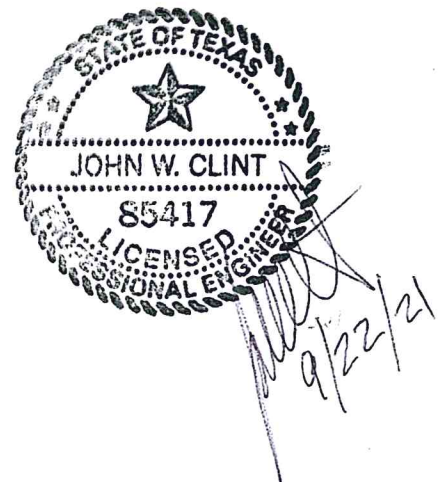


### TECHNICAL SPECIFICATIONS

01 33 00 – Submittal Procedures ..... 01 33 00 – 1 through 14  
01 45 29 – Testing Laboratory Services ..... 01 45 29 – 1 through 4  
01 55 26 – Traffic Control and Regulation..... 01 55 26 – 1 through 4  
01 57 13 – Temporary Erosion and Sedimentation Control ..... 01 57 13 – 1 through 4  
01 57 23 – TPDES Requirements (SWPPP provided by Contractor) ..... 01 57 23 – 1 through 2  
02 21 13 – Field Surveying..... 02 21 13 – 1 through 2  
02 41 13.13 – Removing Existing Pavement and Structures..... 02 41 13.13 – 1 through 4  
02 41 13.23 – Cut, Plug and Abandonment of Mains..... 02 41 13.23 – 1 through 2  
31 06 20.16 – Utility Backfill Materials ..... 31 06 20.16 – 1 through 8  
31 10 00 – Site Clearing – Preparation of Site ..... 31 10 00 – 1 through 2  
31 23 00 – Earthwork, Excavation, Fill and Grading ..... 31 23 00 – 1 through 2  
31 23 16.16 – Excavation & Backfill for Minor Structures..... 31 23 16.16 – 1 through 8  
31 23 23.13 – Excavation and Backfill for Utilities ..... 31 23 23.13 – 1 through 14  
31 41 33 – Trench Safety Systems..... 31 41 33 – 1 through 4  
31 71 19 – Pipe and Casing Augering ..... 31 71 19 – 1 through 6  
33 05 16 – Concrete for utility Construction ..... 33 05 16 – 1 through 14  
33 14 13 – Waterline Pipework ..... 33 14 13 – 1 through 10



## Section 01 33 00 - SUBMITTAL PROCEDURES

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Submittal procedures for:
1. Schedule of Values.
  2. Construction Schedules.
  3. Shop Drawings, Product Data, and Sampler.
  4. Operations and Maintenance Data.
  5. Manufacturer's Certificates.
  6. Construction Photographs and Videos.
  7. Project Record Documents.
  8. Design Mixes.

## 1.2 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 Owner 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 10 working days from the delivery of the submittal to the Engineer. Resubmittals shall be subject to the same review schedule. This time for submittal review, or resubmittals, shall in no way be justification for delays or additional compensation to the Contractor.
  3. Submittal Format: Include the following information in each submittal:
    - a. Project name.
    - b. Date.
    - c. Name of Engineer.
    - d. Name of Construction Manager (if applicable).
    - e. Name of Contractor.
    - f. Name of firm or entity that prepared submittal.
    - g. Names of subcontractor, manufacturer, and supplier.
    - h. Sequentially number each submittal 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.
    - i. Category and type of submittal.
    - j. Submittal purpose and description.
    - k. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
    - l. Drawing number and detail references, as appropriate.
    - m. Indication of full or partial submittal.

- n. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
  - o. Location(s) where product is to be installed, as appropriate.
  - p. Other necessary identification.
  - q. Remarks.
  - r. Signature of transmitter.
4. Contractor's Stamp
- a. Apply Contractor's stamp, 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.
  - b. As a minimum, Contractor's Stamp shall include:
    - 1) Contractor's name.
    - 2) Job number.
    - 3) Submittal number.
    - 4) Certification statement that the Contractor has reviewed the submittal and it is in compliance with the Contract Documents.
    - 5) Signature line for Contractor.
5. Paper Submittals:
- a. Place a permanent label or title block on each submittal coversheet item for identification; include name of firm or entity that prepared submittal.
  - b. Provide a 3" x 4" clear space on the coversheet to record the action taken by the Engineer.
  - c. Submit, to the Engineer, 4 copies of submittals unless otherwise specified in the following paragraphs or in the Specifications. Upon submittal review completion, the Engineer will provide the Owner and the Contractor with one paper submittal, with approval or review comments. The Engineer will retain one extra copy of the submittal, for the project folder.
  - d. Number and assemble each submittal individually as described in Section 1.02.3.h.
6. Electronic Submittals:
- a. Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with project name, date and submittal number.
  - b. E-Mail: Prepare submittals as PDF and transmit to Engineer by sending via e-mail with delivery confirmation return receipt. Include submittal identification information in email subject line. The Owner shall be carboned-copied on any emailed submittal, or resubmittal, made by the Contractor.
  - c. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project Management software website as directed by the Project Manager. Enter required data in web-based software site to fully identify submittal.
7. 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 Owner or 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.

8. 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.

### 1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  2. Submit schedule of values for bid schedule items identified as Lump Sum or items which may require work during multiple payment periods, or items as directed by the Engineer.
  3. Submit schedule of values to the Engineer at earliest possible date, but no later than 15 working days before the date scheduled for submittal of initial Application for Payment.
  4. All schedule of value items must be approved by the Owner and Engineer prior to the Contractor's Application for Payment for such item.
- B. Format and Content: Use Project Manual bid schedule as a guide to establish line items for the schedule of values. Provide at least two items for each bid item providing a schedule of value.
  1. Provide a breakdown of the bid item in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the bid item.
  2. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials, equipment or fabrications and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site.
    - b. Follow the contract documents for payment of material and equipment as it becomes incorporated into the Work.
  3. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line item value of unit costs allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
  4. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
  5. Other Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  6. Mobilization: Provide a separate line item for mobilization, demobilization, bonding insurance and other project costs projected during the life of the project when such costs arise.
  7. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Work Change Directive.
  8. The Owner has the right to request documentation justifying the value provided by the Contractor in the schedule of values. The Owner retains the right to request additional unit price itemization in the schedule of values during the project.

### 1.4 CONSTRUCTION SCHEDULES

- A. Contractor's Construction Schedule: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules. Use Microsoft Project, Primavera or a program as directed by the Engineer for current Windows operating system.
1. Include an updated construction schedule with each Application for Payment, or as directed by the Engineer. Issue updated schedule before each regularly scheduled progress meeting.
  2. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  3. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, duration, actual starts and finished, and activity durations.
  4. As the Work Progresses, indicate Final Completion percentage for each activity.
  5. Critical Path: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestones dates.
  6. Contract Modifications: Incorporate time-impact associated with each contract modification and prepare a time-impact analysis to demonstrate the effect of the proposed change on the Project Schedule.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to the date of Substantial and Final Completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
  2. Prepare initial Construction Schedule with a float time approved by the Engineer. Distribute float time along the critical path based on the contractor's experience with each activity. Float time belongs to the Owner and can only be adjusted or distributed by the Owner.
- C. Activities: Treat each level or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 working days, unless specifically allowed by Engineer.
  2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
    - a. Securing of approvals and permits required for performance of the Work.
    - b. Temporary facilities.
    - c. Time for Owner provided items.
    - d. Coordination with Separate Contracts.
    - e. Regulatory Agency approvals.
    - f. Punch List and Correction Items.
  3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 calendar days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittal review, approvals, purchasing fabrication and delivery of materials and equipment needed for the Work.

4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, Subcontract awards, submittals, purchases, fabrication, sample testing, deliveries, installation, tests and inspections, adjusting, curing, and other project related factors.
  5. Startup and Testing Time: Include no fewer than 15 calendar days for startup and testing, if applicable.
  6. Commissioning Time: Include no fewer than 15 calendar days for commissioning, if applicable.
  7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
  8. Punch List and Final Completion: Include not more than 30 or less than 20 calendar days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents such as coordination with other construction by Owner or Others, limitations of continued occupancies, uninterruptible services, partial occupancy before substantial completion, use of premises restrictions, seasonal variations, environmental controls, or other constricts. Show how the sequence of Work is affected.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- 1.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- A. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on standard sheets dimensions of 8-1/2 by 11 inches, 11 by 17 inches, or 24 by 36 inches.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment. In addition to the information below, include the required product data information as specified in the design plans or other specification sections.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  3. Email Transmittal: Provide PDF transmittal including digital image file illustrating Sample characteristics, and identification information for record.
  4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based software website. Enter required data in web-based software site to fully identify submittal.
  5. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
  6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
  - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - a. Number of Samples: Submit three sets of Samples. Engineer will retain two sample sets; remainder will be returned.
  - b. Submit a single sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
  - c. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a sample, submit at least three sets of paired units that show approximate limits of variations.

#### 1.6 OPERATIONS AND MAINTENANCE DATA

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
  1. Binders: Heavy-duty, three-ring, vinyl-covered, post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary, to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.



2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
  - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
  - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

#### C. SYSTEMS AND EQUIPMENT OPERATION MANUALS

1. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
  - a. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - b. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
2. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  - a. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  - b. Performance and design criteria if Contractor has delegated design responsibility.
  - c. Operating standards.
  - d. Operating procedures.
  - e. Operating logs.
  - f. Wiring diagrams.
  - g. Control diagrams.
  - h. Piped system diagrams.
  - i. Precautions against improper use.
  - j. License requirements including inspection and renewal dates.
3. Descriptions: Include the following:
  - a. Product name and model number. Use designations for products indicated on Contract Documents.
  - b. Manufacturer's name.
  - c. Equipment identification with serial number of each component.
  - d. Equipment function.
  - e. Operating characteristics.
  - f. Limiting conditions.

- g. Performance curves.
  - h. Engineering data and tests.
  - i. Complete nomenclature and number of replacement parts.
4. Operating Procedures: Include the following, as applicable:
- a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Instructions on stopping.
  - f. Normal shutdown instructions.
  - g. Seasonal and weekend operating instructions.
  - h. Required sequences for electric or electronic systems.
  - i. Special operating instructions and procedures.
5. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
6. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

#### D. SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

1. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
- a. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - b. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
2. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
3. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
4. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
- a. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
    - b. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
    - c. Identification and nomenclature of parts and components.
    - d. List of items recommended to be stocked as spare parts.
  5. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
    - a. Test and inspection instructions.
    - b. Troubleshooting guide.
    - c. Precautions against improper maintenance.
    - d. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    - e. Aligning, adjusting, and checking instructions.
    - f. Demonstration and training video recording, if available.
  6. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
    - a. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
    - b. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
  7. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
  8. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
  9. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
    - a. Include procedures to follow and required notifications for warranty claims.
  10. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
    - a. Do not use original project record documents as part of maintenance manuals.
- 1.7 MANUFACTURER'S CERTIFICATE
- A. When specified in Specification sections, submit manufacturers' certificate of compliance for review by the Owner.
  - B. Contractor's Stamp, as described in paragraph 1.2.A.4, shall be placed on front page of the certification.

- 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 the Owner.

#### 1.8 CONSTRUCTION PHOTOGRAPHS AND VIDEOS

- A. The Contractor shall be responsible for the production of pre-construction, during-construction (construction progress), post-construction and other documentation, as directed by the Engineer, videos and photographs.
  - 1. Digital Photographs: Submit image files within 7 days of taking photographs.
    - a. Submit photos on an electronic flash drive. Photographs shall be labeled as follows Project Abbreviation- Brief Location Description- Picture Number - date (MM-DD-YY). Use location description for similar type photos.
    - b. Include a tabled index of photographs, in digital PDF format, including the following:
      - 1. Name of Project
      - 2. Name and contact information of photographer
      - 3. Name of Engineer
      - 4. Name of Contractor
      - 5. Date photographs was taken
      - 6. Description of location, vantage point and direction
      - 7. Unique sequential identifier coordinating to the design plans.
    - c. Digital Photographs: Provide color images in JPG format, produced by a digital camera with a minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, including vibration-reduction technology. Use flash in low light levels or backlit conditions.
    - d. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.
      - 1. Field identify construction limits and stationing before taking construction photographs.
      - 2. Take adequate number of photographs to show existing conditions adjacent to property before starting the Work.
      - 3. Take adequate number of photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
      - 4. Take additional photographs as required to record existing damaged to adjacent structures, pavements, and improvements.
      - 5. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
        - a. Underground utilities.
        - b. Underslab services.
        - c. Piping.

- d. Electrical conduit.
  - e. Waterproofing and weather-resistant barriers.
- e. Periodic Construction Photographs: Take 20 photographs, or as directed by the Engineer, within one week of submittal of each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- f. Final Completion Construction Photographs: Take adequate number of photographs after date of Substantial Completion and one-month following Final Acceptance of the Project for submission as part of the Project Record Documents.
- g. Additional Photographs: The Engineer may request photographs in addition to periodic photographs specified. Additional requested photographs will not be considered for additional payment.
2. Video Recordings: Submit video recordings within 7 days of recording.
- a. Submit video recordings on an electronic flash drive. Videos shall be labeled as follows Project Abbreviation- Brief Video Description- Picture Number - date (MM-DD-YY).
  - b. Identification: Include a tabled index of videos, in digital PDF format, including the following:
    - 1. Name of Project
    - 2. Name and contact information of photographer
    - 3. Name of Engineer
    - 4. Name of Contractor
    - 5. Date video was recorded
    - 6. Description of vantage point, indicating location, direction (by compass point), and elevation.
    - 7. Unique sequential identifier coordinating to the design plans.
  - c. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with a minimum sensor size of 12 megapixels, and capable of recording in full high-definition model with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.
  - d. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation of construction.
    - 1. Confirm date and time at beginning and end of recording.
    - 2. Begin each video recording with name of Project, date and time, Contractor's name, videographer's name, and Project location.
  - e. Preconstruction Video Recording: Before starting construction, record video recording of Project site and surrounding properties from different vantage points. Minimum recording time shall be 30 minutes(s).
    - 1. Field identify construction limits and stationing before recording construction video recordings.

2. Show existing conditions adjacent to Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
- f. Periodic Construction Video Recordings: Record video recording within one week of submittal of each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded.

#### 1.9 PROJECT RECORD DOCUMENTS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Particular attention should be given to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Locations and depths of installed underground utilities.
    - d. Locations, depths and sizes of encountered underground utilities not shown.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Changes made by Change Order or Work Change Directive.
    - j. Changes made following Engineer's written orders.
    - k. Details not on the original Contract Drawings.
    - l. Field records for variable and concealed conditions.
    - m. Record information on the Work that is shown only schematically.
  3. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  4. Mark important additional information that was either shown schematically or omitted from original Drawings.
  5. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
  6. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets as follows:
    - a. Project name.
    - b. Date.

- c. Designation "PROJECT RECORD DRAWINGS."
  - d. Name of Engineer.
  - e. Name of Contractor.
7. Format: Provide Engineer with digital copy in PDF electronic format, with full comment enabled function, on a flash drive.
  8. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  9. Record Prints and Digital Data Files shall be clean, legible and clearly show the Engineer the accurate depictions of the constructed improvements. For a minimum period of 6 months after substantial completion, the Contractor shall be available to answer any questions and clarify any items the Engineer may have regarding the provided Record Data.

#### 1.10 DESIGN MIXES

- A. When specified in Specifications, submit design mixes for review.
- B. Contractor's Stamp, as described in paragraph 1.2.A.4, shall be placed on front page of each design mix.
- C. Mark each design mix to identify proportions, gradations, and additives for each class and type of design mix submitted. Include applicable test results on samples for each mix.
- D. Maintain a copy of approved design mixes at mixing plant.

PART 2 - PRODUCTS - [Not Used]

PART 3 - EXECUTION – [Not Used]

END OF SECTION

## Section 01 45 29 - TESTING LABORATORY SERVICES

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Testing laboratory services and Contractor responsibilities related to those services.

## 1.2 REFERENCES

- A. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
- B. ASTM D 3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.
- C. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- D. ASTM E 329 - Specification for Minimum Requirements for Agencies Engaged the Testing and/or Inspection of Materials Used in Construction.
- E. ISO/TEC Guide 25 - General Requirements for the Competence of Calibration and Testing Laboratories.

## 1.3 SELECTION AND PAYMENT

- A. The Owner will select, employ, and pay for services of an independent testing laboratory to perform inspection and testing as required.
- B. When required, the Contractor shall employ and pay for services of an independent testing laboratory or laboratories to perform inspection and testing identified in "Products" sections of the individual Specification.
- C. Employment of a testing laboratory by the Owner shall not relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.
- D. The Contractor will have the cost of retesting deducted from the estimate for payment whenever failed work must be removed and replaced and retested.

## 1.4 QUALIFICATION OF LABORATORY

- A. Meet laboratory requirements of ASTM E 329 and applicable requirements of ASTM C 1077, ASTM D 3666, and ASTM D 3740.
- B. Meet the ISO/TEC Guide 25 conditions for accreditation by the American Association for Laboratory Accreditation (A2LA) in specific fields of testing required in individual Specification sections.
- C. Where a laboratory subcontracts any part of the testing services, such work shall be placed with a laboratory complying with the requirements of this Section.



### 1.5 LABORATORY REPORTS

- A. The testing laboratory shall provide and distribute copies of laboratory reports to the following: Owner(s), Engineer, and Contractor. Other copies of the reports may be required to be submitted to other parties. The testing laboratory will be informed of any other persons that required laboratory reports.
- B. One copy of each laboratory report distributed or emailed to the Contractor shall be kept at the site field office for the duration of the project.
- C. Before close of business on the working day following test completion and review, reports which indicate failing test results shall be transmitted immediately via email from the testing laboratory to the Owner, Contractor, and Engineer.

### 1.6 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 the Contractor.
- D. Laboratory has no authority to stop the Work unless a safety risk is imminent. The laboratory's representative shall immediately inform the Engineer and the Owner of any conflicts with the Contractor or Contractor's construction methods.

### 1.7 CONTRACTOR RESPONSIBILITIES

- A. Provide safe access to the Work and to applicable facilities (e.g. manufacturers, suppliers) for the Owner, Engineer, and testing laboratory personnel.
- B. Provide to the testing laboratory a copy of the construction schedule and a copy of each update to the construction schedule.
- C. Notify the Engineer and the testing laboratory during normal working hours of the day previous, but not less than 18 hours prior notice, to the expected time for operations requiring inspection and testing services. If the Contractor fails to make timely prior notification, then the Contractor shall not proceed with the operations requiring inspection and testing services.
- D. Notify the Engineer 24 hours in advance if the Specification requires the presence of the Engineer for sampling or testing.
- E. Request and monitor testing as required to provide timely results and to avoid delay to the Work. Provide samples to the laboratory in sufficient time to allow the required test to be performed in accordance with specified test methods before the intended use of the material.
- F. Cooperate with laboratory personnel in collecting samples on site. Provide incidental labor and facilities for safe 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.

### PART 2 - PRODUCTS – [Not Used]

PART 3 - EXECUTION

3.1 CONDUCTING TESTING

- A. Laboratory sampling and testing specified in individual Specification sections shall conform to the latest issues of ASTM standards, TxDOT methods, or other recognized test standards as approved by the Engineer.
- B. The requirements of this section shall also apply to those tests for approval of materials, for mix designs, and for quality control of materials as performed by the testing laboratories employed by the Contractor.

END OF SECTION

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## Section 01 55 26 - TRAFFIC CONTROL AND REGULATION

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

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

## 1.2 UNIT PRICES

- A. Unit Prices
  - 1. No separate payment will be made for work performed under this Section. Include cost of such work in Contract unit prices for items listed in bid form requiring traffic control and regulation.

## 1.3 SUBMITTALS

- B. The contractor shall submit for approval by the Owner and prior to the beginning of work a Traffic Control Plan responsive to the Texas Manual on Uniform Traffic Control Devices (TMUTCD) and sealed by a Registered Professional Engineer.
- C. For both the traffic control plan and flagmen use, submit schedules of values in accordance with Section 01 33 00 - Submittal Procedures.
- D. Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

## PART 2 - PRODUCTS

## 2.1 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 - EXECUTION

## 3.1 PUBLIC ROADS

- A. Abide by laws and regulations of governing authorities when using public roads. If the Contractor's work requires that public roads be temporarily impeded or closed, approvals shall be obtained from governing authorities and permits paid for before starting any work. Coordinate activities with the Owner.
- B. Contractor shall always maintain 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 not obstruct the normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by the Owner.

- D. Contractor shall maintain local driveway access to residential and commercial properties adjacent to work areas at all times.
- E. Cleanliness of Surrounding Streets: Keep streets used for entering or leaving the job area free of excavated material, debris, and any foreign material resulting from construction operations.

### 3.2 CONSTRUCTION PARKING CONTROL

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

### 3.3 FLARES AND LIGHTS

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

### 3.4 HAUL ROUTES

- A. Utilize haul routes designated by authorities or shown on the Drawings for construction traffic.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

### 3.5 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. Install and operate traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.
- C. Relocate traffic signs and signals as Work progresses to maintain effective traffic control.

### 3.6 BRIDGING TRENCHES AND EXCAVATIONS

- A. Whenever necessary, bridge trenches and excavation to permit an unobstructed flow of traffic.
- B. Vehicle crossings must be designed by and installed under the supervision of a registered professional engineer.
- C. 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.
- D. Install bridging to operate with minimum noise.
  - E. Adequately shore the trench or excavation to support bridge and traffic.
  - F. Extend steel plates used for bridging a minimum of two foot beyond edges of stable trench walls or excavation. Use temporary paving materials (premix) to feather edges of plates to minimize wheel impact on secured bridging.
  - G. Steel plates shall support H-20 loaded truck or loadings that produces maximum stress.

### 3.7 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

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## SPECIFICATION 01 57 13 - TEMPORARY EROSION AND SEDIMENT CONTROL

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Description of erosion and sediment control and other control-related practices, which shall be utilized during construction activities.

## 1.2 UNIT PRICES

- A. Payment for this item shall be made on a lump sum basis for the maintenance of the temporary erosion and sediment control and other TPDES requirements. The costs associated with TPDES inspection and reporting shall also be included in this item.

## 1.3 RESPONSIBILITY

- A. It is the contractor's responsibility to acquire a Texas Pollutant Discharge Elimination System (TPDES) Permit as indicated in Section 01 57 23 TPDES Requirements (SWPPP provided by Contractor).
- B. All work performed under this section must be as per construction plans and TPDES approved Permit.

## PART 2 - PRODUCTS - [Not Used]

## PART 3 - EXECUTION

## 3.1 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 Owner's Representative 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 SWPPP, Drawings, and this Specification.
- E. The Contractor shall install, maintain, and inspect erosion/sediment control measures and practices as specified in the SWPPP, TPDES Permit, Drawings, and in this or other Specifications.

## 3.2 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, berm, dikes, waterways, 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, immediately prior to dumping and spreading the topsoil, loosen the sub grade by disking or by scarifying to a depth of at least 2 inches to permit bonding of the topsoil to the subsoil.
4. No sod or seed shall be placed on soil which has been treated with soil sterility until sufficient time has elapsed to permit dissipation of toxic materials.

### 3.3 SEDIMENT CONTROL MAINTENANCE

- A. All erosion, sediment, and water pollution controls will be maintained in good working order. A rain gauge provided by the Contractor shall be located on the project site. Within 24 hours of a rainfall event of 0.5 inches or more as measured by the project rain gauge, the Contractor and the Owner's Representative shall inspect the entire project to determine the condition of the control measures. Sediment shall be removed and devices repaired as soon as practicable but no later than 7 days after the surrounding ground has dried sufficiently to prevent further damage from equipment operations needed for repairs.
- B. In the event of continuous rainfall over a 24 hour period, or other circumstances that preclude equipment operation in the area, the Contractor shall install additional backup storm water pollution control devices, as determined by the Owner's Representative, by other appropriate methods. The Contractor shall remove sediment accumulations and deposit the spoils in an area approved by the Owner's Representative as soon as practical and in accordance with the SWPPP. Any corrective action needed for the control measures is to be accomplished in the sequence directed by the Owner's Representative; however, areas adjacent to receiving waters shall generally have priority, followed by devices protecting storm sewer inlets.

### 3.4 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. Spray-on adhesives on mineral soils when not used by traffic.
  4. Tillage to roughen surface and bring clods to the surface.
  5. Irrigation by water sprinkling.
  6. Barriers using solid board fences, snow fences, burlap fences, crate walls, bales of straw, or similar materials.

- C. Implement dust control methods immediately whenever dust can be observed blowing on the project site.

### 3.5 OFFSITE ROADWAY MAINTENANCE

- 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 shown in the construction plan Details, as Stabilized Construction Exit Detail.
- B. In addition to stabilized construction exits, shovel or sweep the pavement to the extent necessary to keep the street clean. Water hosing or sweeping of debris and mud off of the street into adjacent areas is not allowed.

### 3.6 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.

### 3.7 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.

### 3.8 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.

### 3.9 STORAGE OF CONSTRUCTION MATERIALS AND CHEMICALS

- A. Isolate sites where chemicals, cements, solvents, paints, or other potential water pollutants are stored in areas where they will not cause runoff pollution.

- B. Store toxic chemicals and materials, such as pesticides, paints, and acids in accordance with manufacturers' guidelines. Protect groundwater resources from leaching by placing a plastic mat, packed clay, tar paper, or other impervious materials on any areas where toxic liquids are to be opened and stored.

### 3.10 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.

### 3.11 SANITARY FACILITIES

- A. Provide and maintain sanitary facilities for persons on the job site; comply with the regulations of State and local departments of health.
- B. 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 sewer and waste hauled off-site and properly disposed in accordance with local regulations.
- C. Located toilets near the Work site and secluded from view insofar as possible. Keep toilets clean and supplied throughout the course of the Work.

### 3.12 PESTICIDES

- A. Use and store pesticides during construction in accordance with manufacturers' guidelines and with local, state, and federal regulations. Avoid overuse of pesticides which could produce contaminated runoff. Take great care to prevent accidental spillage. Never wash pesticide containers in or near flowing streams or storm water conveyance systems.

END OF SECTION

## Section 01 57 23 – TPDES REQUIREMENTS

## PART 1 GENERAL

## 1.01 SECTION INCLUDES

- A. This Section describes the required documentation to be prepared and signed by the Contractor before conducting construction operations, in accordance with the terms and conditions of the Texas Pollutant Discharge Elimination System (TPDES) General Permit Number TXR150000 for discharges of storm water runoff from small construction sites.
- B. The Contractor shall be responsible for providing and implementing a Storm Water Pollution Prevention Plan (SWPPP), prepared by and sealed by a licensed professional engineer, for this project.
- C. Contractor shall review implementation of the SWPPP in a meeting with the Owner and Engineer prior to start of construction.

## 1.02 UNIT PRICES

- A. Payment for this item shall be made on a lump sum basis and shall cover the preparation and submittal of all required plans, forms, payment of permit fees (if any), cost of implementation and maintenance of the storm water control measures as required throughout the project.

## 1.03 REFERENCES

- A. Part II.E.2. of the Texas Commission on Environmental Quality (TCEQ) General Permit Number TXR150000.
- B. Part II.F.3 of TCEQ General Permit Number TXR150000 (notification of MS4 operator)

## PART 2 PRODUCTS - As required by Storm Water Pollution Prevention Plan.

## PART 3 EXECUTION

## 3.01 STORM WATER POLLUTION PREVENTION PLAN

- A. Prior to start of construction activities, the Contractor shall provide a Storm Water Pollution Prevention Plan, prepared by and sealed by a registered professional engineer, for this project.
- B. Contractor shall be responsible for implementation, maintenance, and inspection of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other practices shown on the SWPPP, or as specified by TCEQ or elsewhere in this or other Specifications.

## 3.02 RETENTION OF RECORDS

- A. The Contractor shall keep a copy of the Storm Water Pollution Prevention Plan at the construction site or at the Contractor's office from the date that it became effective to the date of project completion.
- B. At project closeout, the Contractor shall submit to Owner all TPDES forms and certifications, as well as a copy of the SWPPP. Storm water pollution prevention records and data will be retained by Owner for a period of 3 years from the date of project completion.

## 3.03 NOTICES

The following notices shall be posted from the date that this SWPPP goes into effect until the date of final site stabilization:

## A. Regulatory Agency Notices

1. Small Construction Site Notice: The Contractor shall complete and sign the attached Small Construction Site Notice. Copies of the signed notice shall be submitted to TCEQ, the Owner, Engineer, and Owner. Copy of the signed notice shall also be posted at the construction site, as specified.
2. Notice of Intent: The Contractor shall complete and sign a Notice of Intent (NOI) as "Operator" and submit it along with all required fees to the TCEQ, the Owner, Engineer, and other required agencies.
3. TPDES General Permit: A copy of the TCEQ's TPDES storm water general construction permit TXR150000 acknowledgement certificate shall be submitted to Owner, Engineer, and other required agencies and shall be posted at the construction site, as specified.

## B. OTHER REQUIRED NOTICES

1. Notice to drivers of equipment and vehicles, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post such notices at every stabilized construction exit area.
2. In an easily visible location on site, post a notice of waste disposal procedures.
3. If applicable, notice of hazardous material handling and emergency procedures shall be posted on site. Keep copies of Material Safety Data Sheets at a location on site that is known to all personnel.
4. Keep a copy of each signed certification at the construction site or at Contractor's office.

END OF SECTION

## Section 02 21 13 - FIELD SURVEYING

## PART 1 - GENERAL

## 1.1 QUALITY CONTROL

- A. Conform to State of Texas laws for surveys requiring licensed surveyors.

## 1.2 UNIT PRICES

- A. No separate payment will be made for work performed under this Section. Include cost of such work in Contract unit prices for items listed in bid form requiring surveying.

## 1.3 SUBMITTALS

- A. Submit documentation verifying accuracy of survey work upon request.
- B. Submit certificate signed by surveyor, that the elevations and locations of the Work are in conformance with Contract Documents.
- C. Submit information under provisions of Section 01 33 00 - Submittal Procedures.

## 1.4 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and survey work as it progresses.
- B. Prepare a certified survey setting forth dimensions, locations, angles, and elevations of construction and site work upon completion of foundation walls and major site improvements.
- C. Submit Project Record Documents under provisions of Section 01 33 00 - Submittal Procedures.

## 1.5 EXAMINATION

- A. Verify locations of survey control points prior to starting Work.
- B. Notify Engineer immediately of any discrepancies discovered.

## 1.6 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 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.

1.7 SURVEY REQUIREMENTS

- A. Utilize recognized engineering survey practices.
- B. Establish elevations, lines and levels to provide appropriate controls for the Work. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading; fill and topsoil placement; utility locations, slopes, and invert elevations.
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, ground floor elevations.
- C. Verify periodically layouts by same means.

PART 2 - PRODUCTS – [Not Used]

PART 3 - EXECUTION – [Not Used]

END OF SECTION

## Section 02 41 13.13 - REMOVING EXISTING PAVEMENTS AND STRUCTURES

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Removing concrete paving, asphaltic concrete pavement and base courses.
- B. Removing concrete curbs, concrete curbs and gutters, sidewalks and driveways.
- C. Removing pipe culverts and sewers.
- D. Removing existing inlets and manholes.
- E. Removing miscellaneous structures of concrete or masonry.

## 1.2 UNIT PRICES

- A. Unit Prices.
  - 1. Payment for removing and disposing of asphaltic surfacing and of base under asphaltic surfacing, regardless of the thickness encountered, is on a square yard basis measured between lips of gutters.
  - 2. Payment for removing and disposing of base under surfacing with curbs, regardless of the thickness encountered, is on a square yard basis measured from back-to-back of curbs.
  - 3. Payment for removing and disposing of reinforced concrete pavement, regardless of its thickness, is on a square foot basis.
  - 4. Payment for removing and disposing of monolithic curbs and gutters, and concrete curbs, is on a linear foot basis measured along the back of the curb.
  - 5. Payment for removing and disposing of cement stabilized base course, with or without asphaltic surfacing, is on a square yard basis.
  - 6. Payment for removing and disposing of concrete sidewalks and driveways is on a square foot basis.
  - 7. Payment for removing and disposing of miscellaneous concrete and masonry is on a unit price basis for each structure removed.
  - 8. Payment for removing and disposing of pipe culverts and sewers is on a linear foot basis for each diameter and each material type of pipe removed.
  - 9. Payment for removing and disposing of existing inlets is on a unit price basis for each inlet removed.
  - 10. Payment for removing and disposing of existing manholes is on a unit price basis for each manhole removed.



11. No separate payment will be made for saw cutting of pavement, concrete, driveways, sidewalks, or curbs and gutters, or other items required for removal items under this Section. Include cost of such work in Contract unit prices for items listed in bid form requiring saw cutting.
12. No payment will be made for work outside project limits, or for pavements or structures removed for the Contractor's convenience.

### 1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate removal work with utility companies.

## PART 2 - PRODUCTS – [NOT USED]

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Obtain advance approval from the Owner's representative for dimensions and limits of removal work.
- B. Identify known utilities below grade. Stake and flag locations.

### 3.2 PROTECTION

- A. Protect the following from damage or displacement:
  1. Adjacent public and private property.
  2. Trees, plants, and other landscape features designated to remain.
  3. Utilities designated to remain.
  4. Pavement and utility structures designated to remain.
  5. Benchmarks, monuments, and existing structures designated to remain.

### 3.3 REMOVALS

- A. Remove pavements and structures by methods that will not damage underground utilities. Do not use a drop hammer near existing underground utilities.
- B. Minimize amount of earth loaded during removal operations.
- C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to a minimum depth of 2 inches.
- D. Where street and driveway saw cut, locations coincide or fall within 3 feet of existing construction or expansion joints, remove concrete to nearest existing joint.

- E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.
- F. Where existing end of pipe culvert or end of sewer is to remain, install an 8-inch-thick concrete plug in pipe end prior to backfill.

3.4 BACKFILL

- A. Backfill of removal areas shall be in accordance with requirements of Section 31 23 16.16 - Excavation and Backfill for Minor Structures.

3.5 DISPOSAL

- A. Inlet frames, grates, and plates; and manhole frames and covers, may remain Owner's property. Disposal shall be in accordance with local and state laws and the responsibility of the Contractor.
- B. Remove from the site debris resulting from work under this section in accordance with local and state laws and the responsibility of the Contractor.

END OF SECTION

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## Section 02 41 13.23 - CUT, PLUG, AND ABANDONMENT OF MAINS

## PART 1 - GENERAL

## A. SECTION INCLUDES

1. Cut, plug, and abandonment of water mains.

## B. MEASUREMENT AND PAYMENT

1. There shall be no separate payment for work covered under this section. All costs associated with this item shall be included as subsidiary to other items included in the bid schedule.

## C. SUBMITTALS

1. Submittals shall conform to requirements of Section 01 33 00 - Submittal Procedures.
2. Submit product data for proposed plugs and clamps for approval.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Concrete for reaction blocks: Class B conforming to requirements of Section 33 05 16 - Concrete for Utility Construction.
- B. Plugs and clamps: Applicable for type of pipe to be plugged.

## PART 3 - EXECUTION

## 3.1 APPLICATION

- A. Do not begin cut, plug and abandonment operations until replacement main has been constructed, disinfected, and tested, and 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 the Owner immediately. Cut and plug abandoned main at point of other feed as directed by the Owner.
- E. Plug or cap ends or openings in abandoned main in manner approved by the Owner.
- F. Remove and dispose of surface identifications such as valve boxes and fire hydrants. Valve boxes in improved streets, other than shell, may be filled with concrete after removing cap.
- G. Backfill excavations in accordance with Section 31 23 23.13 - Excavation and Backfill for Utilities.

H. Repair street surfaces in accordance with Section 32 01 00 - Pavement Repair and Resurfacing.

END OF SECTION

## Section 31 06 20.16 - UTILITY BACKFILL MATERIALS

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Material Classifications.
- B. Utility Backfill Materials:
  - 1. Concrete sand
  - 2. Gem sand
  - 3. Pea gravel
  - 4. Crushed Aggregate: Crushed stone
  - 5. Crushed Aggregate: Crushed concrete
  - 6. Bank run sand
  - 7. Select backfill
  - 8. Random backfill
- C. Material Handling and Quality Control Requirements.

## 1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
  - 1. No payment will be made for backfill material under this Section. Include payment in unit price for applicable utility installation.

## 1.3 DEFINITIONS

- A. Unsuitable Material: Unsuitable soil materials are the following:
  - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
  - 2. Materials that cannot be compacted to the required density because of either gradation, plasticity, or moisture content.
  - 3. Materials that contain large clods, aggregate, and stones greater than 4 inches in any dimension; debris, vegetation, and waste; or any other deleterious materials.
  - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material: Suitable soil materials are the following:
  - 1. Those meeting this specification requirements.
  - 2. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement.
- C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for the structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

- D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. The foundation base provides a smooth, level working surface for the construction of the concrete foundation.
- E. Backfill Material: Classified soil material meeting specified quality requirements for the designated application as embedment or trench zone backfill.
- F. Embedment Material: Soil material placed under controlled conditions within the embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching, and initial backfill.
- G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in the trench zone from top of embedment zone to base coarse in paved areas or to the surface grading material in unpaved areas.
- H. 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.
- I. 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.
- J. Refer to Section 31 23 16.16 - Excavation and Backfill for Utilities for other definitions regarding utility installation by trench construction.

#### 1.4 REFERENCES

- A. ASTM C 33 - Specification for Concrete Aggregate.
- B. ASTM C 40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 123 - Test Method for Lightweight Pieces in Aggregate.
- D. ASTM C 131 - Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- E. ASTM C 136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- F. ASTM C 142 - Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. ASTM D 1140 - Test Method for Amount of Materials in Soils Finer Than No. 200 Sieve.
- H. ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- I. ASTM D 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
- J. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- K. ASTM D 4643 - Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.

- L. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.
- M. TxDOT Tex-104-E - Test Method for Determination of Liquid Limit of Soils (Part 1)
- N. TxDOT Tex-106-E - Test Method - Methods of Calculating Plasticity Index of Soils.
- O. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.

#### 1.5 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 - Submittal Procedures.
- 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 2.3, Materials Testing.
- D. Before stockpiling materials, submit a copy of temporary easement or approval from landowner for stockpiling backfill material on private property.
- E. For each delivery of material, provide a delivery ticket which includes source location.

#### 1.6 TESTS

- A. Perform tests of sources for backfill material in accordance with Paragraph 2.3.
- B. Verification tests of backfill materials may be performed by the Owner in accordance with Section 01 45 29 - Testing Laboratory Services and in accordance with Paragraph 3.3.
- C. Random fill obtained from the project excavation as source is exempt from pre-qualification requirements by Contractor but must be inspected by the testing lab for unacceptable materials based on ASTM D 2488.

### PART 2 - PRODUCTS

#### 2.1 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 2.1B, or by product descriptions, as given in Paragraph 2.2.
- B. Class Designations Based on Laboratory Testing:
  - 1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
    - a. Plasticity index: nonplastic.
    - b. Gradation: D60/D10 - 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 gravels and sands, little to moderate fines:
  - a. Plasticity index: nonplastic to 4.
  - b. Gradations:
    - (1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
    - (2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
    - (3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.
3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
  - a. Plasticity index: greater than 7.
  - b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
4. Class IVA: Lean clays (CL).
  - a. Plasticity Indexes:
    - (1) Plasticity index: greater than 7, and above A line.
    - (2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
  - b. Liquid limit: less than 50.
  - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
  - d. Inorganic.
5. Class IVB: Fat clays (CH)
  - a. Plasticity index: above A line.
  - b. Liquid limit: 50 or greater.
  - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
  - d. Inorganic.
6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to the more restrictive class.

## 2.2 PRODUCT DESCRIPTIONS

- A. Soils classified as silt (ML), 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 Owner. Soils in Class IVB, fat clay (CH) may be

used as backfill materials where allowed by the applicable backfill installation specification. Refer to Section 31 23 16.16 - Excavation and Backfill for Utilities.

- B. Provide backfill material that is free of stones greater than 4 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, such as crushed concrete, may be substituted for natural soil or rock products where indicated in the product specification, and approved by the 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 D 1140. 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 percent.
    - b. Plasticity index: not exceeding 7.
- E. Concrete Sand: Natural sand, manufactured sand, or a combination of natural and manufactured sand conforming to the requirements of ASTM C 33 and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

- F. Gem Sand: Sand conforming to the requirements of ASTM C 33 for coarse aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	95 to 100
No. 4	60 to 80
No. 8	15 to 40

- G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
1/2"	100
3/8"	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

- H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for the same construction activity from a single source.
2. Non-plastic fines.
3. Los Angeles abrasion test not exceeding 45 percent when tested in accordance with ASTM C 131.
4. Crushed aggregate shall have a minimum of 90 percent of the particles retained on the No. 4 sieve with 2 or more crushed faces as determined by Test Method Tex-460-A, Part I.
5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from a naturally occurring single source. Uncrushed gravel is not acceptable material for embedment where crushed stone is shown on the applicable utility embedment drawing details.
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, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.
7. 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

- I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Section 32 01 00 - Pavement Repair and Resurfacing, to meet plasticity criteria. Structural Select Backfill shall need the requirements described in the design plans or as directed by the Engineer.

- J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by the applicable backfill installation specification. Refer to Section 31 23 16.16 - Excavation and Backfill for Minor Structures and Section 31 23 23.13 - Excavation and Backfill for Utilities.
- K. Cement Stabilized Sand: Conform to requirements of Section 31 32 13.16 - Cement Stabilized Sand.
- L. Concrete Backfill: Conform to Class B concrete as specified in Section 33 05 16 - Concrete for Utility Construction.

### 2.3 MATERIAL TESTING

- 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.
- B. 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:
  - 1. 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.
  - 2. Plasticity of material passing the No. 40 sieve.
  - 3. Los Angeles abrasion test of material retained on the No. 4 sieve.
  - 4. Clay lumps.
  - 5. Lightweight pieces
  - 6. Organic impurities
- C. Production Testing. Provide reports to the Owner and the Engineer from an independent testing laboratory that backfill materials to be placed in the Work meet applicable specification requirements.
- D. Assist the Owner and Testing Lab in obtaining material samples for verification testing at the source or at the production plant.

## PART 3 - EXECUTION

### 3.1 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 approved source.
- B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that the Owner or Lab may obtain samples for verification testing.

- C. Obtain approval for each material source by the Owner before delivery is started. If sources previously approved do not produce uniform and satisfactory products, furnish materials from other approved sources. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet 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 Owner, expense for sampling and testing required to change to a different material will be credited to the Owner through a change order.
- D. 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.
- E. The Owner or any provided geotechnical reference information does not represent or guarantee that any soil found in the excavation work will be suitable and acceptable as backfill material.

### 3.2 MATERIAL HANDLING

- A. When backfill material is obtained from either a commercial or non-commercial borrow pit, open the pit to expose the vertical faces of the various strata for identification and selection of approved material to be used. Excavate the selected 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 Owner 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.

### 3.3 FIELD QUALITY CONTROL

- A. Quality Control
  - 1. The Owner or 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 Owner or Engineer may resample material at any stage of work or location if changes in characteristics are apparent.
- B. Production Verification Testing: The Owner's testing laboratory will provide verification testing on backfill materials, as directed by the Engineer. Samples may be taken at the source or at the production plant, as applicable.

END OF SECTION

## Section 31 10 00 - SITE CLEARING - PREPARATION OF SITE

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. This Item shall govern for the preparation of the site for construction operations by the removal and disposal of all obstructions, including obstructions not otherwise shown on the plans and specifications.
- B. Such obstructions shall be considered to include remains of houses, foundations, floor slabs, concrete, brick, lumber, plaster, septic tank drain fields, basements, abandoned utility pipes or conduits, equipment, fences, retaining walls, outhouses and shacks.
- C. This Item shall also include the removal of trees and shrubs and other landscape features not designated for preservation, stumps, brush, roots, vegetation, logs, curb and gutter, driveways, paved parking areas, miscellaneous stone, sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron and debris, whether above or below ground except live utility facilities.

## 1.2 UNIT PRICES

- A. No separate payment will be made for work performed under this Section. Include cost of such work in Contract unit prices for items listed in bid form requiring site clearing – preparation of site.

## PART 2 - EXECUTION

## 2.1 PREPARATION

- A. All areas, as shown on the plans, shall be cleared of all structures and obstructions as defined above. Those trees, shrubs and other landscape features specifically designated by the Engineer for preservation shall be carefully protected from abuse, marring, or damage during construction operations. Continual parking and/or servicing of equipment under the branches of trees marked for preservation will not be permitted. When trees and shrubs are designated for preservation and require pruning, they shall be trimmed as directed by the Engineer and all exposed cuts over 2 inches in diameter shall be treated with a material approved by the Engineer.
- B. Culverts, storm sewers, manholes and inlets shall be removed in proper sequence for maintenance of traffic and drainage.
- C. Underground obstructions, except those items designated for preservation, shall be removed to the following depths:
  - 1. In areas to receive embankment: 2 feet below natural ground, except when permitted by the plans, trees and stumps may be cut off as close to natural ground as practicable on areas which are to be covered by at least three feet of embankment.
  - 2. In areas to be excavated: 2 feet below the lower elevation of the excavation.
  - 3. All other areas: 1 foot below natural ground.

**2.2 DISPOSAL**

- A. Unless otherwise instructed by Owner or Engineer, all brush from existing trees and vegetation cleared on project site shall be collected and neatly stored on-site, in an area designated by Owner (for mulching and reuse).
- B. Contractor shall remove all debris, rock, trash and other material deemed objectionable by Owner or Engineer. Disposal shall be off-site shall be at contractor's sole expense.
- C. Unless otherwise shown herein, all materials and debris removed shall become the property of the Contractor and shall be removed from the project site in a manner satisfactory to Owner and Engineer.
- D. No timber shall be cut or defaced outside of the areas identified for clearing and demolition.

**2.3 BACKFILL**

- A. Holes remaining after removal of all obstructions, objectionable material, trees, stumps, etc., shall be backfilled with approved material, compacted and restored to approximately its original contours by blading, bulldozing, or by other methods, as approved by the Engineer. In areas to be immediately excavated, the backfilling of holes may not be required when approved by the Engineer.
- B. Before backfilling, the remaining ends of all abandoned storm sewers, culverts, sanitary sewers, conduits, and water or gas pipes over 3 inches in diameter, shall be plugged with an adequate quantity of concrete to form a tight closure.

END OF SECTION

## Section 31 23 00 - EARTHWORK, EXCAVATION, FILL AND GRADING

## PART 1 - GENERAL

1.1 This section shall cover earthwork, including general clearing, removal, disposal or reutilization of all excavated earthen materials necessary and placement of imported fill material for performing the Work as shown on the drawings, including sheeting and bracing, drainage, and other Work incidental to the preparation of the site for subsequent construction Work.

## 1.2 UNIT PRICES

## A. Unit Prices.

1. No separate payment will be made for work performed under this Section unless listed in the bid items. Include cost of such work in Contract unit prices for items listed in bid form requiring earthwork, excavation, fill and grading.

## PART 2 - PRODUCTS

- 2.1 Excavated Material: Contractor will utilize all of the excess excavated soil material that is not deemed objectionable unless otherwise instructed. All material will be placed, spread, compacted to lines and grades shown on plans or as directed by Engineer
- 2.2 Imported Fill: Select Backfill is acceptable as follows - Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 7 and 20. For pavement subgrade, select fill will serve as an equal to soil treated with lime in accordance with Section 32 11 13.13 – Lime Treatment for Subgrade, to meet plasticity criteria.
- 2.3 Imported Fill: Random Backfill is acceptable as follows - Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by the applicable fill or backfill installation specification. Refer to Section 31 23 16.16 - Excavation and Backfill for Minor Structures.
  - A. Excavation and Backfill for Utilities. If Random backfill is to be used for pavement subgrade, it shall be treated with lime in accordance with Section 32 11 13.13 – Lime Treatment for Subgrade, to meet plasticity criteria.

## PART 3 - EXECUTION

## 3.1 GENERAL:

- A. Prior to commencing construction operations, the contractor shall make all the provisions necessary to assure the protection of all existing improvements, both onsite and offsite. Where identified, he shall protect trees, shrubs, planting and grass areas and shall make provisions for maintaining public travel in an acceptable manner.
- B. PROTECTION OF EXISTING IMPROVEMENTS. Before any excavation is started, adequate protection shall be provided for all lawns, trees, shrubs, landscape work, fences, sidewalks, hydrants, utility poles, street, alley and driveway paving, curbs, storm sewers, ditches, headwalls, catch basins, surface inlets and all other improvements that are to remain in place. Such protection shall be provided as long as necessary to prevent damage from the Contractor's operations. Shrubs, bushes, small trees and flowers, which have to be removed to permit excavation for the waterline, shall be protected and



replanted or replaced when the backfill is completed. The Contractor shall exercise every precaution to prevent damage to property within and outside easements.

- C. Any damage to driveways, buildings, fences, retaining walls, culverts, drains, paving, sidewalks, etc. which are removed or damaged during construction shall be repaired by contractor. Repair, restoration or replacements of any improvements damaged or removed shall be the obligation of the contractor at no additional cost to Owner.
- D. Contractor will obtain all necessary permits in public and private rights-of-way from the Owner or any other local regulatory authority, as required
- E. Drainage: Contractor shall make provisions for temporarily handling runoff on site, flows in existing water bodies, ditches, sewers, and trenches by employing pipes, flumes, or other approved methods at all times when his operations would, in any way, interfere with the natural functioning of said water bodies, ditches, sewers and drains. The contractor shall at all times during construction provide and maintain sufficient equipment for the lawful disposal of all ponding water, or water which enters excavations, to render such area firm and dry through the construction phase.

### 3.2 DISPOSAL OF EXCAVATED MATERIAL

- A. Contractor will utilize all of the excess excavated material, unless otherwise instructed. In such event, Contractor shall dispose of material off site at no cost to Owner. All material will be graded and compacted as shown on plans or as directed by Engineer.

### 3.3 DESCRIPTION

- A. Work shall consist of the required excavation and placement of excavated materials, and the placement and compaction of imported fill material, within the limits of the site as shown on the plans. The proper utilization of all excavated and imported fill material and the construction shaping and finishing of all earth work on the entire length of pavement, and all other areas within the site will be done in conformity with the required lines, grades, and typical cross sections in accordance with specification requirements herein outlined.

### 3.4 CONSTRUCTION METHODS

- A. All excavation and corresponding embankment construction shall be performed as specified herein and in the design plans and the completed site shall conform to the established alignment, grades and cross sections.
- B. When using either excavated material or imported soil material to perform fill or grading operations, each lift shall be mechanically compacted in 6" (six inch) layers to a minimum density of 90% Standard Proctor, for general areas. Engineer may select random areas for density testing to confirm minimum compaction. In areas of street construction (subgrade) minimum density shall be 95%. For backfill of utilities (trenches) or structures, minimum density shall be as prescribed in the applicable specifications, or on the plans.

END OF SECTION

## Section 31 23 16.16 - EXCAVATION AND BACKFILL FOR MINOR STRUCTURES

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Excavation, backfilling, and compaction of backfill for minor structures.

## 1.2 UNIT PRICES

- A. Unit Prices.
  - 1. No payment will be made for structural excavation and backfill under this Section. Include payment in unit price or lump sum for construction of structures.

## 1.3 DEFINITIONS

- A. Unsuitable Material: Unsuitable soil materials are the following:
  - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
  - 2. Materials that cannot be compacted to the required density due to gradation, plasticity, or moisture content.
  - 3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
  - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.
- C. Select Material: Material as defined in Section 31 06 20.16 - Utility Backfill Materials.
- D. Backfill: Select material meeting specified quality requirements, placed and compacted under controlled conditions around structures.
- E. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for the structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.
- F. Foundation Base: For foundation base material, use crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. The foundation base provides a smooth, level working surface for the construction of the concrete foundation.
- G. Foundation Subgrade: Foundation subgrade is the surface of the natural soil which has been excavated and prepared to support the foundation base or foundation backfill, where needed.
- H. Ground Water Control Systems: Installations external to the excavation such as well points, eductors, or deep wells. Ground water control includes dewatering to lower the ground water, intercepting

seepage which would otherwise emerge from the side or bottom of the excavation, and depressurization to prevent failure or heaving of the excavation bottom. Refer to Section 31 23 19 - Control of Ground Water and Surface Water.

- I. Surface Water Control: Diversion and drainage of surface water runoff and rainwater away from the excavation. Remove rainwater and surface water which accidentally enters the excavation as a part of excavation drainage.
- J. Excavation Drainage: Removal of surface and seepage water in the excavation by sump pumping and using French drains surrounding the foundation to intercept the water.
- K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below the foundation as shown on Drawings and backfilled with foundation backfill material.
- L. Shoring System: A structure that supports the sides of an excavation to maintain stable soil conditions and prevent cave-ins.

#### 1.4 REFERENCES

- A. ASTM D 558 - Test Methods for Moisture-Density Relations of Soil Cement Mixtures.
- B. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in. (304.88-mm) Drop.
- C. ASTM D 1556 - Density of Soil in Place by the Sand-Cone Method.
- D. ASTM D 2487 - Classification of Soils for Engineering Purposes.
- E. ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D 3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
- G. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- H. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.
- I. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.
- J. Federal Regulations, 29 CFR, Part 1926, Standards - Excavation, Occupational Safety and Health Administration (OSHA).

#### 1.5 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 - Submittal Procedures.
- B. Submit a work plan for excavation and backfill for each structure with complete written description which identifies details of the proposed method of construction and the sequence of operations for construction relative to excavation and backfill activities. The descriptions, with supporting

illustrations, shall be sufficiently detailed to demonstrate to the Owner that the procedures meet the requirements of the Specifications and Drawings.

- C. Submit excavation safety system plan.
  - 1. The excavation safety system plan shall be in accordance with applicable OSHA requirements for all excavations.
  - 2. The excavation safety system plan shall be in accordance with the requirements of Section 31 41 33 - Trench Safety System, for all excavations that fall under State and Federal trench safety laws.
- D. Submit a ground and surface water control plan in accordance with requirements in this Section and Section 31 23 19 - Control of Ground Water and Surface Water.
- E. Submit backfill material sources and product quality information in accordance with requirements of Section 31 06 20.16 - Utility Backfill Materials.

## 1.6 TESTS

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the Owner in accordance with requirements of Section 01 45 29 - Testing Laboratory Services and as specified in this Section.
- B. Contractor shall perform embedment and backfill material source qualification testing in accordance with requirements of Section 31 06 20.16 - Utility Backfill Materials and the design plans.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT

- A. Perform excavation with equipment suitable for achieving the requirements of this Specification.
- B. Use equipment which will produce the degree of compaction specified. Backfill within 3 feet of walls shall be compacted with hand operated equipment. Do not use equipment weighing more than 10,000 pounds closer to walls than a horizontal distance equal to the depth of the fill at that time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

### 2.2 MATERIAL CLASSIFICATIONS

- A. Backfill materials shall conform to the classifications and product descriptions of Section 31 06 20.16 - Utility Backfill Materials. The classification or product description for backfill applications shall be as shown on the Drawings and as specified.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Conduct an inspection to determine condition of existing structures and other permanent installations.
- B. Set up necessary street detours and barricades in preparation for excavation if construction will affect traffic. Conform to State and local government requirements. Maintain barricades and warning

devices at all times for streets and intersections where work is in progress, or where affected by the Work, and is considered hazardous to traffic movements.

- C. Perform work in accordance with OSHA standards. Employ an excavation safety system as specified in Section 31 41 33 - Trench Safety Systems.
- D. Remove existing pavements and structures, including sidewalks and driveways, in accordance with requirements of Section 02 41 13.13 - Removing Existing Pavements and Structures.
- E. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 31 23 19 – Dewatering - Control of Ground Water and Surface Water.

### 3.2 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.
- 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 are indicated on the Drawings.
- D. Prevent erosion of excavations and backfill. Do not allow water to pond in excavations.
- E. Maintain excavation and backfill areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no additional cost to the City.

### 3.3 EXCAVATION

- A. Perform excavation work so that the underground structure can be installed to depths and alignments shown on Drawings. Use caution during excavation work to avoid disturbing surrounding ground and existing facilities and improvements. Keep excavation to the absolute minimum necessary. No additional payment will be made for excess excavation not authorized by Owner.
- B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Owner and obtain instructions before proceeding in such areas.
- C. Immediately notify the agency or company owning any line which is damaged, broken or disturbed. Obtain approval from Owner and agency for any repairs or relocations, either temporary or permanent.
- D. Avoid settlement of surrounding soil due to equipment operations, excavation procedures, vibration, dewatering, or other construction methods.
- E. Provide surface drainage during construction to protect work and to avoid nuisance to adjoining property. Where required, provide proper dewatering and piezometric pressure control during construction.
- F. Conduct hauling operations so that trucks and other vehicles do not create a dirt nuisance in streets. Verify that truck beds are sufficiently tight and loaded in such a manner that objectionable materials will not spill onto streets. Promptly clear away any dirt, mud, or other materials that spill onto streets or are deposited onto streets by vehicle tires.

- G. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed, replace those which are damaged or destroyed by the Work.
- H. Provide sheeting, shoring, and bracing where required to safely complete the Work, to prevent excavation from extending beyond limits indicated on Drawings, and to protect the Work and adjacent structures or improvements. Sheeting, shoring, and bracing used to protect workmen and the public shall conform to requirements of Section 31 41 33 - Trench Safety Systems.
- I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, concrete fill, cement stabilized sand, or other material approved by Owner.
- J. After completion of the structure, remove sheeting, shoring, and bracing unless shown on Drawings to remain in place or directed by Owner in writing that such temporary structures may remain. Remove sheeting, shoring and bracing in such a manner as to maintain safety during backfilling operations and to prevent damage to the Work and adjacent structures or improvements.
- K. Immediately fill and compact voids left or caused by removal of sheeting with cement stabilized sand or material approved by Owner.

### 3.4 HANDLING EXCAVATED MATERIALS

- A. Classify excavated materials. Place material which is suitable for use as backfill in orderly piles at a sufficient distance from excavation to prevent slides or cave-ins.
- B. Provide additional backfill material if adequate quantities of suitable material are not available from excavation and trenching operations at the site.

### 3.5 DEWATERING

- A. Provide ground water control per Section 31 23 19 - Control of Ground Water and Surface Water.
- B. Keep ground water surface elevation a minimum of 2 feet below the bottom of the foundation base.
- C. Maintain ground water control as directed by Section 31 23 19 - Control of Ground Water and Surface Water and until the structure is sufficiently complete to provide the required weight to resist hydrostatic uplift with a minimum safety factor of 1.2.

### 3.6 FOUNDATION EXCAVATION

- A. Notify Owner at least 48 hours prior to planned completion of foundation excavations. Do not place the foundation base until the excavation is accepted by the Owner.
- B. Excavate to elevations shown on Drawings, as needed to provide space for the foundation base, forming a level undisturbed surface, free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or a material as directed by the Owner. Prior to placing material over it, recompact the subgrade where indicated on the Drawings, scarifying as needed, to 95 percent of the maximum Standard Dry Density according to ASTM D 698. If the specified level of compaction cannot be achieved, moisture condition the subgrade and recompact until 95 percent is achieved, over-excavate to provide a minimum layer of 24 inches of foundation backfill material, or other means acceptable to the Owner.
- C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by the Owner.

- D. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying to maintain foundation subgrade in a satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement.
- E. Soils which become unsuitable due to inadequate dewatering or other causes, after initial excavation to the required subgrade, shall be removed and replaced with foundation backfill material, as directed by Owner, at no additional cost to the City.
- F. Place foundation base, or foundation backfill material where needed, over the subgrade on same day that excavation is completed to final grade. Where base of excavation is left open for longer periods, protect them with a seal slab or cement-stabilized sand.
- G. Crushed aggregate, and other free draining Class I materials, shall have a filter fabric separating it from native soils or select material backfill. The fabric shall overlap a minimum of 12 inches beyond where another material stops contact with the soil.
- H. Crushed aggregate, and other Class I materials, shall be placed in uniform layers of 8-inch maximum thickness. Compaction shall be by means of at least two passes of a vibratory compactor.

### 3.7 FOUNDATION BASE

- A. After the subgrade is properly prepared, including the placement of foundation backfill where needed, the foundation base shall be placed. The foundation base shall consist of a 12-inch layer of crushed stone aggregate or cement stabilized sand. Alternately, a 2000psi concrete seal slab with a minimum thickness of 4 inches may be placed. The foundation base shall extend a minimum of 12 inches beyond the edge of the structure foundation, unless shown otherwise on the Drawings.
- B. Where the foundation base and foundation backfill are of the same material, both can be placed in one operation.

### 3.8 BACKFILL

- A. Complete backfill to surface of natural ground or to lines and grades shown on Drawings. Use existing material that qualifies as select material, unless indicated otherwise. Deposit backfill in uniform layers and compact each layer as specified.
- B. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that the concrete has reached a minimum of 85 percent of the specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill operations until the slab or intermediate walls have been placed and concrete has attained sufficient strength.
- C. Remove concrete forms before starting backfill and remove shoring and bracing as work progresses.
- D. Maintain fill material at no less than 2 percent below nor more than 2 percent above optimum moisture content. Place fill material in uniform 8-inch maximum loose layers. Compaction of fill shall be to at least 95 percent of the maximum standard dry density according to ASTM D 698 under paved areas. Compact to at least 90 percent around structures below unpaved areas.
- E. Where backfill is placed against a sloped excavation surface, run compaction equipment across the boundary of the cut slope and backfill to form a compacted slope surface for placement of the next layer of backfill.

- F. Place backfill using cement stabilized sand in accordance with Section 31 32 13.16 - Cement Stabilized Sand.

### 3.9 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Section 01 45 29 - Testing Laboratory Services.
- B. Tests will be performed initially on minimum of one different sample of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is a noticeable change in material gradation or plasticity.
- C. In-place density tests of compacted subgrade and backfill will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at the following frequencies and conditions:
  - 1. A minimum of one test for every 100 cubic yards of compacted backfill material.
  - 2. A minimum of three density tests for each full work shift.
  - 3. Density tests will be performed in all placement areas.
  - 4. The number of tests will be increased if inspection determines that soil types or moisture contents are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density.
- D. At least one test for moisture-density relationships will be initially performed for each type of backfill material in accordance with ASTM D 698. Additional moisture-density relationship tests will be performed whenever there is a noticeable change in material gradation or plasticity.
- E. If tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

### 3.10 DISPOSAL OF EXCESS MATERIAL

- A. Removal of site debris resulting from work under this section are the responsibility of the Contractor. Dispose of in accordance with local and state regulations.

END OF SECTION



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## SECTION 31 23 23.13 - EXCAVATION AND BACKFILL FOR UTILITIES

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

## 1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
  - 1. No additional payment will be made for trench excavation, embedment and backfill under this Section. Include cost in the unit price for installed underground piping, sewer, conduit, or duct work.
  - 2. 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.

## 1.3 DEFINITIONS

- A. Pipe Foundation: Suitable and stable native soils that are exposed at the trench subgrade after excavation to depth of bottom of the bedding as shown on the Drawings, or foundation backfill material placed and compacted in over-excavations.
- B. Pipe Bedding: The portion of trench backfill that extends vertically from top of foundation up to a level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.
- C. Haunching: The material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.
- D. Initial Backfill: The portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to a level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.
- E. Pipe Embedment: The portion of trench backfill that consists of bedding, haunching and initial backfill.
- F. Trench Zone: The portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.
- G. Unsuitable Material: Unsuitable soil materials are the following:
  - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
  - 2. Materials that cannot be compacted to required density due to either gradation, plasticity, or moisture content.
  - 3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.

4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- H. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement are considered suitable, unless otherwise indicated.
  - I. Backfill: Suitable material meeting specified quality requirements, placed and compacted under controlled conditions.
  - J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Section 31 23 19 - Control of Ground Water and Surface Water.
  - K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as a part of excavation drainage.
  - L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using a drainage layer, as defined in ASTM D 2321, placed on the foundation beneath pipe bedding or thickened bedding layer of Class I material.
  - M. Trench Conditions are defined with regard to the stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.
    1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as a result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
    2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
      - a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
      - b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in the embedment zone in combination with ground water control in predominately sandy or silty soils.
    3. Unstable Trench: Unstable trench conditions exist in the pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.
  - N. Subtrench: Subtrench is a special case of benched excavation. Subtrench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of a subtrench depends upon trench stability and safety as determined by the Contractor.

- O. Trench Dam: A placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along the trench.
- P. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.
- Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.
- R. Trench Safety Systems include both protective systems and shoring systems as defined in Section 31 41 33 - Trench Safety Systems.
- S. Trench Shield (Trench Box): A portable worker safety structure moved along the trench as work proceeds, used as a protective system and designed to withstand forces imposed on it by cave-in, thereby protecting persons within the trench. Trench shields may be stacked if so designed or placed in a series depending on depth and length of excavation to be protected.
- T. Shoring System: A structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of the ground affecting adjacent installations or improvements.
- U. Special Shoring: A shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on the Drawings.

#### 1.4 REFERENCES

- A. ASTM C 12 - Standard Practice for Installing Vitriified Clay Pipe Lines.
- B. ASTM D 558 - Test Methods for Moisture-Density Relations of Soil Cement Mixtures.
- C. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (304.8-mm) Drop.
- D. ASTM D 1556 - Test Method for Density in Place by the Sand-Cone Method.
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
- F. ASTM D 2487 - Classification of Soils for Engineering Purposes.
- G. ASTM D 2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- H. ASTM D 3017 - Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- I. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- J. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.

- K. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.
- L. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

#### 1.5 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.

#### 1.6 SUBMITTALS

- A. Conform to Section 01 33 00 - Submittal Procedures.
- 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 pre-manufactured 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 31 23 19 – Dewatering - Control of Ground Water and Surface Water.
- D. Submit backfill material sources and product quality information in accordance with requirements of Section 31 06 20.16 - Utility Backfill Materials.
- E. Submit a trench excavation safety program in accordance with requirements of Section 31 41 33 - Trench Safety System. Include designs for special shoring meeting the requirements defined in Paragraph 1.08, Special Shoring Design Requirements.
- 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.

#### 1.7 TESTS

- A. Density testing of compacted subgrade material for first coarse and second coarse of compacted base shall be made at all driveways and intersecting streets. In addition, one (1) density test per lift per five hundred (500) feet of installed pipeline shall be conducted.
- 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 01 45 29 - Testing Laboratory Services and as specified in this Section.

- C. Perform backfill material source qualification testing in accordance with requirements of Section 32 23 23.16 - Utility Backfill Materials.

## 1.8 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 pre-manufactured system selected by the Contractor's Professional Engineer to meet the project site requirements based on the manufacturer's standard design.

## PART 2 - PRODUCTS

### 2.1 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 requirements as specified in Paragraph 1.09, Shoring Design Requirements.

### 2.2 MATERIAL CLASSIFICATIONS

- A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Section 32 23 23.16 - Utility Backfill Materials.
- B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Section 33 05 16 - Concrete for Utility Construction.
- C. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.
- D. Timber Shoring Left in Place: Untreated oak.

## PART 3 - EXECUTION

### 3.1 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.
- C. Ditching machines will be permitted at Contractor's option, subject to the approval of the Owner, whenever their use is applicable and practical for work shown on the drawings. A certain amount of hand excavation may be required due to special field conditions and to minimize damage to improvements and trees.
- D. In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Any pipe damaged thereby shall be repaired or replaced at the option of the OWNER and at the expense of the Contractor.

### 3.2 PREPARATION

- A. Establish traffic control to conform with requirements of Section 01 55 26 - Traffic Control and Regulation. Maintain barricades and warning lights for streets and intersections affected by the Work that is considered hazardous to traffic movements.
- B. Perform work to conform with applicable safety standards and regulations. Employ a trench safety system as specified in Section 31 41 33 - 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 Owner and Utility Owner for any repairs or relocations, either temporary or permanent.
- D. Remove existing pavements and structures, including sidewalks and driveways, to conform with requirements of Section 02 41 13.13 - Removing Existing Pavements and Structures, as applicable.
- E. Install and operate necessary dewatering and surface water control measures to conform with Section 31 23 19 - Dewatering - 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 02 21 13 - Field Surveying.

### 3.3 PROTECTION

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within the grading limits.
- 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 are indicated on the Drawings.
- D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to City.

## 3.4 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 18	O.D. + 18
18 to 30	O.D. + 24
Greater than 30	O.D. + 36

- D. Use sufficient trench width or benches above the embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from the surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.
- E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify the Owner and obtain instructions before proceeding.
- F. Shoring of Trench Walls.
  - 1. Install Special Shoring in advance of trench excavation or simultaneously with the trench excavation, so that the soils within the full height of the trench excavation walls will remain 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 Owner, 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 shall be the equivalent of a 1-inch-thick steel plate. 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.

### 3.5 HANDLING EXCAVATED MATERIALS

- A. Use only excavated materials which are suitable as defined in this Section and conforming with Section 32 23 23.16 - 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 with requirements of Section 32 23 23.16 - Utility Backfill Materials.
- C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect excess stockpiles for use on site. Maintain site conditions in accordance with Section 31 10 00 – Site Clearing – Preparation of Site.

### 3.6 GROUND WATER CONTROL

- A. Implement ground water control according to Section 31 23 19 – Dewatering - Control of Ground Water and Surface Water. Provide a stable trench to allow installation in accordance with the Specifications.

### 3.7 TRENCH FOUNDATION

- A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.
- B. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

### 3.8 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 as shown on Drawings.
- C. For pipe installation, manually spread embedment materials around the pipe to provide uniform bearing and side support when compacted. Do not allow materials to free-fall from heights greater

than 24 inches above top of pipe. Perform placement and compaction directly against the undisturbed soils in the trench sidewalls, or against sheeting which is to remain in place.

- 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. Place geotextile to prevent particle migration from the in-situ soil into open-graded (Class I) embedment materials or drainage layers.
- F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.
- G. Place haunching material manually around the pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside the pipe with sandbags or other suitable means.
- H. Install electrical conduit as directed in the design plans or as specified in other Sections.
- I. Shovel in-place and compact embedment material 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 next lift. Water tamping is not allowed.
- J. OPEN CUT BACKFILL - Backfilling of excavated trenches in open cut shall be commenced as soon as possible after the water or sewer line is laid and the jointing and alignment are approved, but not until authorized by the Owner.

**BEDDING PROCEDURES** - The following bedding procedures will be used for Polyvinyl Chloride (PVC) Pipe, Asbestos Cement Pipe and Vitrified Clay Pipe. Before pipes have been tested and approved, partial backfilling shall be done with approved material free from large clods.

When trench bottom is unstable, or when pipe is to be placed under groundwater (below water table), foundation preparation shall be required, preferably with ground water drawdown procedures. If drawdown equipment is not used or gravel stabilization or approved substitute shall be required and no pipe will be laid until stabilization is to the satisfaction of the Utility Owner.

Sand bedding shall meet Bank Run Sand as per Section 31 06 20.16 – Utility Backfill Materials.

Sand Bedding zone shall extend from a point at least 6 inches below bottom of pipe to a point at least 6 inches above top of pipe, as well as at least 6 inches on each side of pipe and shall be compacted to at least 90% of maximum density as determined by ASTM Standard D698, latest revision.

Sand bedding from 6 inches below bottom of pipe to bottom of pipe shall be placed in one lift and shall be mechanically tamped. Sand bedding from bottom of pipe to spring line of pipe shall be placed by hand in 4 inch lifts and shall be hand tamped with proper tools. Sand bedding from spring line of pipe to 6 inches above top of pipe shall be placed in 6 inch lifts and shall be hand tamped with proper tools.

Final Backfill Above Pipe Zone (6" Above Pipe or Conduit to base of roadway section or finished grade elevation). The backfill above the pipe zone shall be, unless otherwise indicated on the drawings, in accordance with the following.

- 1. Class "A" Mechanical Compaction. Trench under existing or proposed flexible pavements and gravel surfaces - place Type "D" (as per design plans) sand backfill material in layers not to

exceed six (6) inches compacted measurement. Compact with mechanical tampers to a dry density of at least 95% of maximum density as determined by ASTM Standard D698, latest revision. Each layer, before compaction, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the water or sewer line in any way. When the material does not contain sufficient moisture to obtain thorough compaction, it shall be moistened or wetted as directed by the Utility Owner.

2. Class "B" Mechanical Compaction. Trench under unimproved roadways, unsurfaced road shoulders, unimproved driveways and under turfed or seeded lawn areas - place Type "E" (as per design plans) excavated material in backfill layers not to exceed twelve (12) inches loose measurement. Compact with mechanical tampers to at least 90% of maximum density as determined by ASTM Standard D698, latest revision. Each layer, before compaction, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the water or sewer line in any way. When the material does not contain sufficient moisture to obtain thorough compaction, it shall be moistened or wetted as directed by the Utility Owner.

- K. SPECIAL BACKFILL CONDITIONS - The trenches need not be completely backfilled until all required pressure and leakage tests are performed and until the utilities system as installed conform to the requirements specified.

Trenches improperly backfilled shall be reopened to the depth required for proper compaction, and refilled and compacted as specified, or the condition shall be otherwise corrected as permitted by the Owner. The surface shall be restored to its original condition as nearly as practicable and as hereinafter specified. Immediately after the pipe, or utility lines, is bedded and joined, as indicated on the drawings or specified, the backfill material shall be deposited within the pipe zone in uniform layers not to exceed six (6) inches and at the proper moisture content. The layers shall be compacted with mechanical hand tampers or other approved equipment to the density herein specified. The backfill shall rise the same on each side of the pipe and coincidentally be tamped in layers until there is a cover of 12 inches over the top of the pipe. Walking or working over the pipe will not be permitted until the trench is backfilled to 12 inches above the pipe.

Where pavement on a State Highway or other system roadway is cut, final backfill material and pavement shall be replaced in accordance with Texas Department of Transportation requirements.

Where pavement is cut in locations other than State Highways, whether gravel topping or hard surfaced, the surfacing shall be restored to its original finish and in equal condition and quantities as found at the beginning of construction. Trenches on hard surfaced roads and State Highways shall be backfilled to a density of 95% as determined by the American Association of State Highway Officials Method T99 for compaction and density of soils.

Successful Contractor shall determine all requirements of various controlling agencies in connection with backfilling, pavement replacement and general construction before starting construction.

In traffic areas including individual driveways, Contractor shall restore traffic surfaces to usable condition immediately upon completion of pipe installation. In such locations, Owner will rely upon hydrostatic test to determine acceptability of construction. All excess dirt from all construction work shall be disposed of promptly by Contractor, either by hauling or at directions of Owner.

- L. Place trench dams in Class I embedments in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

### 3.9 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 water and sewer lines, backfill in trench zone, including auger pits, as per the design plans and section 3.8.J.
- D. When shown on Drawings, a random backfill of suitable material may be used in trench zone for trench excavations outside pavements.
- E. Backfill materials shall be placed in uniform layers and compacted to percentage of density hereinafter specified. Moisture shall be controlled between optimum and 2 percentage points over. Methods to secure optimum moisture content shall be Contractor's responsibility. Compacting equipment and method of compaction shall be the responsibility of Contractor and shall be such that uniform density will be obtained over entire area and depth of material being compacted. Fill material shall be thoroughly broken up before being spread into uniform layers.

Backfill not otherwise specified shall be compacted to at least 95% of maximum density as determined by ASTM Specification D698.

- F. 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.
  - 4. Moisture content as necessary to achieve density.
- G. For electric conduits, remove formwork used for construction of conduits before placing trench zone backfill.

### 3.10 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.

### 3.11 FIELD QUALITY CONTROL

- A. Test for material source qualifications as defined in Section 31 06 20.16 - Utility Backfill Materials.
- B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to Owner.

- C. Tests will be performed on a minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is a noticeable change in material gradation or plasticity.
- D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Additional moisture-density relationship tests will be performed whenever there is a noticeable change in material gradation or plasticity.
- E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at the following frequencies and conditions.
1. A minimum of one test for every 20 cubic yards of compacted embedment and for every 50 cubic yards of compacted trench zone backfill material.
  2. A minimum of three density tests for each full shift of Work.
  3. Density tests will be distributed among the placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.
  4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.
  5. Density tests may be performed at various depths below the fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.
  6. Two verification tests will be performed adjacent to in-place tests showing density less than the acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.
  7. Recompact 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.
- H. Determination of density of backfill, shall be made in conformance with the requirements of ASTM D2922, ASTM D1556 or ASTM D2167.
- I. Determination of density of cohesionless material shall be made in accordance with ASTM D2049. Relative density of 75% shall be considered as satisfactory for cohesionless material.
- J. Testing shall be performed by a soil consultant employed by the Owner and at no expense to the Contractor to test compaction of backfill material. When soil tests indicate densities less than those specified by this section, the material shall be recompact and tested at the Contractor's expense.

## 3.12 DISPOSAL OF EXCESS MATERIAL

- A. Dispose of excess materials in accordance with all applicable local and state regulations and as required in the contract documents.
- B. The Contractor shall restore or replace all removed or damaged paving, curbing sidewalks, gutters, shrubbery, fences, sod, or other disturbed surfaces of structures in a condition equal to that before the work began and to the satisfaction of the Owner and shall furnish all labor and material incidental thereto, in restoring improved surfaces, new pavement shall be laid. No permanent surface shall be placed within 30 days after the backfilling has been completed, except by order of the Owner.
- C. Surplus pipeline material, tools and temporary structures shall be removed by the Contractor. All dirt, rubbish, and excess earth from excavations shall be hauled to a dump provided by the Contractor, and the construction site shall be left clean, to the satisfaction of the Owner.

END OF SECTION

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## Section 31 41 33 - TRENCH SAFETY SYSTEMS

## PART 1 - GENERAL

## 1.1 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.

## 1.2 UNIT PRICES

- A. Payment for this item shall be made on a lump sum basis and shall cover an approved trench safety system plan prepared and sealed by a Texas licensed professional engineer and as per OSHA 29CFR. Costs associated with any changes or revisions to the Contractor's Trench Safety Plan shall be borne on by the Contractor.
- B. Payment for trench safety systems used on trench excavations of greater than 5-foot depth is on a linear foot basis measured along the centerline of the trench.

## 1.3 DEFINITIONS

- A. A trench shall be 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 will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and these installation to dimensions equivalent of a trench as defined.
- C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

## 1.4 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01 33 00 - Submittal Procedures.
- 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.
- C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by the Contractor.
- D. Review of the safety program by the Owner or Engineer will only be regarding compliance with this specification and will not constitute approval by the Owner or Engineer nor relieve Contractor of obligations under State and Federal trench safety laws.

## 1.5 REGULATORY REQUIREMENTS



- A. Install and maintain trench safety systems in accordance with the detail specifications set out in 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 City projects. The City 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 regarding Trench Safety Systems, is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., §756.021 (Vernon 1991).

#### 1.6 INDEMNIFICATION

- A. Contractor shall indemnify and hold harmless the Owner, Engineer and their employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgements or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.
- B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner and Engineer in case the Owner or Engineer are 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

##### 3.1 INSTALLATION

- A. Install and maintain trench safety systems in accordance with provisions of OSHA 29CFR.
- 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.
- C. A competent person, as identified in the Contractor's Trench Safety Program, shall verify that trench boxes and other pre-manufactured systems are certified for the actual installation conditions.

##### 3.2 INSPECTION

- A. Contractor, or Contractor's independently retained consultant, shall make daily inspections 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, Contractor shall immediately stop work in the trench and move personnel to safe locations until the necessary precautions have been taken by Contractor to safeguard personnel entering the trench.

C. Maintain a permanent record of daily inspections.

3.3 FIELD QUALITY CONTROL

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

END OF SECTION

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## Section 31 71 19 - PIPE AND CASING AUGERING

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Installation of casing for pipe by dry augering or slurry boring methods, together with installation of pipe in the casing.
- B. Installation of pipe by slurry boring methods. Construction casing may be used at the Contractor's option.

## 1.2 UNIT PRICES

## A. Unit Prices.

- 1. Casing installed by augering methods shown on the Drawings, will be measured and paid by the linear foot from end to end of the augered section. Casing installed in the auger pits or open cuts adjacent to augered sections shall be paid for under a separate bid item.
- 2. Casing installed by open-cut methods where shown on the Drawings, will be measured and paid by the linear foot from end to end of the casing.
- 3. Pipe augering shown on the Drawings, will be measured and paid by the linear foot from end to end of the augered section.
- 4. Payment will include and be full compensation for labor, equipment, materials and supervision for excavation and construction of the pipe, complete in place including disposal of excess materials, shoring, dewatering, utility adjustments, grouting, backfill, clean-up, and other related work necessary for construction as indicated on the Drawings and specified this Section.
- 5. Cost for pits and other excavations are to be included in the unit price for pipe with or without casing.
- 6. Trench safety systems for pits are to be included in the unit price for pipe with or without casing.

## 1.3 DEFINITIONS

- A. Augering means either "dry augering" or "slurry boring".
- B. Dry augering is jacking a casing while excavating the soil at the heading and transporting the spoil back through the casing by an otherwise uncased auger.
- C. Slurry boring is installing a casing or pipe by drilling a small diameter pilot hole, followed by reaming the bore to full diameter with the assistance of slurry or drilling fluids.

## 1.4 REFERENCE STANDARDS

- A. American Railway Engineering Association (AREA) Manual for Railway Engineering.

- B. American Association of State Highway and Transportation Officials (AASHTO).
- C. AWWA C 200 - Steel Water Pipe, 6-Inch and Larger.

#### 1.5 SUBMITTAL

- A. Make submittals in conformance with Section 01 33 00 - Submittal Procedures.
- B. For installation by augering, submit for review:
  - 1. Description of mechanized excavating equipment.
  - 2. Method of controlling line and grade.
  - 3. Grouting techniques to be used for filling annular void between pipe and casing, and void between pipe or casing and the ground, including equipment, pumping and injection procedures, pressure grout types, and mixes.
  - 4. Locations and dimensions of pits.
  - 5. Pit design and construction drawings.
  - 6. Identification of casings required and paid under the Contract and casings installed at the Contractor's option.
  - 7. Design of casings.
- C. Prepare auger pit and casing design submittals that are site specific. Have auger pit and casing design submittals signed and sealed by a qualified Professional Engineer registered in the State of Texas.

#### 1.6 CRITERIA FOR DETERMINING CASING INSTALLATION LOADS

- A. Select and design casing pipe and pipe joints to carry the thrust of jacks or loads due to the pulling mechanism in combination with overburden, earth and hydrostatic loads. Select casings for dry augering to withstand the action of the auger without damage.
- B. Have a Professional Engineer determine design stresses, design deflections and factors of safety for design of casing. Present such determination as a part of the design submittal. Apply the following maximum casing pipe stresses and deflections to casings shown on the Drawings:
  - 1. Design stress in the pipe wall: 50 percent of the minimum yield point of the steel or 18,000 psi, whichever is less, when subjected to the applicable loading conditions.
  - 2. Wall thickness: Maximum allowable deflection which does not exceed 3 percent of nominal casing diameter.
- C. Use Cooper E-80 locomotive loading distributions as criteria for railroad crossings in accordance with AREA's specifications for culverts. In the design, account for additive loadings due to multiple tracks.
- D. Use H-20 vehicle loading distributions as criteria for truck loading in accordance with AASHTO.

- E. When not specifically indicated on the Drawings, select casing diameter to permit practical installation (including skids if applicable) and grouting.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Provide casing pipe which is straight, circular in section, uncoated, welded steel pipe, manufactured in accordance with AWWA C 200.
- B. Provide pipe in accordance with the plans.
- C. Provide restrained-joint pipe when installing pipe in slurry bored holes by a pull-back method.

## PART 3 - EXECUTION

### 3.1 LOCATION AND SIZE OF AUGER PITS

- A. Locate auger pits for slurry boring so that the distance between pits is no greater than 80 feet; and for dry augering not more than 120 feet apart.
- B. Where possible, locate auger pits and associated work areas to avoid blocking driveways and cross streets and to minimize disruption to business and commercial interests. Avoid auger pit locations near areas identified as potentially contaminated.
- C. Make size adequate for construction of any structures indicated on the Drawings. Provide adequate room to meet Contractor's operational requirements for augering.
- D. Provide a portable concrete traffic barrier around the periphery of the pit, meeting applicable safety standards. Properly maintain the barrier throughout the period the pit remains open. Angle traffic barriers in the direction of the lane flow; do not place barriers perpendicular to on-coming traffic.
- E. Provide a full cover or other security fencing for each access pit in which there is no construction activity or which is unattended by Contractor's personnel.

### 3.2 DRY AUGERING OF CASING

- A. Provide jacks, mounted on a frame or against a backstop, of a capacity suitable for forcing the excavating auger and casing through the soil conditions to be encountered. Operate jacks so that even pressure is applied to the casing.
- B. Provide steerable front section of casing to allow vertical grade adjustments. Provide a water level or other means to allow monitoring of the grade elevation of the auger casing.
- C. Bentonite slurry may be used to lubricate the casing during installation. The use of water to facilitate removal of spoil is permitted; however, water jetting for excavation of the soil is not allowed when jacking casing.
- D. Tolerances from lines and grades shown on the Drawings for pipe installed in casing are plus or minus 6 inches in horizontal alignment, and plus or minus 1-1/2 inches in elevation.

### 3.3 SLURRY BORING OF CASING OR PIPE

- A. Drill a small diameter pilot hole and check for line and grade at the receiving end. Redrill the pilot hole if the bored pipe does not meet specified tolerances.
- B. Using the pilot hole as a guide, bore a larger diameter hole of sufficient size for pipe or casing installation. Water jetting is not permitted.
- C. Bentonite slurry may be used to maintain a stable hole and furnish lubrication for pipe or casing installation.
- D. Tolerances from lines and grades shown on the Drawings for the installed pipe are plus or minus 6 inches in horizontal alignment and plus or minus 1-1/2 inches in elevation.
- E. Completely fill the annular space between the pipe and the surrounding soil or casing with grout, without displacing the pipe during the grouting operation.

### 3.4 PIPE IN CASING

- A. Grout the annular void between pipe and any casing from end to end of the casing. Block and brace the pipe to prevent movement during grout placement and to maintain specified line and grade.

### 3.5 SETTLEMENT MONITORING

- A. Monitor the ground surface elevation along the length of the augering operation. Locate and record settlement monitoring points with respect to construction baseline and elevations. Record elevations to an accuracy of 0.01 feet for each monitoring point location. Establish monitoring points at locations and by methods that protect them from damage by construction operations, tampering, or other external influences. As a minimum, locate survey points as follows:
  - 1. For road crossings: Centerline and each shoulder.
  - 2. Railroads: Track subbase at centerline of each track.
  - 3. Utilities and Pipelines: Directly above and 10 feet before and after the utility or pipeline intersection.
  - 4. Long bores under improved areas such as pavements: Ground surface elevations must be recorded on the centerline ahead of augering operations at locations not to exceed 50 feet apart (including points located for roads, railroads, utilities, and pipelines), or at least three locations per augering drive.
- B. Reading Frequency and Reporting. Take settlement survey readings:
  - 1. Prior to the auger excavation reaching the point.
  - 2. After the auger reaches the monitoring point in plan.
  - 3. After grouting of the ground supporting pipe or casing is complete.
- C. Immediately report to the Engineer any movement, cracking, or settlement which is detected.

- D. Following substantial completion but prior to final completion, make a final survey of all monitoring points.
- E. All damage done, by the augering operation, to roadways or other structures shall be repaired by the Contractor at no cost to the Owner.

3.6 DISPOSAL OF EXCESS MATERIAL

- A. Remove and dispose of spoil from the job site.

END OF SECTION



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## Section 33 05 16 - CONCRETE FOR UTILITY CONSTRUCTION

## PART 1 - GENERAL

## 1.1 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, and in-place liners for manhole rehabilitation.

## 1.2 UNIT PRICES

## A. Unit Prices.

- 1. No payment will be made for concrete for utility construction under this Section. Include cost in applicable utility structures and fittings.

## 1.3 REFERENCES

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- E. ACI 308 - Standard Practice for Curing Concrete.
- F. ACI 309R - Guide for Consolidation of Concrete.
- G. ACI 311 - Batch Plant Inspection and Field Testing of Ready Mixed Concrete.
- H. ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- I. ACI 318 - Building Code Requirements for Reinforced Concrete.
- J. ACI 544 - Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete.
- K. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- L. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- M. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- N. ASTM A 767 - Standard Specifications for Zinc-coated (Galvanized) Bars for Concrete Reinforcement.
- O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- P. ASTM A 820 - Steel Fibers for Fiber Reinforced Concrete.
- Q. ASTM A 884 - Specification for Epoxy-coated Steel Wire and Welded Wire Fabric for Reinforcement.
- R. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- S. ASTM C 33 - Standard Specification for Concrete Aggregates.
- T. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- U. ASTM C 42 - Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- V. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- W. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.
- X. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- Y. ASTM C 150 - Standard Specification for Portland Cement.
- Z. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

- AA. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.
- BB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- CC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- DD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
- EE. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- FF. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.
- GG. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
- HH. ASTM C 1017 - Chemical Admixtures for Use in Producing Flowing Concrete.
- II. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
- JJ. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
- KK. ASTM D 638 - Test Method for Tensile Properties of Plastics.
- LL. ASTM D 746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- MM. ASTM D 747 - Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
- NN. CRSI MSP-1 - Manual of Standard Practice.
- OO. CRSI - Placing Reinforcing Bars.
- PP. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints
- QQ. NRMCA - Concrete Plant Standards.

#### 1.4 SUBMITTALS

- A. Conform to Section 01 33 00 - Submittal Procedures.
- B. Submit proposed mix design and test data for each type and strength of concrete in the Work.
- C. Submit laboratory reports prepared by an independent testing laboratory stating that materials used comply with requirements of this Section.
- D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by the Engineer.
- E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.
- F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.
- G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

#### 1.5 HANDLING AND STORAGE

- A. Cement: Store cement off 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

### 2.1 CONCRETE MATERIALS

#### A. Cementitious Material:

1. Portland Cement: ASTM C 150, Type II, unless the use of Type III is authorized by the Engineer; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.
2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in the form of  $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$ .

- B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.

#### C. Aggregate:

1. Coarse Aggregate: ASTM C 33. 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 C 33.
3. Determine the potential reactivity of fine and coarse aggregate in accordance with the Appendix to ASTM C 33.

- D. Air Entraining Admixtures: ASTM C 260.

#### E. Chemical Admixtures:

1. Water Reducers: ASTM C 494, Type A.
2. Water Reducing Retarders: ASTM 494, Type D.
3. High Range Water Reducers (Superplasticizers): ASTM C 494, 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 A 615, ASTM A 767, or ASTM A 775, 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 A 185 or ASTM A 884. Supply the gauge 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 A 82. Use 16-1/2 gauge minimum for tie wire, unless otherwise indicated.

#### H. Fiber:

##### 1. Fibrillated Polypropylene Fiber:

- a. Addition Rate: 1.5 pounds of fiber per cubic yard of concrete.
- b. Physical Properties:
  - (1) Material: Polypropylene.
  - (2) Length: 1/2 inch or graded
  - (3) Specific Gravity: 0.91.
- c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.

##### 2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A 820.

- a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
- b. Physical Properties
  - (1) Material: Steel.
  - (2) Aspect Ratio (for fiber lengths of 0.5 to 2.5-inch, length divided by diameter or equivalent diameter): 30:1 to 100:1.
  - (3) Specific Gravity: 7.8.
  - (4) Tensile Strength: 40-400 ksi.
  - (5) Young's Modulus: 29,000 ksi.
  - (6) Minimum Average Tensile Strength: 50,000 psi.
  - (7) Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to an angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking.

- I. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

## 2.2 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. For 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 materials that tend to disfigure or discolor concrete in a gauge 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.

2.3 PRODUCTION METHODS

- A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

2.4 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 C 685.
- B. Measure water and liquid admixtures by volume.

2.5 DESIGN MIX

- A. Use design mixes prepared by a certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.
- B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to the Engineer for review.
- C. Proportioning on the basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, if approved by the Engineer.
- D. Classification:

Class	Type	Minimum Compressive Strength (lbs/sq. in.)		Maximum W/C Ratio	Air Content (Percent)	Consistency range in slump (inches)
		7-day	28-day			
A	Structural	3200	4000	0.45	4+ 1	2 to 4*
B	Pipe Block Fill, Thrust Block	----	2500	----	4+ 1	5 to 7

\*When ASTM C 494, Type F or Type G admixture is used to increase workability, this range may be 6 to 9.

- E. Add steel or polypropylene fibers only when called for on the Drawings or in another section of these Specifications.
- F. Determine air content in accordance with ASTM C 138, ASTM C 173 or ASTM C 231.
- G. Use of Concrete Classes: Use classes of concrete as indicated on the Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, and concrete fill unless indicated otherwise. Use Class A for all other applications.

## 2.6 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:
  - 1. Thickness: not less than 3/8 inch
  - 2. Acceptable Manufacturers:
    - a. Kirkhill Rubber Co., Brea, California
    - b. Water Seals, Inc., Chicago, Illinois
    - c. Progress Unlimited, Inc., New York, New York
    - d. Greenstreak Plastic Products Co., St. Louis, Missouri
    - e. Approved equal.

## 2.7 RESILIENT WATERSTOP

- A. Resilient Waterstop: Where shown on the Drawings; 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 asphaltic.
  - 2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.
  - 3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch.
  - 4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.
- C. Adhesive Waterstop:
  - 1. Preformed plastic adhesive waterstop at least 2 inches in diameter.
  - 2. Meets or exceeds requirements of Federal Specification SS-S-210A.
  - 3. Supplied wrapped completely by a 2-part protective paper.

4. Submit 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.
5. Provide primer, to be used on hardened concrete surfaces, from the same manufacturer who supplies the waterstop material.
6. Acceptable Manufacturer: Synko-Flex Preformed Plastic Adhesive Waterstop, Synko-Flex Products, Inc.; or approved equal.

## PART 3 - EXECUTION

### 3.1 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 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.

### 3.2 PLACING REINFORCEMENT

- A. Place reinforcing steel accurately in accordance with approved Drawings. Secure steel adequately in position in forms to prevent misalignment. Maintain reinforcing steel in place using approved concrete and hot-dip galvanized metal chairs and spacers. Place reinforcing steel in accordance with CRSI



- Publication "Placing Reinforcing Bars." Request inspection of reinforcing steel by the Engineer and obtain acceptance before concrete is placed.
- B. Minimum spacing center-to-center of parallel bars: 2-1/2 times nominal bar diameter. Minimum cover measured from surface of concrete to face of reinforcing bar unless shown otherwise on the Drawings: 3 inches for surfaces cast against soil or subgrade, 2 inches for other surfaces.
  - C. Detail bars in accordance with ACI 315. Fabricate reinforcing steel in accordance with CRSI Publication MSP-1, "Manual of Standard Practice." Bend reinforcing steel to required shape while steel is cold. Excessive irregularities in bending will be cause for rejection.
  - D. Do not splice bars without written approval of the Engineer. Approved bar bending schedules or placing drawings constitute written approval. Splice and development length of bars shall conform to ACI 318, Chapters 7 and 12, and as shown on Drawings. Stagger splices or locate at points of low tensile stress.

### 3.3 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.

### 3.4 BATCHING, MIXING AND DELIVERY OF CONCRETE

- A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, 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 C 685, Sections 6 through 8.
- C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of the Engineer before adjustment and change of mix proportions.
- D. Ready-mixed concrete delivered to the site shall be accompanied by batch tickets providing the information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing the information required by ASTM C 685, Section 14.
- E. When high temperatures are expected, prepare ingredients, place, cure and protect in accordance with ACI 301, ACI 305.1, and as follows:
  - 1. When high air temperatures are expected that would affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or above 95 degrees F and rising.
  - 2. Maintain concrete temperature below 90 degrees F at the time of placement, furnish test data or other proof that admixtures and mix ingredients for not produce flash set plastic shrinkage, or cracking as a result of heat of hydration and the ambient air temperatures. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.

3. Provide windbreaks, shading, fog spraying, sprinkling, wet cover or other means as necessary to maintain at or below specified temperature.
- F. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when 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.
- G. Clean, maintain and operate equipment so that it thoroughly mixes material as required.
- H. Hand-mix only when approved by the Engineer.

### 3.5 PLACING CONCRETE

- A. Give sufficient advance notice to the Engineer (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to the Engineer's approval.
- B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, if necessary, to continue after daylight hours, light the site as required. If rainfall occurs after placing operations are started, provide covering to protect the work.
- C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.
- D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken an 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. 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.
- G. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

### 3.6 WATERSTOPS

- A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for the extent of the joint; make splices necessary to provide such continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.

- B. Install waterstops in concrete on one side of joints, leaving other side exposed until the next pour. When a waterstop will remain exposed for 2 days or more, shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.
- C. Splicing PVC Waterstops:
1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.
  2. Butt end-to-end joints of two identical waterstop sections may be made in the forms during placement of waterstop material.
  3. Prior to placement in formwork, prefabricate waterstop joints involving more than two ends to be joined together, an angle cut, an alignment change, or the joining of two dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the Engineer, install prefabricated waterstop joint assemblies in formwork, and butt-weld ends of the 24-inch strips to the straight-run portions of waterstop in the forms.
- D. Setting PVC Waterstops:
1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete and to prevent folding over of the waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.
  2. Where a waterstop in a vertical wall joint does not connect with any other waterstop and is not intended to be connected to a waterstop in a future concrete placement, terminate the waterstop 6 inches below the top of the wall.
- E. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying to the Specifications.
- F. Resilient Waterstop:
1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.
  2. When requested by the Engineer, provide technical assistance by manufacturer's representative in the field at no additional cost to the Owner.
  3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
  4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop a minimum of 6 inches and place in contact with the PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form a smooth joining surface.
  5. At the free top of walls without connecting slabs, stop the resilient waterstop and grooves (where used) 6 inches from the top in vertical wall joints.

6. Bentonite Waterstop:
  - a. Locate bentonite waterstop as near as possible to the center of the joint and extend continuous around the entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
  - b. Where thickness of concrete member to be placed on 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 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. With a wire brush thoroughly clean the concrete surface on which the waterstop is to be placed and then 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 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.

### 3.7 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 Engineer. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.

3. 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.

### 3.8 CURING

- A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for a period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from the concrete surface after placing and finishing. A curing day is any calendar day in which the temperature is above 50 degrees F for at least 19 hours. Colder days may be counted if air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at the end of calendar days equal to twice the required number of curing days. However, leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Engineer.
- B. Cure formed surfaces not requiring rubbed-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. Finishes:
  1. Broom Finish:
    - a. After completion of straightedge operation, make first pass of traverse broom as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired textured depth. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.
  2. Rubbed Finish:
    - a. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging the surface and immediately apply rub completely within 4 hours.
    - b. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.
- D. Unformed Surfaces: Cure by membrane curing compound method.
  1. After concrete has received a final finish and surplus water sheen has disappeared, immediately seal surface with a uniform coating of approved curing compound, applied at the rate of coverage recommended by manufacturer or as directed by the Engineer. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of the compound.
  2. Thoroughly agitate the compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.

3. Do not apply compound to a dry surface. If concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or if rain falls on a newly coated surface before film has dried sufficiently to resist damage, apply an additional coat of compound at the specified rate of coverage.

### 3.9 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 rubbed-finish when concrete has aged for the required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.
- B. Leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Engineer.

### 3.10 DEFECTIVE WORK

- A. Immediately repair any defective work discovered after forms have been removed. If concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace the entire section.

### 3.11 FINISHING

- A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with carr-bond and verticoat or approved equal. 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 approved 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 approved equal. After rubbing, allow paste on the surface to reset; then wash surface with clean water. Leave structure with a clean, neat and uniform-appearing finish.
- C. Apply a wood float finish to concrete slabs.

### 3.12 FIELD QUALITY CONTROL

- A. Testing shall be performed under provisions of Section 01 45 29 - Testing Laboratory Services.
- B. Unless otherwise directed by 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 C 1077.
  1. Take concrete samples in accordance with ASTM C 172.

2. Make one set of four compression test specimens, or as directed by the Engineer, 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 C 31 and ASTM C 39.
  3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.
  4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R.
- C. Test Cores: Conform to ASTM C 42.
- 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. For Early Strength Concrete, a set of 5 specimen cylinders shall be required.
- E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. If additional curing fails to produce the required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by the Engineer, at no additional cost to the Owner.

### 3.13 PROTECTION

- A. Protect concrete against damage until final acceptance by the Owner.
- B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide such protection while the concrete is still plastic, and whenever such precipitation is imminent or occurring.
- C. Do not backfill around concrete structures or subject them to design loadings until components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the Engineer.

END OF SECTION

## Section 33 14 13 – WATERLINE PIPE WORK

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. This section shall cover the furnishing, laying, jointing and testing of all water pipe, including water appurtenances, both in open cut and in tunnels, as shown on the drawings, or as directed by the Engineer.

## 1.2 UNIT PRICES

## A. Unit Prices.

1. Payment for water mains installed by open-cut or augered, with or without casing, is on a linear foot basis for each size of pipe installed.
2. Payment for water services installed by open-cut or augered, with or without casing, is on a unit price basis for each diameter service, long and short services.
3. No separate payment will be made for water pipe branches associated with fire hydrant assemblies. Include cost of such pipework in Contract unit prices for items listed in bid form requiring fire hydrants.
4. No separate payment will be made for waterline fittings associated with pipe work, unless listed in the contract unit prices. Include cost of such items in the Contract unit prices for items listed in bid form requiring waterline pipework.
5. No separate payment will be made for thrust blocks and pipe restraints associated with pipe work. Include cost of such items in the Contract unit prices for items listed in bid form requiring waterline pipework.
6. Payment of valves will be on a unit price basis for each valve installed for each size and type of valve.
7. Payment of fire hydrants will be on a unit basis for each fire hydrant assembly installed. Fire hydrant assembly include connecting tee, water pipe branches (regardless of length), gate valve, fire hydrant and necessary restraints and thrust blocking.

## PART 2 - PRODUCTS

## 2.1 MATERIAL

The material used in pipe work shall be furnished by the Contractor, as approved by the Owner, to meet the requirements of the Work of the Contractor as specified herein.

- A. Water Pipe - 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. 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. 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.

1. Water pipe for main lines may be of any of the following classifications. Any pipe found defective, not meeting the specifications, or improperly installed, shall be rejected and so marked, and shall be replaced by pipe approved by the Owner at no additional cost to the Owner.
  - a. Polyvinyl chloride pipe for waterlines 14-inch diameter or greater shall conform to or exceed Ultra-Blue AWWA C-909 Molecularly Oriented Polyvinyl Chloride (PVCO); nominal 20-foot lengths; cast-iron equivalent outside diameter. All waterline piping shall be the color WHITE. Gaskets shall meet the requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight. Do not use PVC gasket material for water mains in potentially contaminated areas.
  - b. Polyvinyl chloride pipe for waterlines 6-inch to 12-inch shall conform to or exceed AWWA F1483 Ultra-Blue Class 200 Molecularly Oriented Polyvinyl Chloride (PVCO); nominal 20-foot lengths; steel pipe equivalent outside diameters. All waterline piping shall be the color WHITE. Gaskets shall meet the requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight. Do not use PVC gasket material for water mains in potentially contaminated areas.
  - c. Pipe 6 through 12-inch: Certain Teed Certalok Yelomine SDR21 Class 200 (ASTM D2241) RJ Restrained Joint PVC Pipe; nominal 20-foot lengths; steel pipe equivalent outside diameters.
  - d. Pipe 14-inch and greater: Certain Teed Certalok DR25 C905 RJ Restrained Joint PVC Pipe; nominal 20-foot lengths; steel pipe equivalent outside diameters.
  - e. Pipe 6-inch through 12-inch: Fusible AWWA C-900 DR-25 PVC; nominal 20, 30, or 40-foot lengths; steel pipe equivalent outside diameters.
  - f. Pipe 14-inch through 36-inch: Fusible AWWA C-905 DR-25 PVC; nominal 20, 30, or 40-foot lengths; steel pipe equivalent outside diameters.
2. Waterline Fittings - Fittings for water lines may be of any of the following classifications.
  - a. Fittings for polyvinyl chloride (PVC) pipe 4-inch through 12-inch shall meet AWWA Standard C-100 or C153 "Ductile-Iron Compact Fittings, 3 inch through 12 inch for Water and Other Liquids," and C104, latest revision, and shall be sized to fit PVC water pipe. No adapters for fittings with outside diameters different from PVC pipe shall be used. All fittings shall be coated on the interior with AWWA C-550, Induron 3300 or approved equal, non-toxic, impacts no taste to water, functions as physical, chemical and electrical barrier between base material and surroundings, minimum 10-mil wet thickness, fusion-bonded epoxy. Exterior surfaces shall be prime coated with asphaltic coating conforming to ANSI A 21.10, ANSI A 21.15, or ANSI A 21.51 for pipe and fittings in open cut excavation and in casings. All fittings shall be wrapped in a plastic protector in conformance with AWWA Standard C-105 and ANSI A21.5 (2.5 to 3 percent carbon black content, low or high density) "Polyethylene Encasement for Gray and Ductile Cast-Iron piping for Water and Other

Liquids" and conforming to ASTM D 1248. Fitting wrapping shall be installed in such a manner as to curtail or prevent corrosion of the metallic fittings.

- (1) Flanged Fittings: ANSI A 21.10; ANSI B 16.1 cast or ductile iron. Flanges: ANSI B 16.1, Class 125; pressure rated at 250 psig. Bolts shall be corten or carbon steel with greased ends.
  - (2) Mechanical Joint Fittings: ANSI A 21.11 (AWWA C 110); pressure rated at 250 psi. Bolts shall be corten or carbon steel with greased ends.
  - (3) Restraining Joints:
    - a. Fittings: Mega Lug by Ebaa Iron Inc. or JCM 610 Sur-Grip Fitting Restrainer by JCM Industries, Inc., or approved equal.
    - b. Bell and Spigot: Mega Lug by Ebaa Iron Inc. or JCM 610 Sur-Grip Fitting Restrainer by JCM Industries, Inc., or approved equal.
  - (4) Flexible (Dresser Type) Coupling
    - a. Install where shown on Drawings or where allowed by the Engineer for Contractor's convenience. Use galvanized flexible couplings when installed on galvanized pipe which is cement lined, or when underground. Provide gaskets manufactured from Neoprene, Buna-N, or approved equal.
    - b. For steel pipe; sleeve-type flexible couplings, Smith-Blair type, or approved equal. Thickness of middle ring equal to or greater than thickness of pipe wall.
    - c. Flanged adapter couplings for steel pipe; Dresser Style 128, Rockwell Type 913, or approved equal.
    - d. Use Type 316 stainless steel bolts, nuts and washers where flexible couplings are installed underground. Coat entire coupling with 20-mil of T.C. Mastic as manufactured by the Tape Coat Company, Inc., Bitumastic No. 50 as manufacturer by Koppers Company, Inc., or approved equal.
  - (5) Victaulic Joints: Make joint with Victaulic Style 77 coupling fitted with Grade H molded synthetic rubber gasket or approved equal.
- b. Fittings for polyvinyl chloride (PVC) Schedule 40 pipe less than 4 inch shall conform to ASTM Standard D2466, latest revision.
  - c. Taps for PVC Water Mains: Use Mueller SS Stainless Steel Service Saddle with all 304SS exterior hardware or approved equal. Saddle shall be flanged, machined recess, AWWA C207, Class D, ANSI 150-pound drilling. Flange bolts shall be 304SS or 316SS. Saddle to include gasket affixed around recess of tap opening to prevent rolling or binding during installation.

Any fittings found defective, not meeting the specifications, or improperly installed, shall be rejected and so marked, and shall be replaced by fittings approved by the Owner, at no additional cost to the Owner.

3. Service Connections - Water service connections shall be installed as per the design plans and as approved by the Utility Owner.
  - a. Provide Type K annealed, seamless, copper tubing: 3/4-inch to 2-inch in diameter conforming to requirements of ASTM B88 and manufactured in the USA. Provide 3/4-inch to 2-inch in diameter tubing in coils of minimum 60-feet in length. Provide flared or compression-type brass fittings for use with Type K annealed copper tubing in accordance with AWWA C800.
  - b. Cross-linked polyethylene (PEX) water service line shall conform to AWWA C904.
  - c. Polyvinyl chloride casing for water service lines shall be Schedule 40 PVC and shall conform to ASTM Standard "Polyvinyl Chloride (PVC) Plastic Pipe" D-1785, latest revision.
  - d. Provide bronze service clamp taps (Ford Meter Box, Mueller Company or approved equal) for water main and service sizes shown in the design plans. Angled curb stops, corporation stops, and other brass fittings shall meet AWWA C 800 as manufactured by Ford Meter Box or Mueller Company. Curb stops shall be compression-type fitting inlet end with O-ring straight plug type and Teflon ball valve. Curb stop female outlets shall be 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.

Any material found defective, not meeting the specifications, or improperly installed, shall be rejected and so marked and shall be replaced with material approved by the Owner's Engineer at no additional cost to the Owner. Service line tubing crossings under traveled roadways shall be installed as specified on the plans with a minimum cover of 30" below roadway surface.

4. Valves
  - a. Gate valves (2 to 16-inch diameter) shall conform to the following:
    - (1) Non-directional, resilient seated (AWWA C 509), 200 psig, bronze mounting, Mechanical Joint ends, and nut-operated unless otherwise specified. Provide resilient seated valves manufactured by Mueller 2360 Series or approved equal.
    - (2) Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.
    - (3) Body: Cast iron, flange bonnet and stuffing box together with 304 SS or 316 SS bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.
    - (4) Bronze: Valve components in waterway to contain no more than 15 percent zinc and not more than 2 percent aluminum.
    - (5) Stems: ASTM B 763 bronze, alloy number 995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
    - (6) O-rings: AWWA C 509, sections 2.2.6 and 4.8.2.
    - (7) Stem Seals: Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar.
    - (8) Stem Nut: Independent or integrally cast of ASTM B 62 bronze.
    - (9) Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 2000; seat against epoxy-coated surface in valve body.
    - (10) Bolts: AWWA C 509 Section 4.4; 304 or 316 stainless steel only.
    - (11) Direct bury Valves open counterclockwise.
    - (12) Coatings: AWWA C-550, Induron 3300 or approved equal, non-toxic, impacts no taste to water, functions as physical, chemical and electrical barrier between base material

and surroundings, minimum 10-mil wet thickness, fusion-bonded epoxy. Prior to assembly of valve, apply protective coating to internal and exterior surfaces of body.

- b. Gate valves (greater than 16-inch diameter) shall be cast iron body conform to the following: Non-directional, resilient seated (AWWA C 509), 200 psig, bronze mounting, Mechanical Joint ends, and nut-operated unless otherwise specified. Provide resilient seated valves manufactured by Mueller 2361 Series, or approved equal, and meeting the requirements in Section 4a above.
5. Fire Hydrants - Provide fire hydrants manufactured by Mueller Super Centurion 250, or approved equal. Fire hydrants shall conform to AWWA Standard "Dry-Barrel Fire Hydrants" C502, latest revision. Hydrants shall be cast iron, fully bronze mounted and have a working pressure of 150 psi. Fire hydrants shall have a minimum valve opening of 5 1/4 inch. Hydrants shall be furnished with Hydrant Defender with barrel lock. Apply finish coat of Silicone Alkyd Resin Enamel, Acro Products No. 2215, or approved equal meeting SSPC Paint Specification No. 21. Total dry film thickness (DFT): 2 to 3 mils. Exception: Hydrants shall be painted RED with WHITE bonnets.
6. Air and Vacuum Release Valves: Provide combination air valves designed to fulfill functions of air release (permit escape of air accumulated in line at high point of elevation while line is under pressure) and vacuum relief. Air release and vacuum relief valves 8 inches and smaller in diameter shall be self-contained in one unit. Provide inlet and outlet connections, and orifice as shown on Drawings. Use ARI D-040 Air Release Valve or approved equal.

### PART 3 - EXECUTION

#### 3.1 CONSTRUCTION METHODS

##### A. PIPE LAYING

1. All water mains shall be installed as specified in plans with a minimum cover of 48 inches from the top of pipe to an established grade. Where pipe is installed beneath State Highways, there shall be a minimum vertical distance of 4 feet from top of pipe to the lowest pavement elevation on the highway, or as per the Highway Department's permit requirements. In special locations, Highway Department may require additional cover. Construction clearance and other requirements to cross under State Highways shall be obtained by Owner. Where pipe is installed beneath drainage or irrigation ditches, there shall be a minimum vertical distance of 3 feet from top of pipe to the flowline of the ditch, or as shown in the design plans or by permit requirements. Where pipe is installed beneath railroad tracks, there shall be a minimum vertical distance of 4 feet-6 inches from the top of pipe casing to top of railroad ties, or as shown in the design plans or by permit requirements. Utility crossing permits to cross under railroad track will be obtained from Railroad Authority by Owner. Any expense associated with permit costs, insurance requirements, construction bracing or supports to tracks during excavation operation beneath trackage shall be considered the responsibility of the Contractor and part of the Contract.
2. For all pipe, the Contractor shall familiarize himself with the TCEQ Chapter 290 and 217 Separation Distance Requirements and verify that all proposed work conforms to these regulations. The Contractor shall immediately notify Utility Owner and the Engineer once the Contractor discovers that field conditions cannot meet the TCEQ Separation Distance Requirements.
3. Inform the Utility Owner if any un-metered connections exist which are not shown on the design plans. Make transfer only after approval by the Utility Owner.

4. Procedure - After the trench is excavated to grade as specified, it shall be backfilled in accordance with the details shown in the design plans. Bedding material shall provide a smooth and uniform pipe bed for the entire length of the water pipe barrel. Trenching and pipe laying shall be uniformly in a straight line and to uniform elevation unless otherwise specified on plans. Pipe, fittings and valves shall be carefully handled to avoid damage. Before placing pipe into the trench, the outside of the spigot and the inside of the bell shall be wiped clean and dry, free from oil and grease. Every precaution shall be taken to prevent foreign material from entering the pipe. During layout operation, no debris, tools, clothing or other material shall be placed into the pipe. After placing a length of pipe in the trench, the spigot end shall be centered in the bell; the pipe forced home, brought to the correct alignment and covered with an approved backfill material. Detectable warning metallic tape with "Waterline Below" shall be buried above pipe at a depth of 18 inches below finished grade for surface locating purposes. The minimum width of the metallic tape shall be 6-inches wide as manufactured by Presco Detectable Warning Tape or approved equal. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other approved means. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.
- B. PIPE JOINTING - In laying the water pipe to line and grade, the pipe shall be jointed in accordance with one of the following approved jointing methods. Owner reserves the right, before construction, or while construction is in progress, to change the type of joints if Owner's Engineer so directs.
1. Asbestos Cement Pipe Jointing - The Contractor shall furnish and install asbestos cement pipe in accordance with AWWA Standard "Installation of Asbestos Cement Pressure Pipe" C603-78, latest revision. The machined ends of the pipe to be jointed, coupling grooves and rubber rings shall be cleaned immediately before assembly. Care should be taken not to roll, pinch or reverse the gasket when placed in the bell. Each pipe joint shall be sealed with a coupling consisting of an asbestos cement sleeve and two rubber rings or an equivalent coupling or joint of equivalent strength and performance, as determined by Engineer. The pipe joint shall not be deflected either vertically or horizontally beyond the limits recommended by the manufacturer.
  2. Polyvinyl Chloride (PVC) Pipe Jointing - The Contractor shall make certain before jointing polyvinyl chloride pipe that the ring groove in the bell of the pipe is clean, with no dirt or foreign material that could interfere with proper seating of the ring. Make sure pipe end is clean. Wipe with a clean dry cloth around the entire circumference from the end to one inch beyond the reference mark. Lubricate the spigot end of the pipe, using only the lubricant supplied by the manufacturer. Be sure the entire circumference is covered. The coating should be the equivalent of a brush coat of enamel paint. It can be applied by hand, cloth, pad, sponge or glove. Do not lubricate the ring groove in the bell to avoid lubrication causing ring displacement. The level end is then inserted into the bell so that it is in contact with the ring. Brace the bell, while the level end is pushed in under the ring, so that previously completed joints in the line will not be closed. The spigot end is pushed until the reference mark on the spigot end is flush with the end of the bell. **DO NOT OVER INSERT BEYOND THE REFERENCE MARK.** If undue resistance to inserting of the level end is encountered or the reference mark does not reach the flush position, disassemble the joint and check the position of the ring. If it is twisted or pushed out of its seat, clean the ring, bell and level end and repeat the assembly steps.

Make curves and bends by deflecting joints or other method as recommended by the pipe manufacturer and approved by the Utility Owner. Contractor may submit details of other methods or providing curves and bends for considerations by the Utility Owner, and if accepted, shall be installed at no additional cost to the Owner. Deflection of pipe joints shall not exceed maximum

deflection recommended by pipe manufacturer. If deflection exceeds that specified but is less than 5-percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded. If deflection is equal to or exceeds 5-percent from that specified, remove entire portion of deflected pipe section with new pipe. Assessment of pipe deflection will be measured by the Engineer at any location along the pipe. Arithmetical averages or deflection or similar average measurement methods will not be deemed as meeting intent of standard. When rubber gasketed pipe is laid on a curve, join pipe in a straight alignment and then deflect to curved alignment.

- C. WET CONNECTIONS - Schedules of existing fittings and proposed new fittings needed to make wet connections to existing waterlines as shown on the plans are estimates only. It is to be recognized that after existing lines and fittings are uncovered, that some discrepancies may occur. Where discrepancies occur, the Contractor shall request a decision by the Owner as to how the connection in question shall be made. Additional fittings shall be included in the costs associated with applicable bid items. Contractor shall plan his work concerning wet connections in such a way that a minimum of inconvenience shall occur to existing water customers due to water service interruptions. Before water service interruptions are made to any customer, Contractor shall notify designated official and cooperate with operating personnel in every way to minimize service interruptions due to wet conditions. In certain locations, other utility lines or conduits will be obstructing the normal path of proposed waterlines. In such instances, gravity lines of all kinds hold priority as to grade over water pressure lines, gas lines, electric conduits, or other obstruction conduits or combinations of conduits, which may be encountered. Contractor shall analyze conditions carefully, while considering TCEQ Chapter 290 separation distance requirements, and then use best judgment in determining proper method of proceeding through obstructed area with waterline construction, and shall notify the Owner forty-eight (48) hours in advance of making such connection after obtaining approval from the Owner's Engineer.
- D. APPURTENANCES - Appurtenances to the waterline shall be provided and laid in accordance with the drawings and in the manner as specified herein.
1. Valves. Valves shall be installed with restraining joints and concrete thrust blocks (braced against undisturbed soil) at the locations shown and as specified in the design plans. All valves shall be wrapped in a plastic protector in conformance with AWWA Standard C-105 and ANSI A21.5 "Polyethylene Encasement for Gray and Ductile Cast-Iron piping for Water and Other Liquids." Valve wrapping shall be installed in such a manner as to curtail or prevent corrosion of the metallic valves.
  2. Fire Hydrants. All fire hydrants shall be located as shown in the plans, and in a manner to provide complete accessibility, and to minimize the possibility of damage from vehicles or injury to pedestrians. All hydrants shall stand plumb with the pumper nozzle facing the curb (or as shown in the design plans) and the bury line of the hydrant at the finished grade. A 12-inch gravel pocket (in all directions) shall be installed around the drain ports. Do not cover drain ports when placing concrete thrust block. Located nozzle center line a minimum 18-inches above finished grade. Fire hydrants installed near State Highways shall be in accordance with State Department of Highways and Public Transportation requirements. Set fire hydrant plumb and brace at locations and grades as shown on Drawings. When barrel of hydrant passes through concrete slab, place a 1-inch-thick piece of standard sidewalk expansion joint material around section of barrel passing through concrete. All fire hydrants shall be connected to the main in the manner shown in the design plans. Place 12-inch x 12-inch yellow indicators (plastic, sheet metal, plywood, or other material approved by the Owner) on pumper nozzles of new or relocated fire hydrants installed on new mains not in service. Remove indicators after new main is tested and approved by the Owner. Install Hydrant defenders upon removal of indicators.

3. Services. Set service taps at right angles to proposed meter location and locate taps in upper pipe segment within 0 degrees of pipe springline. Tapped collars of appropriate sizes: Approved in new construction only provided they are set at right angles to proposed meter location. Use tapping machine manufactured for pressure tapping purposes for 2-inch and smaller service taps on pressurized water mains.

Install service lines in open-cut trench in accordance with Section 31 23 23.13 - Excavation and Backfill for Utilities except that service lines under paved roadways, other paved areas and areas indicated on Drawings shall be installed in cased bored hole in accordance with paragraph 3.01G.

Lay service lines with minimum of 48 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 ditches to service lines.

Service lines across existing street (push-unders): Pull service line through prepared hole under paving. Only full lengths of tubing shall 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.

Maintain service lines free of dirt and foreign matter.

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. Do not flatten tube. In 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.

Install service lines so that top of meter will be 3 to 6 inches below finished grade.

Locate water meters one foot inside property line, or if this is not feasible, one foot inside street right-of-way. Contact Utility Owner when major landscaping or trees conflict with service line and meter box location.

### 3.2 TESTING AND STERILIZATION

- A. TESTING. All newly laid sections of pipe shall be hydrostatically tested at a gauge pressure of 150 psi. Contractor has the option of running hydrostatic test before or after trench has been completely backfilled. Trenches must be at least partially backfilled before hydrostatic testing to prevent pipe shift. Hydrostatic tests shall be in accordance with AWWA Standard C600 Section 4 "Hydrostatic Testing" latest revision.
  1. Hydrostatic Test Procedure - The Contractor shall provide all necessary equipment, water, safety, and other appurtenances necessary for testing procedures. All waterlines shall be disinfected prior to hydrostatic testing. Allow pipeline to sit a minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar lining to become saturated. All testing procedures shall be conducted in the presence of the Owner. Air pressure testing will not be allowed. For large diameter water mains, test waterlines in lengths between valves or plugs, but no greater than 4,400 feet in length. Small diameter waterlines shall be tested in lengths between valves or plugs of not more than 2,800 feet in length.
  2. Furnish, install and operate connections, pump, meter and gauges necessary for hydrostatic testing. The line shall be slowly filled with water to the specified test pressure. The lowest

elevation point of the section being tested shall be determined and any corrections necessary shall be corrected to the elevation of the test gauge by means of a hand pump, gasoline or electrically driven test pump connected to the pipe. A blow off or fire hydrant shall be installed at the end of the line under test. Before applying the specified test pressure, all air shall be expelled from the test section including service connections. If hydrants or blow offs are not available at high places, tap at points of highest elevation shall be made before the test is made and brass plugs inserted after the test has been completed. After all air is expelled, apply a minimum hydrostatic pressure of 150 psi. Begin test by 4 p.m., unless otherwise approved by the Owner. Maintain test pressure until 8 a.m. the following morning. If large quantity of water is required to maintain pressure during test, testing shall be discontinued until cause of water loss is identified and corrected. Leakage tests shall be conducted concurrently with pressure tests. Owner will inspect all pipe, fittings, valves and joints under tests. Any faults found to be due to improper workmanship shall be corrected by the Contractor at no expense to Owner. Allowable pressure loss is a maximum of 5-psi leakage over the 16-hour, overnight test period. If this pressure requirement is failed 3 (three) times, use AWWA Standard C600 Section 4 "Hydrostatic Testing" latest revision.

- B. **STERILIZATION.** Pipeline construction shall be in accordance with Section 4 of AWWA Standard C651-01, latest revision. Upon or during completion of the hydrostatic test, the new section of pipe shall be sterilized in accordance with AWWA Standard "Disinfecting Water Mains" C601, latest revision; and the State of Texas Health Standards. Chlorine may be applied by the following methods: Continuous Feed Method and Chlorine Tablet Method. Contractor shall provide all equipment and chemicals necessary for sterilization.

Use required temporary blind flanges, cast-iron sleeves, plugs, and other items needed to facilitate disinfection of new mains prior to connection to the Owner's water distribution system. Normally, each valve section of water line requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for water lines up to and including 6-inch diameter. Fire hydrants shall be used as blow-offs to flush newly constructed water lines 8-inch diameter and above. Where fire hydrants are not available on water lines, 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.

Slowly fill each section of pipe with water in a manner approved by the Owner. Average water velocity when filling pipeline should be less than one foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.

1. **Continuous Feed Method** - This method is suitable for general application. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 mg/l available chlorine. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main to be tested is filled with the chlorine solution. The chlorine water shall be retained in the main for at least 24 hours during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water shall contain no less than 25 mg/l chlorine throughout the length of the main.
2. **Chlorine Tablet Method** - Tablet disinfection is best suited to short extensions (up to 2,500 feet) and smaller diameter mains (up to 8-inch diameters). Because the preliminary flushing step must



be eliminated, this method shall be used only when scrupulous cleanliness has been exercised. It shall not be used if trench water or foreign material has entered the main or if the water is below 5°C (41°F). Calcium hypochlorite tablets are placed in each section of pipe and in hydrants, hydrant branches and other appurtenances. They shall be attached by an adhesive, except for the tablets placed in hydrants and in the joints between the pipe sections. All the tablets within the main must be at the top of the main. If the tablets are fastened before the pipe section is placed in the trench, their position should be marked on the section to assure that there will be no rotation. In placing tablets in joints, either crushed or placed on the inside annular space or, if the type of assembly does not permit, they are rubbed like chalk on the butt ends of the sections to coat them with calcium hypochlorite. The adhesive may be Permatex No. 1 or any alternative approved by the Owner. There shall be no adhesive on the tablet except on the broad side next to the surface to which the tablet is attached. If desired, the calcium hypochlorite may be placed in the pipe in granular form at a rate of one (1) cup (4 fl. oz.) per each pipe. When installation has been completed, the main shall be filled with water at a velocity of less than 1-ft./sec. This water shall remain in the pipe for at least 24 hours. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

3. Final Flushing - After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/l. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline.
4. Bacteriologic Tests - After final flushing, and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. If the number and frequency of samples is not prescribed by the public health authority having jurisdiction, at least one sample shall be collected from chlorinated supplies when the chlorine residual is maintained throughout the new main. From unchlorinated supplies, at least two samples shall be collected at least 24 hours apart. In the case of extremely long mains, it is desirable that samples be collected the length of the line as well as at its end. Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in collection of samples. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.
5. Repetition of Procedure. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. The tablet method cannot be used in these subsequent disinfections. When the samples are satisfactory, the main may be placed in service.

END OF SECTION