drawings.
 - 5. Tolerance for troweled finish: FF25/ F_L 20 for slabs on grade, and F_F 25/ F_L 17 for elevated slabs, unless otherwise shown on Drawings.

3.13 CURING

- A. Conform to requirements of Section 03370 - Curing Concrete.

END OF SECTION

PART 1 G E N E R A L**1.01 SECTION INCLUDES**

- A. Curing of structural concrete.

1.02 UNIT PRICES

- A. No separate payment will be made for concrete curing under this Section. Include payment in unit price for structural concrete.

1.03 DEFINITIONS

- A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

1.04 SUBMITTALS

- A. Conform to Section 01300 - Submittals.
- B. Product Data: Submit description of proposed curing method for concrete. When use of membrane-forming compound is proposed, submit manufacturer's technical information including material specifications, installation instructions and recommendations, and evidence that compound is satisfactory for intended application. State locations where curing compound will be used.
- C. When membrane-forming compounds are to be used, submit certification by the manufacturer of compliance with specified requirements and compatibility with toppings, coatings, finishes, and adhesives to be applied.

PART 2 P R O D U C T S**2.01 MATERIALS**

- A. Membrane-forming Curing Compound: Conform to ASTM C309, Type 1D, and following requirements.
 - 1. Minimum solids content: 30 percent.
 - 2. Compound shall not permanently discolor concrete. When used for liquid- containing structures, curing compound shall be white-pigmented.
 - 3. When used in areas that are to be coated, or that will receive topping or floor covering, material shall not reduce bond of coating, topping, or floor covering to concrete. Curing compound manufacturer's technical information shall state conditions under which compound will not prevent bond.
 - 4. Conform to local, state and federal solvent emission requirements.
- B. Clear Curing and Sealing Compound (VOC Compliant): Conform to ASTM C309, Type 1, Class B, and the following requirements: 30 percent solids content minimum; non-yellowing under ultraviolet light after 500-hour test in accordance with ASTM D4587. Sodium silicate compounds are not permitted. Conform to local, state and federal solvent emission requirements.
- C. Sheet Material for Curing Concrete: ASTM C171; waterproof paper, polyethylene film or white burlap-polyethylene sheeting.
- D. Curing Mats (for use in Curing Method 2): Heavy shag rugs or carpets, or cotton mats quilted at 4 inches on center; 12 ounce per square yard minimum weight when dry.

- E. Water for curing: Clean and potable.

PART 3 EXECUTION

3.01 CURING PROCEDURES

- A. Comply with ACI 308 and the requirements specified herein. Protect freshly deposited concrete from premature drying and excessively hot or cold temperatures. Maintain minimal moisture loss and relatively constant temperature during time necessary for hydration of cement and proper hardening of concrete.
- B. Unformed Surfaces: For concrete surfaces not in contact with forms, use one of following procedures immediately after completion of placement and finishing.
1. Ponding or continuous sprinkling.
 2. Absorptive mat or fabric kept continuously wet.
 3. Sand or other covering kept continuously wet.
 4. Continuous steam bath (not exceeding 150 degrees F at surface of concrete).
 5. Vapor mist bath.
 6. Membrane-forming curing compound applied according to manufacturer's recommendations. After the curing compound has dried, wet slab surfaces and cover with waterproof paper, polyethylene film, or white burlap-polyethylene sheeting after the application of the curing compound. Tape sheet seams together and provide sufficient weights to keep the sheeting in place. Wet the slab surface again if the sheeting becomes dislodged, and replace the sheeting.
 7. Other moisture-retaining coverings as approved by the Engineer and City Engineer.
- C. Restrictions on Use of Curing Compounds: Unless curing compound manufacturer certifies that curing compound will not prevent bond to cured surface, do not use curing compound on surfaces that will be rubbed or receive additional concrete, mortar, topping, terrazzo or other cementitious finishing materials, on slabs under resilient floors or built-up roofing, or on surfaces to be waterproofed, sealed, hardened or painted.
- D. Curing and Sealing Compounds: At locations indicated, cure exposed interior slabs and troweled slabs receiving mastic-applied adhesives with specified clear curing and sealing compound in accordance with manufacturer's recommendations. Do not store materials directly on curing membranes. Use plywood to protect curing membrane from damage. Immediately repair membranes damaged by foot traffic or other operations.
- E. Duration of Curing: Continue curing until cumulative number of days or fractions of days during which ambient temperature is above 50 degrees F has totaled 7. Continue curing of water-retaining structures for a total of 14 days. When high-early-strength concrete has been used, continue curing for total of 3 days. Prevent rapid drying at end of curing period.
- F. Formed Surfaces: During the curing period keep wet steel forms heated by sun and wood forms in contact with concrete. When forms are to be removed during curing period, employ curing materials or methods immediately. Continue such curing for remainder of curing period.
- G. Temperature:
1. Cold Weather: When mean daily temperature of atmosphere is less than 40 degrees F, maintain temperature of concrete between 50 and 70 degrees F for required curing period. When necessary, make arrangements for heating, covering, insulating or housing concrete work in advance of placement to maintain required temperature and moisture conditions. Prevent damage or injury due to concentration of heat. When combustion

- heaters are necessary in enclosed or protected area where concrete slabs are being placed, vent heaters.
2. Hot Weather: In advance of placement make arrangements for shading, fog spraying, sprinkling, ponding or installation of windbreaks or wet covering of light color. Take such protective measures as quickly as concrete hardening and finishing operations will allow.
 3. Temperature Changes: Control so rate of change in temperature of concrete is as uniform as possible. Do not permit temperature change to exceed 5 degrees F in any one-hour or 50 degrees F in any 24-hour period.
- H. Protection from Mechanical Injury: During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration. Protect finished concrete surfaces from damage caused by construction equipment, materials or methods, and by rain or running water. Do not load self-supporting structures in a way that over stresses concrete.

3.02 CURING MASS CONCRETE

- A. Observe the following additional restrictions when curing mass concrete.
1. Minimum curing period: 2 weeks.
 2. When ambient air temperature falls below 32 degrees F, protect surface of concrete against freezing.
 3. Do not use steam or other curing methods that will add heat to concrete.
 4. Keep forms and exposed concrete continuously wet for at least the first 48 hours after placing, and whenever surrounding air temperature is above 90 degrees F during final curing period.
 5. During 2-week curing period, provide necessary controls to prevent ambient air temperature immediately adjacent to concrete from falling more than 30 degrees F in 24 hours.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-shrink grout used wherever grout is shown in the Documents, unless another type is specifically referenced. Two classes of non-shrink grout (Class I and II) and areas of application are specified.

1.02 UNIT PRICES

- A. Include the cost for grout in the lump sum for each structure in which it will be used. No separate payment will be made for grout.
- B. Measurement for extra grout (Class I and II) is on cubic foot basis. Payment includes associated work performed in accordance with related sections included in the Contract Documents.
- C. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

- A. Conform to Section 01300 - Submittals.
- B. Quality Control:
 - 1. The Contractor shall submit manufacturer's literature certifying compliance with the specified properties for Class I and II grouts.
 - 2. The Contractor shall submit manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.
- C. The Contractor shall submit manufacturer's written warranty as specified.

1.04 QUALITY ASSURANCE

- A. Field Tests:
 - 1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Engineer and City Engineer to ensure continued compliance with these Specifications. The specimens will be made by the Testing Laboratory selected by the Owner.
 - 2. Compression tests and fabrication of specimens for non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Engineer and City Engineer. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.
 - 3. Grout already placed which fails to meet the requirements of these Specifications is subject to removal and replacement no additional cost to the Owner.
 - 4. The cost of laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Testing Laboratory in obtaining specimens for testing. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The Contractor shall supply materials necessary for fabricating the test specimens.
- B. Warranty:
 - 1. Provide 1-year warranty for work provided under this Section.
 - 2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to only the purchase price of products or materials furnished.

3. Manufacturer shall warrant participation with Contractor in replacing or repairing grout found to be defective due to faulty materials, as determined by industry standard test methods.

PART 2 PRODUCTS

2.01 APPLICATION

1. The following is a listing of typical applications and the corresponding type of grout which is to be used. Unless indicated otherwise, grouts shall be provided as listed below whether or not called for on the Drawings.

<u>Application:</u>	<u>Type of Grout</u>
Structural member base plates	Non-shrink Class II
Storage tanks and other equipment	Non-shrink Class I
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-shrink Class II (Class I where placement time exceeds 15 minutes)
Under precast concrete elements	Non-shrink Class I
Toppings and concrete fill less than 3 inches thick	Concrete Topping per Section 03310 - Structural Concrete and Section 03345 – Concrete Finishing
Toppings and concrete fill greater than 3 inches thick	Concrete Fill per Section 03310 – Structural Concrete and Section 03345 – Concrete Finishing
Any application not listed above, where grout is called for on the Drawings	Non-shrink Class I, unless noted otherwise

2.02 PREPACKAGED GROUTS

A. Basic Requirements for Cementitious Non-Shrink Grout

1. Provide prepackaged non-shrink grout that is inorganic, flowable, non-gas-liberating, non-metallic, and cement-based, requiring only the addition of water.
2. Deliver grout in original packaging with manufacturer's instructions printed on each container.
3. Select the specific formulation for each class of non-shrink grout specified to conform to that recommended by the manufacturer for the particular application.
4. Compressive strength at 28 days: 7000 psi minimum.
5. Do not use a grout for which the non-shrink property is based on a chemically generated gas or gypsum expansion.

B. Class I Non-Shrink Grout:

1. Supply Class I Grout conforming to these specifications and to CRD-C621 and ASTM C1107 Grade C and B (as modified below) when tested using the amount of water needed to achieve the following properties:
 - a. Fluid consistency (20 to 30 seconds) per CRD-C611 at initial testing.
 - b. Fluid consistency (45 seconds) per CRD-C611 at 30 minutes after mixing.
 - c. At temperatures of 45, 73.4, and 95 degrees F.
2. To satisfy non-shrink requirements, the length change from placement to time of final set shall not have a shrinkage greater than the amount of expansion measured after final set

at 3 and 14 days. The expansion at 3 and 14 days shall not exceed the 28-day expansion.

3. Fluid grout shall pass through the flow cone, with a continuous flow, 1 hour after mixing.
4. Demonstrate in tests that grout maintains contact with the baseplate to provide a minimum effective bearing area of 95 percent of the gross contact area after final set.
5. The grout packaging shall list weight, maximum amount of mixing water to be used, maximum usable working time (pot life) at flowable consistency, and temperature restrictions for preparation and placement within which grout will meet specified requirements.

C. Class II Non-Shrink Grout:

1. Supply Class II Grout confirming to ASTM C1107 and the following requirements when tested using the amount of water needed to achieve the following properties:
 - a. Flowable consistency: 140 percent flow on ASTM C230, five drops in 30 seconds.
 - b. Fluid working time: 15 minutes, minimum.
 - c. Flowable duration: 30 minutes, minimum.
2. When tested, the grout shall not bleed at maximum allowed water.

2.03 CURING MATERIALS

- A. Curing materials: As specified in Section 03370 - Concrete Curing and as recommended by the manufacturer of prepackaged grouts.

2.04 CONSISTENCY

- A. Mix grouts to the consistency necessary to completely fill the space to be grouted. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that base concrete or masonry has attained design strength before grout is placed.
- B. When cementitious grouts are used on concrete surfaces, saturate the concrete surface with water for 24 hours prior to placement of cement-based grout. Upon completion of saturation period remove excess water prior to grouting.

3.02 GROUTING PROCEDURES

- A. Prepackaged Grouts: Perform mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts according to the written instructions of the manufacturer. Use prepackaged materials in the quantities and proportions as directed by the manufacturer unless there is certified test data verifying that the specified properties are attained by modified mix.

3.03 CONSOLIDATION

- A. Place grout in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. This section is intended for projects with limited application of non-shrink grouts including installation of lighter equipment (such as at lift stations). This section must be used in combination with Section 03100 - Concrete Formwork, Section 03310 - Structural Concrete, Section 03345 - Concrete Finishing, and Section 03370 - Concrete Curing. Where non-shrink grout is needed with minor concrete applications, this section can be combined with Section 03305 – Concrete for Utility Construction and Minor Paving with changes in references to Section 03310 – Structural Concrete (and related sections) to Section 03305 – Concrete for Utility Construction and Minor Paving.
- B. The grouts in this reference section include precision grouts for equipment and structural base plates and some repair, and similar applications. Any specialty grout not already covered can be added here. This section does not include grouts for masonry, tile setting, soil stabilization, tunnel lining injection, etc.

END OF NOTES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Repair of cracks, holes and surface defects, and repair of deteriorated concrete surfaces.
- B. Installation of embedded items into existing concrete.

1.02 UNIT PRICES

- A. Measurement for repair materials is on a lump-sum basis for each structure as bid. Payment includes work performed on these structures in accordance with related sections included in the Contract Documents.
- B. Measurement for extra removal of deteriorated concrete and placement of repair mortar is on a cubic-foot basis. Measurement for other repair materials is as defined in the appropriate related sections. Payment includes associated work performed in accordance with related sections included in the Contract Documents.
- C. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

- A. Under provisions of Section 01300 - Submittals, submit manufacturer's product information, installation instructions and recommendations, and certification of compliance with required properties for all repair materials.

1.04 REPAIR SCOPE

- A. Patch and fill openings in existing concrete indicated to be patched or filled.
- B. Patch, fill holes in and otherwise repair damage to concrete and concrete surfaces resulting from removal of penetrating pipes and other embedded items, from installation of pipes or other items embedded in or passed through concrete, and from other construction activities.
- C. Crack Repair: Repair the full length of cracks in concrete members in new structures, and in existing structures as follows:
- D. Deteriorated Concrete:
 - 1. Repair interior concrete surfaces showing signs of deterioration in the following existing structures:
 - 2. The level of deterioration of the concrete varies within each of the listed structures. For bidding purposes, average depth of deteriorated concrete walls and undersides of top slabs is assumed to be one inch. Repair for the portion exceeding one inch in depth, as measured from the existing wall surface, will be paid as extra work as defined above.
- E. Make other repairs to existing structures as follows:

1.05 QUALITY ASSURANCE

- A. Field Tests of Cement-based Grouts:
 - 1. Compression test specimens will be prepared during construction by the Testing Laboratory, from the first placement of each type of mortar or grout, and at intervals thereafter as determined by the Engineer and City Engineer, to ensure continued compliance with these specifications.

2. Specimen preparation and compression testing for repair mortar and non-shrink grout will be performed as specified in ASTM C109. A set of three specimens will be made for testing at 7 days, 28 days, and additional testing as appropriate.
 3. Material failing to meet Contract requirements is subject to removal, and replacement with new material meeting requirements, at no additional cost to the Owner.
 4. Cost of laboratory tests on mortar and grout will be borne by the Owner, except Contractor shall pay for tests failed, and additional testing and investigation work performed because of work not meeting Contract requirements.
 5. Contractor shall supply all materials necessary for fabricating test specimens and assist the Testing Laboratory in obtaining specimens for testing.
- B. Repair concrete shall be tested as required in Section 03310 - Structural Concrete.
- C. Epoxy grout shall be tested as required in Section 03600 - Structural Grout.
- D. Chemical Grout:
1. Installer: A waterproofing contractor with a minimum of 3 years experience in the installation of chemical grout systems as specified herein, and shall be certified or approved by the manufacturer.
 2. Waterproofing contractor shall submit a list of five previous jobs successfully completed by that firm that successfully utilized the specified chemical grout system.
- E. Construction Tolerances: As specified in Section 03100 - Concrete Formwork, and Section 03345 - Concrete Finishing, except as otherwise indicated.

PART 2 PRODUCTS

2.01 REPAIR MORTAR

- A. Repair Mortar: Prepackaged polymer-modified cement-based product specifically formulated for repair of surface defects in concrete, having the following properties:

<u>Physical Property</u>	<u>Value</u>	<u>ASTM Standard</u>
Compressive Strength	(minimum)	C109
1 day	2000 psi	
28 days	6000 psi	
Bond Strength	(minimum)	C882 (modified)
1 day	1200 psi	
7 days	2000 psi	

- B. Manufacturer and Product: Emaco by Master Builders, SR93 by Euclid Chemical Company, Sikacem by Sika Corporation, Five Star Structural Concrete by Five Star Products, Inc., or equal. Where the manufacturer offers products in formulations intended for specific application conditions such as overhead and shotcrete application, use the formulation recommended by the manufacturer for the condition required.
- C. Minimum Repair Thickness: 0.50 inch.

2.02 NON-SHRINK GROUT

- A. Non-shrink Grout: Comply with requirements of Section 03600 - Structural Grout.

2.03 CONCRETE MATERIALS

- A. Cement: Type II portland cement, unless indicated otherwise. Where repairs are made on wall surfaces exposed to view and above normal water surface elevation, blend white Portland cement with Type II cement as needed to match the color of adjacent existing concrete surface.
- B. Repair Concrete: Class A (4000-psi) concrete with one-inch maximum coarse aggregate, complying with Section 03310 - Structural Concrete; minimum repair thickness, 2 inches.
- C. Cement Grout: Comply with Section 03600 - Structural Grout; minimum repair thickness, one inch.
- D. Curing Materials, Bonding Agents and other Miscellaneous Materials: Comply with Section 03310 - Structural Concrete and Section 03370 - Concrete Curing.

2.04 AGGREGATE

- A. Aggregate for Extending Repair Mortar and Non-shrink Grout Products: 3/8 inch clean, washed gravel or crushed stone complying with Section 03310 - Structural Concrete.

2.05 CHEMICAL GROUT

- A. Chemical Grout: Hydrophobic urethane or polyurethane material of low viscosity suitable for pumped injection into cracks, which reacts with water to form a closed-cell foam material that completely fills and seals all cracks against leakage. Cured material shall remain elastic and maintain an expansive pressure through repeated wet-dry cycles.
- B. Manufacturer and Product: Scotch Seal 5600 by the Adhesives, Coatings, and Sealers Division of 3M Products; Flex LV by De Neef America, Inc.; SikaFix by Sika Corporation; or equal. Use different formulations in the same family of materials, accelerators, and other materials necessary for installation where recommended by the manufacturer for specific application conditions.
- C. Reacted and cured chemical grout shall be resistant to organic solvents, mild acids, alkali and microorganisms. Cured material shall be approved for use with potable water by the appropriate federal, state or local government agency.

2.06 EPOXY PRODUCTS

- A. Epoxy Grout: Comply with Section 03600 - Structural Grout, modified as specified herein.
- B. Epoxy for Crack Injection: ASTM C881, Type IV; low viscosity, moisture-insensitive material specifically formulated for that use; 2500 psi minimum bond strength when tested in accordance with ASTM C882 at 14 days, moist cured.

2.07 SEALANT

- A. Sealant: 2-part polyurethane complying with Section 03250 - Joints in Concrete Structures.

2.08 FORMWORK

- A. Formwork, Where Needed: Comply with Section 03100 - Concrete Formwork.

2.09 REINFORCEMENT

- A. Reinforcement, Where Required: Comply with Section 03210 - Reinforcing Steel.

2.10 RESILIENT WATERSTOP

- A. Resilient Waterstop: Comply with Section 03250 - Joints in Concrete Structures.

PART 3 EXECUTION

3.01 PREPARATION AND CURING

- A. Where repairs are made on wall surfaces exposed to view and above normal water surface elevation, installed repair material shall match adjacent concrete surface in color.
- B. Surface Preparation:
1. Clean entire area to be repaired of laitance, foreign material and loose or deteriorated concrete by chipping, hydroblasting or sandblasting; further roughen surfaces as specified herein. Where non-shrink grout or repair mortar is used, perform any additional surface preparation steps recommended by the manufacturer.
 2. Where cementitious repair materials are used, maintain surfaces to be repaired in a saturated surface dry condition and prevent concrete from drying until repair operations are completed. Re-wet surfaces to be repaired by water spray on at least a daily basis. Remove standing water in areas to be repaired prior to placement of repair material. Provide means to remove excess water from the structure.
 3. Where repair material manufacturer recommends use of an epoxy-bonding agent, follow recommendations of both the repair material and epoxy bonding agent manufacturers.
- C. Fully consolidate repair material, completely filling all portions of areas to be filled.
- D. Bring repair surfaces into alignment with adjacent existing surfaces to provide uniform, even surfaces. Unless indicated otherwise, repair surfaces shall match adjacent existing surfaces in texture and receive coatings or surface treatments provided for adjacent existing surfaces.
- E. Curing:
1. Cure repair mortar and non-shrink grout according to manufacturer's recommendations, except that minimum cure period shall be 3 days.
 2. Cure other materials in accordance with Section 03370 - Concrete Curing.
 3. If manufacturer recommends use of a curing compound, use no material that would interfere with the bond of any coating or adhesive required to be applied to the surface.

3.02 TREATMENT OF SURFACE DEFECTS

- A. Definition - Surface Defects: Depressions in concrete surfaces not extending all the way through a member, caused by physical damage, unrepaired rock pockets created during original placement, spalling due to corroded reinforcing steel or other embeds, or removal of embedded items or intersecting concrete members.
- B. Preparation:
1. Remove loose, damaged concrete by chipping to sound material.
 2. Where existing reinforcing bars are exposed, remove concrete at least one inch deep all around the exposed bars. If the existing bars are cut through, cracked, or cross-sectional area is reduced by more than 25 percent, notify the Engineer and City Engineer immediately.
- C. Repair Material:
1. Use only repair mortar to repair surface defects in members normally in contact with water or soil, and defects in interior surfaces of structures which are intended to contain water.

2. Repair of other surface defects may be by application of repair mortar, repair concrete or cement grout, as appropriate.

3.03 PATCHING OF HOLES IN CONCRETE

A. General:

1. Definition - Holes: For the purposes of this section, holes are defined as penetrations completely through a concrete member, with interior surfaces approximately perpendicular to the surface of the existing member. Chip interior surface areas which are inclined and do not meet this criterion as necessary to meet this requirement.
2. Perimeter of holes at the surface shall form a regular shape composed of curved or straight-line segments. Provide at least the minimum placement depth specified for the material used at all locations. Score existing concrete by sawcutting and chip as needed to meet this requirement.
3. Roughen the interior surface of holes less than 12 inches in diameter to at least 0.125-inch amplitude. Roughen larger holes to at least 0.25-inch amplitude.
4. At holes not filled with repair mortar or non-shrink grout, and where otherwise recommended by the repair material manufacturer, coat existing surfaces to be repaired with epoxy bonding agent.
5. Where a surface of a member is exposed to view and the repair material cannot be adjusted to match the color of the existing concrete, hold back the repair material 2 inches from the surface. Fill the remaining 2 inches with color-adjusted cement grout. Roughen the surface of the repair material when placed to improve bond with the cement grout.

B. Patching Small Holes:

1. Fill holes less than 12 inches in least dimension and extending completely through concrete members with repair mortar or non-shrink grout.
2. Fill holes in members normally in contact with water or soil with Class I non-shrink grout in accordance with Section 03600 - Structural Grout.

C. Patching Large Holes:

1. Fill holes larger than 12 inches in least dimension with repair concrete, repair mortar or non-shrink grout.
2. Provide large holes normally in contact with water or soil and not filled with Class I non-shrink grout with resilient waterstop placed in a groove approximately 0.25 inch deep ground into the interior edge of the hole at the center of the wall providing a smooth surface in which to place the resilient waterstop. Alternatively, bond bentonite waterstop to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Install waterstop in accordance with Section 03250 - Joints in Concrete Structures.
3. Provide reinforcing steel in layers matching existing reinforcement locations, except provide concrete cover required by the Contract Documents for the applicable service condition.
4. For holes smaller than 48 inches, reinforcement shall be at least #5 bars on 12-inch centers in each layer required. At all holes larger than 30 inches, drill and grout the reinforcement into the existing concrete.
5. For holes larger than 48 inches, see the drawings for reinforcement details.

3.04 PATCHING OF LINED HOLES

- #### A.
- These provisions apply to openings which have embedded material over all or a portion of the inside edge. Requirements for repairing holes in concrete specified above shall apply as modified herein. The Engineer and City Engineer will determine when the embedded material is allowed to remain.

- B. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface. Roughen or abrade the embedded material to promote good bonding to the repair material. Completely remove any substance that interferes with good bonding.
- C. Completely remove embedded items not securely and permanently anchored in the concrete.
- D. Completely remove embedded items larger than 12 inches in least dimension unless composed of a metal to which reinforcing steel can be welded. Where reinforcement is required, weld it to the embedded metal.
- E. The following additional requirements apply to concrete in contact with water or soil.
 - 1. Fill lined openings less than 4 inches in least dimension with epoxy grout.
 - 2. Coat lined openings greater than 4 inches but less than 12 inches in least dimension with an epoxy-bonding agent prior to filling with Class I non-shrink grout.
 - 3. Coat lined openings greater than 12 inches in least dimension with an epoxy-bonding agent and bond bentonite waterstop to the interior of the opening prior to filling with approved repair material.

3.05 INSTALLATION OF PIPES AND FRAMES

- A. The following applies to installation of permanent pipes and frames in openings cut into existing concrete members.
- B. Cut opening to a size which is a minimum of one inch and a maximum of 3 inches larger than the outside edge of the embedded item. At openings with sharp corners, take care not to sawcut beyond the opening so as to damage existing reinforcing bars. At openings which are greater than 24 inches in least dimension, chip a keyway into the center of the wall. Keyway shall be at least 1.5 inches in depth and from three inches to 1/3 the member thickness in width. All surfaces except at the keyway shall be perpendicular to the member surface as specified herein for patching holes.
- C. Provide embedded items with a flange or other positive means of anchorage to repaired members. At members in contact with soil or water, provide continuous waterstop flanges around embeds where concrete pipe will be embedded, provide resilient waterstop around pipe at wall centerline.
- D. Roughen the interior surface of openings to at least 1/4-inch amplitude. Sandblast the embed surface to be in contact with concrete clean to promote good bonding to the repair material.
- E. Fill the space between the frame and the existing concrete with Class I non-shrink grout.
- F. Where surface of a member is exposed to view and the repair material cannot be adjusted to match the color of the existing material, hold back the repair material 2 inches from the surface. Fill the remaining 2 inches with color-adjusted cement grout.

3.06 NON-FIXED INSTALLATION OF PIPES

- A. The following applies to installation through existing concrete of piping to be sealed with adjustable linked seals, resilient connectors, or packing and sealant. When more appropriate, the Engineer or City Engineer may require installation of a sleeve instead of the core-drilled hole specified herein.
- B. Size core-drilled opening to permit installation of the required seal; locate to minimize cutting of existing reinforcing steel.

- C. Where linked or resilient seals are to be installed, coat the interior surface of the opening with epoxy at least 1/8 inch thick for a smooth and even surface promoting a good seal.
- D. Where packing and sealant are required, seal exposed reinforcing bars with at least an 1/8-inch thick layer of epoxy extending 1/2 inch beyond the bars on all sides. Prepare the surface of the cut concrete and the pipe as recommended by the sealant manufacturer.

3.07 GENERAL CRACK REPAIR

- A. Repair cracks identified by the Engineer or City Engineer as caused by shrinkage or thermal movement by injection with chemical grout as specified herein.
- B. Repair cracks not caused by shrinkage or thermal movement by epoxy injection or as otherwise directed by the Engineer or City Engineer.

3.08 CHEMICAL GROUT CRACK REPAIR

- A. Inject chemical grout into all cracks as directed by the Engineer or City Engineer in those structures included in the scope of work listed herein in accordance with the chemical grout manufacturer's installation instructions and recommendations.
- B. Location of Injection Ports: Locate injection ports as recommended by the chemical grout manufacturer and as needed to insure complete penetration of the joint or crack with the grout. Spacing of injection ports shall not exceed 2 feet.
- C. Drilling Ports: Drill holes for injection ports to the depth needed for proper distribution of the chemical grout. Take care to not damage any reinforcing steel.
- D. Port preparation: Clean holes for injection ports of all debris and fit with an injection fitting as provided by the manufacturer of the chemical grout, or equal. Install injection fittings in accordance with manufacturer's instructions; allow fittings to remain in place until chemical grout injection work is complete in that area. Install caps or valves at injection ports to prevent back flow of uncured chemical grout after it has been injected.
- E. Chemical Grout Injection:
 - 1. Follow instructions and recommendations of the chemical grout manufacturer and its representatives for chemical grout mixing and injection procedures.
 - 2. Seal cracks at the surface where needed to assure complete penetration of injected chemical grout and prevent loss of material.
 - 3. Prior to chemical grout injection, inject water into ports to provide water for the reaction process, flush out foreign matter and verify continuity between adjacent ports. Inject water into each port until it begins to flow from an adjacent or nearby port.
 - 4. If the water injection procedure indicates the potential presence of voids within members or behind members resting against soil, notify the Engineer and City Engineer immediately.
 - 5. Beginning at the lowest injection port, inject chemical grout until the grout begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled. In general, port-to-port travel of the injection process will be from low to high in a continuous operation.
 - 6. If port-to-port continuity does not occur at locations where continuity was verified through water injection, mark location and notify the Engineer and City Engineer.
 - 7. Avoid sudden application of high pressure during the injection process.
 - 8. After completion of the grouting operation, remove all ports and surface sealing materials leaving an undamaged surface.

3.09 EPOXY CRACK REPAIR

- A. Inject epoxy into all cracks in damaged concrete as indicated by the Engineer or City Engineer in structures included in the scope of work listed herein. Follow installation instructions and recommendations of the epoxy manufacturer.
- B. Inject cracks with sufficient pressure to ensure full penetration of epoxy but without causing further damage.
- C. Location, drilling and preparation of ports for injection: As specified for chemical grout herein.
- D. Epoxy Injection:
 - 1. Follow instructions of the epoxy manufacturer and its representatives for all mixing and injection procedures.
 - 2. Seal all cracks at the surface where needed to provide for complete penetration of the injected epoxy and to prevent loss of material.
 - 3. Beginning at the lowest injection port, inject the epoxy until it begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled.
 - 4. If port-to-port continuity does not occur, mark the location and notify the Engineer and City Engineer.
 - 5. Avoid sudden application of high pressure during the injection process.
 - 6. After completion of injection operations, remove all ports and surface sealing materials to leave an undamaged surface.

3.10 REPAIR OF DETERIORATED CONCRETE

- A. These provisions pertain to concrete damaged by abrasion, chemical attack or corrosion of reinforcing steel. The only material acceptable for surface repair is repair mortar as specified herein. Where the repaired surface is to be subsequently covered with a PVC liner or other protective material, coordinate finishing details with the liner material manufacturer.
- B. Surface Preparation:
 - 1. Remove loose, broken, softened and acid-contaminated concrete to sound, uncontaminated concrete.
 - 2. Notify the Engineer and City Engineer when removal of deteriorated concrete is complete. Schedule two weeks for the Engineer and City Engineer to inspect the surface, perform testing for acid contamination, determine if additional concrete must be removed, and to develop any special repair details that may be needed. Should it be determined that additional concrete must be removed to reach sound, uncontaminated material, schedule another two-week period for further evaluation after completion of the additional removal.
 - 3. Follow repair mortar manufacturer's instructions for additional surface preparation.
- C. Repair Mortar Placement:
 - 1. Follow manufacturer's recommendations for mixing and placement of repair mortar. After the initial mixing of the repair mortar, do not add additional water to change the consistency should the mix begin to stiffen.
 - 2. Place repair mortar to the minimum thickness recommended by manufacturer but not less than ½ inch. Should there be areas where less than the minimum repair mortar depth of concrete is removed, Contractor may remove additional concrete to attain the minimum repair mortar thickness or may place repair mortar so as to increase the original thickness of the member. In any case, add repair mortar so that minimum cover over existing reinforcing steel is 2 inches. Do not place repair mortar so as to create locally raised areas. Where there is a transition with wall surfaces which are not in need of repair, do not feather the repair mortar at the transition. Sawcut a score line to not less than the minimum repair mortar depth and chip concrete out to it to form the transition. Take care not to cut or otherwise damage reinforcing steel.

3. Finish repair mortar in an even, uniform plane to restore the member to its original surface. Out-of-plane tolerance: No localized depressions or projections; 0.25-inch maximum gap between repair mortar surface and a 10-foot straight edge in any orientation at any location.
- D. Finishing:
1. Apply a smooth magnesium float finish to repair mortar.
 2. When completed: No sharp edges. Exterior corners, such as at penetrations: One-inch radius. Interior corners: Square, except 2-inch repair mortar fillet at corners to receive PVC lining.

END OF SECTION

NOTES TO SPECIFIER

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

- A. Include this section whenever there are existing structures in the project such as lift stations, bridges and buildings which require repair. Modify the scope of work section to include all such structures and the types of repairs needed. Several types of repair are included; where a project does not require a particular form of repair, the appropriate paragraphs should be removed and the remaining specification adjusted accordingly.
- B. Paragraph 1.05C. Carefully and thoroughly document existing structures having cracks to be repaired, listing structures to be repaired and describing the crack repairs under the Paragraph below, or delete the Paragraph below and refer to the Drawings, if crack repair requirements in existing structures are sufficiently indicated there. Re-letter the remaining Paragraph(s) as required. Coordinate with Paragraph 3.9A.
- C. Paragraph 1.05D. The following is for concrete attacked chemically, usually by hydrogen sulfides which have turned into sulfuric acid. Repair is usually done to prepare for placement of a PVC liner or some other form of protective coating. Revise subparagraph 1 below to define repair scope, carefully describing areas to be repaired and the extent of repairs; refer to drawings if necessary. If possible, engage a testing lab during design to take core samples, test for sulfate levels at depth increments, and determine how much concrete must be removed to reach sound uncontaminated material. If that is done, revise subparagraph 2 below to define the amount of concrete to be removed; if testing ahead of time is not possible, revise subparagraph 2 as necessary to state the estimated amount of concrete to be removed.
- D. Paragraph 1.05E. Carefully and thoroughly document the extent of other repairs required to existing structures, listing the existing structures to be repaired and describing the nature of those repairs under the Paragraph below, or delete the Paragraph below and refer to the Drawings, if repair areas in existing structures are sufficiently indicated there.
- E. Paragraph 2.01A. Repair mortars with faster strength gain and greater 28-day strengths are available if needed for a specific application. Some products listed below greatly exceed specified values. Contact manufacturers listed and adjust the required properties to suit what is available and appropriate.
- F. Paragraph 3.02. Add paragraph 3.02B.3 below if reinforcing bars are known to be corroded or otherwise damaged to the point where replacement is necessary. Define such areas on the drawings, and add provisions in this section (or in Section 03210 - Structural Concrete) specifying repair by welding in replacement bars. The other subparagraphs in 3.02B are intended to cover situations where loss of rebar is not anticipated.
 - 1. Score cut perimeter of damaged area at least one-half inch deep, to a maximum depth so as not to cut existing reinforcing steel. Chip existing concrete up to the score line so that minimum thickness of repair mortar is one-half inch.
- G. Paragraph 3.10C.3. Use tolerances and finish specified below for sheet PVC liner applied to concrete surface. Other liners or coatings may require a different level of finish or tolerance. Edit the following paragraphs to reflect the level of finish needed for the protection system selected for the project.

END OF SECTION